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Effectiveness of Behavioral Interventions to Modify Physical Activity Behaviors in General Populations and Cancer Patients and Survivors

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Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-Based Practice Centers (EPCs), sponsors the development of evidence reports and technology assessments to assist public- and private-sector organizations in their efforts to improve the quality of health care in the United States. This report on *Effectiveness of Behavioral Interventions to Modify Physical Activity Behaviors in General Populations and Cancer Patients and Survivors* was requested and funded by the National Cancer Institute. The reports and assessments provide organizations with comprehensive, science-based information on common, costly medical conditions and new health care technologies. The EPCs systematically review the relevant scientific literature on topics assigned to them by AHRQ and conduct additional analyses when appropriate prior to developing their reports and assessments.

To bring the broadest range of experts into the development of evidence reports and health technology assessments, AHRQ encourages the EPCs to form partnerships and enter into collaborations with other medical and research organizations. The EPCs work with these partner organizations to ensure that the evidence reports and technology assessments they produce will become building blocks for health care quality improvement projects throughout the Nation. The reports undergo peer review prior to their release.

AHRQ expects that the EPC evidence reports and technology assessments will inform individual health plans, providers, and purchasers as well as the health care system as a whole by providing important information to help improve health care quality.

We welcome written comments on this evidence report. They may be sent to: Director, Center for Outcomes and Evidence, Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD 20850.

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The authors of this report are responsible for its content. Statements in the report should not be construed as endorsement by the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services of a particular drug, device, test, treatment, or other clinical service.

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Introduction

Healthy People 2010 places physical activity in the top ten leading indicators of health of Americans.[1] Yet 54.6 percent of U.S. adults report levels of physical activity that fall below the following two guidelines: moderate intensity activity $\geq$ 30 minutes per day, $\geq$ five days per week OR vigorous intensity activity $\geq$ 20 minutes per day, $\geq$ three days per week.[2] Further, 2001 Youth Risk Behavior Survey data indicate that 64.6 percent of high school students meet the Healthy People 2010 goal for vigorous activity (three or more days per week for 20 or more minutes per occasion), and 25.5 percent of high school students meet the Healthy People 2010 goal for moderate intensity activity (at least 30 minutes on five or more of the previous seven days).[1, 3] Clearly, there is a need to understand how to sustainably increase and maintain physical activity behaviors in children, adolescents, and adults.

The first specific aim of this review was to examine the evidence that physical activity interventions, alone or combined with diet modification or smoking cessation, are effective in helping individuals sustainably increase their aerobic physical activity or maintain adequate aerobic physical activity. Further, within this first portion of the review, there were four sub-aims:

1. Is the effectiveness of theoretically based interventions different?
2. Do hypothesized moderators affect the results of these interventions?
3. Do these interventions affect theoretically hypothesized mediators?
4. In these interventions, is there a relationship between changes in theoretically hypothesized mediators and changes in physical activity?

In addition to the importance of physical activity in general populations, physical activity may play a special role in the experience of cancer survivors from the point of diagnosis through the balance of life. Understanding the impact of cancer and its treatment on individuals living years beyond a cancer diagnosis is increasingly important, especially as the population of long-term cancer survivors continues to grow. For example, it is estimated that there are approximately 9.5 million cancer survivors alive in the United States today.[4] As children and adults with a history of cancer are living longer, the challenges that face survivors will gain increasing attention. Current cancer treatments, although increasingly efficacious for preventing death, are toxic in numerous ways and produce negative long-term physiological and or psychological effects. Because physical activity has been shown to improve well-being in healthy people,[5] it has been proposed as a possible intervention to combat the early and late effects of treatment in cancer patients.[6, 7] The American Cancer Society now recommends that cancer survivors perform regular physical activity toward the goal of maintaining a healthy body weight, reducing risk of recurrence, and reducing risk for other common chronic diseases.[8] Therefore, the second specific aim was to examine whether physical activity is efficacious for improving psychosocial or physiologic outcomes among cancer survivors.

Methods

We synthesized evidence from the scientific literature on the effectiveness of behavioral interventions to increase physical activity in the general population, as well as evidence of the effectiveness of physical activity interventions to improve psychosocial and physiologic outcomes for cancer survivors. The methods used for this process were developed by the project team at the Minnesota Evidence-based Practice Center (EPC), in conjunction with representatives from the National Cancer Institute (NCI) and the Agency for Healthcare Research and Quality (AHRQ) and a Technical Expert Panel assembled for the purpose of this report.

The literature to be reviewed for the first key question was initially identified in two ways. A search of PubMed® (1966 to present) was carried out to identify all trials of physical activity interventions. The second source of references was published reviews of physical activity interventions.[9-29] The titles and, if necessary, the full references were reviewed by an expert in physical activity interventions. All possibly qualifying studies were reviewed by a team of reviewers. Forty-seven studies were identified that met inclusion/exclusion criteria.

The literature for the second key question was identified through two searches of MEDLINE® including all available years (1966 to present), review of the results by an expert in physical activity interventions in cancer survivors, and then by a team of peer reviewers. Twenty-four studies were identified that met inclusion/exclusion criteria.

The included references for both key questions were abstracted by a trained abstractor using a computerized data abstraction form. Results of each of these abstractions were reviewed by a senior member of the study team with expertise in physical activity interventions.

After a careful examination of the included studies, it was concluded that it was not possible to pool outcomes. This conclusion was reached for three reasons. First, the diversity of outcomes reported did not allow for a clear metric to be used across studies. Second, important information that would be necessary to pool studies (such as variance estimates) was missing from many studies. Finally, the diversity of studies (including populations, interventions, followup time, etc.) was not conducive to reasonable pooling. Therefore, we elected for both key questions to present semi-quantitative results including counts of positive and statistically significant studies, calculation of post-intervention differences between groups (effect size) and further descriptive information rather than formal quantitative analysis.

Results

General Population

The 47 studies identified addressed a variety of populations. Forty-one studies included adults exclusively, four exclusively children, and two included both. Three studies focused on older adults. Of the studies of adults, eight included only women, whereas two included only men. In all but two of the studies where race was reported, white subjects were in the majority.

There were 72 interventions in the 47 identified studies. (Many studies tested more than one intervention). The physical activity interventions were undertaken in a wide range of settings, and some in more than one. Twenty-four interventions were in the health care setting, 12 in the

home setting, 17 in the community, 8 in schools, 20 in worksites, and 11 more in a government institution, a religious institution, a sports center, or a child care center. A wide variety of interventions were tested using variations of 27 different theoretical constructs, 12 of which were used by more than 15 percent of the interventions. About half of the interventions had no clear theoretical underpinning and the remainder used one of ten different models. The intensity of the interventions varied widely from a single mailing to multiple contacts per week over years. The length of followup also varied from 3 months (the minimum for inclusion in the review) to over 10 years.

A range of different physical activity outcomes was found in the included studies, and many studies included more than one primary outcome. Eight studies had two physical activity outcomes, 11 had three, one had five, two had six, and one had nine. No one specific outcome was used as the primary outcome across studies. Further, what may have been considered the primary outcome domain in one study (such as a measure of leisure time activity) may have been a secondary domain in another study (where the primary outcome could have been overall activity). Therefore, we elected to include all of the physical activity outcomes reported in the results.

Because national guidelines have targets for moderate and vigorous activities,[2] we chose to examine whether interventions had different effects on these individual sorts of activities. For these analyses we categorized the outcomes within "outcome groups" as a measure of "total activities," "moderate activities," "vigorous activities," or "other." Of the 99 outcomes examined in the studies, 23 (23 percent) were classified as "total activities," 50 (51 percent) were classified as "vigorous activities," 25 (25 percent) as "moderate activities," and one (1 percent) as "other."

The effect of the interventions was examined in two ways. First, for those outcomes where it was possible, we calculated an effect size, otherwise known as a standardized mean difference. In its simplest form this is the difference in effect between groups divided by the variance. This gives a unitless common metric for outcomes that were measured in different units. We also examined whether an outcome was found by the investigators to have a statistically significant positive effect. As many studies reported the effects of multiple outcomes and had more than one intervention, we: (1) examined each outcome separately, (2) pooled all of the outcomes of one intervention and examined it, and (3) pooled all of the interventions in a given study to assess to overall effect of the study.

There were 102 outcomes within the 34 studies for which effect sizes could be calculated. Of these, 7.8 percent (eight) had an effect size greater than .8, and 2.9 percent (three) had an effect size between .5 and .8. An additional 32.4 percent of outcomes (33) had an effect size that exceeded our criteria for a small positive effect of .2. Of the 50 interventions for which we could calculate an effect size, 10 percent (five) had an effect size greater than .8 and 4 percent (two) had an effect size between .5 and .8. An additional 44 percent (22) interventions had an effect size that exceeded our criteria for a small positive effect of .2. Finally on the study level, 5.9 percent (two) studies had an effect size greater than .8 and 5.9 percent (two) had an effect size between .5 and .8. An additional 47.1 percent (16) studies had an effect size that exceeded our criteria for a small positive effect of .2. Overall, 58.8 percent of the studies had an effect size that exceeded our guideline of small (.2).

Approximately one-fourth of the outcomes reached statistical significance. Nearly a third of all interventions had at least one outcome that was significant at the .05 level. When interventions are pooled within studies, nearly half of the studies (44.7 percent) had at least one

outcome that was statistically significantly positive. Again, this is not corrected for multiple tests within studies.

Within the outcome groups, only the moderate activity group and the vigorous activity group had any outcomes that exceeded our guide of a large outcome of .8 (two moderate and one vigorous). Approximately 60 percent of moderate activity outcomes had an effect size greater than our guide of .2, whereas approximately 40 percent of the vigorous activity outcomes and total activity outcomes exceeded that threshold. A greater percentage of moderate activity outcomes was statistically significant compared to total activity outcomes (48 percent versus 13 percent; p=.008). The percentage of vigorous activity outcomes that was statistically significant fell between the other two outcome groupings, (28 percent) but was not statistically significantly different from either the "moderate activity" or "total activity" outcome groups.

There was no clear effect of setting on whether studies were positive or statistically significantly positive. Further, there was no clear effect on the use of theory on whether a study was positive. It appeared on examination that more intensive studies may be more likely to be statistically significantly positive. Qualitatively, there did not appear to be an effect on outcome when accessibility to a means to exercise was addressed in a study or when a study addressed diet and smoking as well as physical activity, but the numbers are too small and the studies too diverse to draw firm conclusions.

Too few studies examined outcomes at multiple points in time to provide a clear sense of the changes in physical activity over time after the end of the intervention, although most of those that did provide data showed a decrease in physical activity over time.

Little attention was paid to possible harms in these studies; in all 47 studies, it was mentioned only once. Although many studies examined baseline characteristics of subjects (such as age and gender) that could be considered possible moderators of the interventions, few of the included studies examined these as moderators.

Eleven studies hypothesized mediators.[30-56] Of the studies that hypothesized mediators, all of them intervened on at least one of the hypothesized mediators. Nine of the studies measured the effect of the interventions on the hypothesized mediator, although two did not report any of the mediator results. Statistically significant changes in mediators were seen for greater intention to exercise in one study.[39] In the other studies that reported results, there was either no effect or a non-significant effect. Only one study examined whether a hypothesized mediator affected the outcome.[32]

Eighteen criteria of study quality were examined using a measure derived from that used by the *Guide to Community Preventive Services*. On average the studies met under half of the quality criteria (average 7.5), but there was a wide range from a low of three criteria met to a high of 16. The quality of studies that randomized individuals was also examined using the scale developed by Chalmers.[57] On the zero to nine scale (nine best), most of the studies received a rating of two, with the highest rated study receiving a five.

Review of Interventions in Cancer Survivors

Of the 24 studies included in the review, 54 percent conducted interventions during active cancer treatment. The sample sizes were often small, with average group sizes of 22 and 23 in the control and treatment groups, respectively. The most common diagnosis included in the

studies was breast cancer, with 83 percent of the studies reporting inclusion of breast cancer survivors. All included studies had concurrent comparison groups; 83 percent of them were randomized controlled trials. The majority (79 percent) of the interventions were physical activity only interventions. The interventions tended to be supervised exercise programs, of 3 months' duration or less, with no followup after the end of the intervention, and the exercise prescriptions usually focused on aerobic activity. Eighty-three percent prescribed moderate-to-vigorous intensity activity, and 88 percent prescribed exercise three or more times per week. Fifty-eight percent of the interventions prescribed exercise of less than 40 minutes per session.

Dropout rates ranged from 0 to 25 percent with a mean of 10.8 percent. These dropout rates should be viewed in context of the percent of cancer survivors approached regarding study participation who agree to participate or even to be screened for eligibility. The seven studies that provided data regarding the percentage of cancer survivors approached who agreed to participate or to at least be screened for study eligibility reported values of 28, 30.6, 32.5, 43, 68, 75, and 81 percent, with a mean of 51 percent.[58-64]

In addition to identifying the timing of the interventions with regard to whether they took place during or after treatment, each of the 24 studies has been placed into a category according to the Physical Exercise Across the Cancer Experience (PEACE) framework proposed by Courneya and Friedenreich.[65] The majority of the studies focus on the time period during or immediately following active cancer therapy (coping and rehabilitation). Included interventions focused on buffering prior to cancer treatment (one study), coping during treatment (13 studies), rehabilitation from treatment (ten studies), health promotion (five studies), and survival (one study). No controlled trials that focused on palliation for survivors with advanced cancer were identified.

Sixteen categories of outcomes were examined: physical activity; physical fitness; cardiorespiratory fitness, strength, and flexibility; fatigue/tiredness; body image/dissatisfaction; quality of life; confusion; difficulty sleeping; self-esteem; other psychosocial outcomes; physiologic outcomes; body size; pain; vigor/vitality; symptoms/side effects; immune parameters; and mental/emotional/psychological well-being. The two most common outcomes examined were cardiovascular fitness and fatigue or tiredness, which were examined in 12 of the 24 studies. Depression, anxiety, and quality of life were also commonly examined (10 studies), as well as body weight or body mass index (BMI) (eight studies).

The criterion for considering an intervention positive was if one or more of the outcomes in a given category was positive. An effect was considered to be statistically significantly positive if any one of the outcomes examined within a category was statistically significant. The intention was to convey a level of positivity of results, not to perform a statistical test. Significance was not corrected for multiple tests. The effect sizes reported a comparison of between group means at post-intervention only, given that pre-post correlations for all 16 outcome categories were not available.

Categories with 100-percent positive findings include strength, flexibility, fatigue/tiredness, confusion, difficulty sleeping, self-esteem, psychosocial outcomes, body size (goal to reduce), vigor/vitality, immune parameters, and mental health quality of life.

The percent of studies reporting statistically significant results within the 16 categories ranged from 0 percent for confusion and body size (goal to gain or avoid muscle loss) to 100 percent for flexibility and difficulty sleeping. There were eight categories with 75 percent of

studies reporting at least one statistically significant finding: cardiorespiratory fitness, flexibility, fatigue/tiredness, quality of life, difficulty sleeping, psychosocial outcomes, physiologic outcomes, and immune parameters.

Mean effect sizes within the 16 outcome categories ranged from –0.055 for immune parameters to 2.93 for physical activity behavior. Outcome categories with effect sizes of 0.20 or greater include physical activity behavior, cardiorespiratory fitness, flexibility, fatigue/tiredness, body image/dissatisfaction, quality of life, confusion, vigor/vitality, symptoms/side effects, depression, anxiety, and the combined multiple constructs section of mental/emotional/ psychological well-being.

We examined whether the results of studies would be more likely to be positive during versus post active cancer treatment. The number of studies that fall into each category is small so that no clear conclusions can be drawn regarding timing of the intervention.

Discussion

General Population

Over half of adults and over a third of children do not meet national guidelines for physical activity. Finding interventions that can sustainably increase physical activity is an important public health goal. This review sought to identify those studies that have attempted to increase physical activity in a general population and tested whether there was an effect at least 3 months following the end of the intervention. This is important from a public health standpoint as interventions that increase physical activity during the intervention but for which physical activity is not maintained after the intervention ceases will not bring about long-term changes in the population.

This review focused on studies that examined whether interventions had an effect at least 3 months after the intervention concluded. Because we otherwise included studies of any populations or settings, the literature examined in this review is very diverse. Many different populations are examined in different settings with different interventions with the assessment of different outcomes. Given the great diversity, any conclusions that look across the studies must be viewed with caution. Real effects could be missed because the diversity of the studies masks effects. Similarly, what appear to be possible effects could be the result of confounding by differences between the studies. Nonetheless, with those caveats, a number of conclusions can be drawn from this review:

- It is possible to intervene on subjects to increase their physical activity for at least 3 months after the intervention stopped.
    - We found that overall 45 percent of the studies had at least one statistically significant positive effect on physical activity.
- Although many studies had effects that met the criteria of statistical significance, the overall effect of interventions to increase physical activity is small.
- Although there are no strict criteria of strength of effect, by our guidelines only 5.6 percent of studies (two) had a strong effect (an effect size greater than .8) and 2.8 percent (one) had a moderate effect (effect size between .5 and .8). Outcomes that assessed some sort of moderate activity were more likely to be statistically significantly positive than

those that assessed total activities. This may reflect that a given change in moderate activities in an individual results in a overall smaller magnitude change in that individual's total activities because others that make up the total activities may not be changing.

- The setting did not appear to have an important role in whether an intervention would be successful.
    - In all of the settings at least a quarter of the trials resulted in a statistically significant increase in physical activity on at least one measure three or more months after the end of the intervention. There was no clear pattern of effect sizes within the different setting.
- It is not necessary to have an intensive intervention to get an effect.
    - We found that there were successful interventions at all levels of intensity; in fact, there was not a clear trend that more intensive interactions were more successful.
- It is difficult to assess durability of the effects in these studies because relatively few had tests at multiple points in time. Yet there appears to be some durability to the effects.
    - Over 25 percent of the studies that looked at 1 year or more post-intervention had a statistically significant increase in physical activity.

Because of the issues with the literature, we cannot draw any clear conclusions about the effect of studies that use theory, the effect of studies that address accessibility to exercise, or those that address diet and smoking in addition to exercise compared to studies that did not do those things.

Limitations in the literature did not allow us to address in detail a number of questions we initially sought to answer. There were not sufficient studies that examined moderators or mediators to draw any meaningful conclusions.

Future Research

A number of areas could be addressed in future research to allow the questions addressed in this review to be answered more fully:

- Examine longer outcomes
    - A large portion of the physical activity literature was excluded from this review because there was no followup beyond the end of the intervention period. As the point of physical activity interventions is to change behavior over a long period, more studies should be directed at longer outcomes.
- Standardize followup intervals
    - Even if studies address longer outcomes, it will be difficult to compare the effects of individual studies or groups of studies unless they examine outcomes at similar intervals.
- Standardize the domains of physical activity measured
    - A measure of walking, for example, may or may not be closely correlated with a measure of total activity. So the effect of various interventions can be compared; some attempt at standardization should be undertaken.

- Standardize, if possible, the outcome measures
    - Even where the outcome domain is the same, different measures may do a better or worse job of capturing the domain. It will be easier to compare the effects of interventions if they use standard validated measures
- Use, where possible, blinded measures of outcome rather than self-reporting
    - Given the nature of these interventions blinding of subjects and investigators is impractical. However, the interpretation of some measures such as activity monitors can be blinded to the reader.
- Reduce attrition from studies
    - Many of these studies suffered from attrition that may bias the results. Attention should be paid in future research to reducing this issue.
- Standardize reporting of study results
    - Many of these studies did not report sufficient information, particularly variance estimates, that would facilitate the comparison across studies. Attention should be paid to more complete reporting of the results.
- Use appropriate statistical methodology to examine moderators and mediators of effect
    - None of the studies in this review used appropriate techniques such as Structural Equation Modeling to fully examine the effect of mediators.
- Examine harms
    - To fully understand the risks and benefits of these interventions, more attention needs to be put on possible harms of the interventions as a few people with a moderate or severe harm (such as a fracture) could outweigh the benefits of the intervention.

If these issues are addressed, we may be able to gain a fuller understanding of the overall effectiveness of interventions to increase physical activity in general populations.

Cancer Survivors

The presentation of mean effect sizes for each outcome category allows for discussion of the relative impact on each outcome category of physical activity interventions on cancer survivors. However, because the effect sizes were calculated based on post intervention between group differences only and not adjusted for sample size, interpretive caution is urged. For example, the mean effect size of 2.93 for physical activity behavior is mostly driven by between group differences that existed at baseline and persisted to the end of the intervention.[66] Given this interpretive caution, the conclusions that can be drawn from a review of the literature on the efficacy of physical activity interventions to positively impact physiologic and psychosocial outcomes are outlined below.

Controlled trials in cancer survivors consistently report a mean effect size > 0.2 and consistent (five or more studies) positive effects of physical activity (usually aerobic exercise) on the following outcomes:

- Vigor and vitality (effect size 0.850).
- Cardiorespiratory fitness (effect size 0.647).
- Quality of life (effect size 0.427).

- Depression (effect size 0.418).
- Anxiety (effect size 0.333).
- Fatigue/tiredness (effect size 0.217).

The outcomes with the greatest consistency across the cancer experience are cardiorespiratory fitness and fatigue/tiredness. The exercise prescription associated with these-positive outcomes in cancer survivors was generally moderate-to-vigorous intensity aerobic activity on 3 or more days per week, for 10-60 minutes per session. For many of the other variables, there are too few studies to evaluate whether the findings differ for survivors during compared to post treatment. The findings for some categories, such as cardiovascular fitness, strength, flexibility, body size, and anxiety and depression parallel results reported from exercise interventions in general populations.[67]

Other variables for which there is either consistent evidence that is either less strong or results from fewer studies include:

- Confusion (effect size 0.402).
- Symptoms/side effects (effect size 0.400).
- Psychosocial outcomes (effect size 0.191).
- Body size (goal to reduce) (effect size 0.187).
- Self-esteem (effect size 0.100).
- Mental health quality of life (no effect size available).
- Strength (no effect size available).

Variables for which there is less consistent evidence include:

- Body image/dissatisfaction (effect size 0.310).
- Anger hostility (effect size 0.070).
- Physical activity behavior (no valid effect size estimate available).
- Body size (goal to gain or avoid muscle mass loss) (no effect size estimate available).
- Pain (no effect size estimate available).

The nine studies that measured non-fitness and non-anthropometric physiologic outcomes were placed into one of three categories: immune parameters, symptoms/side effects, or physiologic outcomes. The outcomes from studies with outcomes in these three categories were disparate and reflected goals of evaluating the safety of exercise during active cancer treatment, the efficacy of exercise to prevent muscle loss or assist patients in recovering from active cancer treatment, and two studies specifically interested in whether exercise could favorably alter physiologic parameters hypothesized to be associated with breast cancer etiology.[68, 69] Given the broad variety of potential physiologic variables that may be of interest for cancer survivors across the cancer experience, nine studies is too few to enable a summary or to draw any conclusions beyond the general statement that the majority of the reviewed studies reported changes in the hypothesized direction. This area of research has just begun to develop.

An overview of 14 physical activity interventions in cancer survivors that were excluded because of the lack of a concurrent comparison group indicated that the conclusions of this report would not have been measurably altered had these studies without comparison groups been included.

For physical activity to be clinically recommended for cancer survivors, it is important to first understand the potential for adverse outcomes. The results of the reviewed studies generally indicate that it is safe for cancer survivors to be physically active, even during bone marrow

transplant procedures and high-dose chemotherapy. Given the small number of studies reviewed, several questions regarding the safety of physical activity across the cancer survivor experience remain, including the potential for bias in self-reported worsening of symptoms or side effects, risk for the development of lymphedema, and worsening of some immune parameters.

Future Research

The process of conducting this review has revealed numerous potential areas for future research on the efficacy of physical activity to positively alter physiologic and psychosocial outcomes in cancer survivors across the cancer experience. The small number of studies for each outcome category underscores the need for an expansion of research on a broad spectrum of cancer control outcomes, across broad timing from the point of diagnosis and through the balance of life. Therefore, rather than focus the need for additional research on specific outcomes, below is a listing of broader themes and methodological issues to be addressed as well as recommendations for efficient forward progress toward greater understanding of the effects of physical activity in cancer survivors.

- Convene researchers with expertise and interest in the efficacy of physical activity to favorably effect physiologic and psychosocial outcomes in cancer survivors to discuss and reach consensus on:
  - Priorities with regard to cancer control outcomes of interest.
  - Priorities with regard to timing of physical activity interventions across the cancer experience.
  - Standardization of measurement tools for cancer control outcomes of interest.
  - Standardization of outcomes reporting for cancer control outcomes of interest.
  - Development of survivor registries from which participants for studies of all types (not just physical activity) could be recruited.
- Increase funding to adequately power studies to examine the effects of physical activity on cancer survivors across the cancer experience.
- Improve reporting of recruitment experiences and demographic description of participants from recruitment to study completion or dropout, for improved assessment of bias and generalizability.

Availability of the Full Report

The full evidence report from which this summary was taken was prepared for the Agency for Healthcare Research and Quality (AHRQ) by the University of Minnesota Evidence-based Practice Center, under Contract No. 290-02-0009. It is expected to be available in June 2004. At that time, printed copies may be obtained free of charge from the AHRQ Publications Clearinghouse by calling 800-358-9295. Requesters should ask for Evidence Report/Technology Assessment No. 102, *Effectiveness of Behavioral Interventions to Modify Physical Activity Behaviors in General Populations and Cancer Patients and Survivors.* In addition, Internet users will be able to access the report and this summary online at www.ahrq.gov or http://dccps.nci.nih.gov/d4d/evidence_report.html.

Suggested Citation

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Evidence Report

Chapter 1. Introduction

Purpose

This report has two primary purposes, both of which were identified by the National Cancer Institute's Division of Cancer Control and Population Sciences. The first purpose was to conduct a systematic review of the scientific literature to assess the evidence that behavioral interventions are an effective means to help the general population meet current aerobic physical activity recommendations or to maintain or increase their level of aerobic activities in interventions that had a minimum of three months of non-intervention followup time. By specifically examining results of interventions with a minimum of three months of non-intervention followup time, the intent is to focus on the sustainability of the physical activity changes produced by behavioral interventions.

Further, in reviewing the effectiveness of physical activity interventions in the general population, there were several more specific goals stated, including examining whether the effectiveness of theoretically based interventions differed from non-theoretically based interventions, whether hypothesized moderators affect results of these interventions, whether the interventions affect theoretically hypothesized mediators, and whether there is a relationship between changes in theoretically hypothesized mediators and changes in physical activity.

The second primary purpose of this study was to conduct a systematic review of the scientific literature to assess the evidence that physical activity interventions are efficacious for producing improvements in psychological and physiologic outcomes in cancer survivors.

Healthy People 2010 places physical activity in the top ten leading indicators of health of Americans.[1] Yet 54.6 percent of U.S. adults report levels of physical activity that fall below the following two guidelines: moderate intensity activity ≥ 30 minutes per day, ≥ five days per week OR vigorous intensity activity ≥ 20 minutes per day, ≥ three days per week.[2] Further, 2001 Youth Risk Behavior Survey data indicate that 64.6 percent of high school students meet the Healthy People 2010 goal for vigorous activity (three or more days per week for 20 or more minutes per occasion), and 25.5 percent of high school students meet the Healthy People 2010 goal for moderate intensity activity (at least 30 minutes on five or more of the previous seven days).[1, 3] Clearly, there is a need to understand how to sustainably increase and maintain physical activity behaviors in children, adolescents, and adults.

In addition to the importance of physical activity in general populations, physical activity may play a special role in the experience of cancer survivors from the point of diagnosis through the balance of life, regardless of the outcome of treatment. Understanding the impact of cancer and its treatment on individuals living years beyond a cancer diagnosis is increasingly important, especially as the population of long-term cancer survivors continues to grow. It is estimated that there are approximately 9.5 million cancer survivors alive in the United States today[4] and the population of long-term cancer survivors continues to grow. As children and adults with a history of cancer are living longer, the challenges that face survivors will gain increasing attention. Current cancer treatments, although increasingly efficacious for preventing death, are toxic in numerous ways and produce negative long-term physiological and or psychological effects. Because physical activity has been shown to improve well-being in healthy people,[5] it has been proposed as a possible intervention to combat the early and late effects of treatment in

cancer patients.[6,7] Further, the American Cancer Society now recommends that cancer survivors perform regular physical activity toward the goal of maintaining a healthy body weight, reducing risk of recurrence, and reducing risk for other common chronic diseases.[8] Therefore, to repeat, our second goal was to conduct a systematic review of the scientific literature to assess the evidence that physical activity interventions are efficacious for producing positive psychological and physiologic outcomes in cancer survivors.

Key Questions

The specific aims of this review were to examine the evidence that physical activity interventions, alone or combined with diet modification or smoking cessation, are effective in helping:

1. Individuals in the general population sustainably increase their aerobic physical activity or maintain adequate aerobic physical activity. Further, within this first portion of the review, there were four sub-aims:
    a. Is the effectiveness of theoretically based interventions different?
    b. Do hypothesized moderators affect the results of these interventions?
    c. Do these interventions affect theoretically hypothesized mediators?
    d. In these interventions, is there a relationship between changes in theoretically hypothesized mediators and changes in physical activity?
2. Cancer survivors improve their psychosocial outcomes or physiologic outcomes

Definitions: Physical Activity, Exercise, Fitness, General Population, Cancer Survivor, and Effect Size

In order to understand this report, it is important to first define what we mean by physical activity, exercise, health related physical fitness, general population, cancer survivors, and effect size. The following definitions of physical activity, exercise, and physical fitness were first published in 1985.[9]

Physical activity is defined as any 'bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level.' All domains of activity are included in this definition, including leisure time physical activity, occupational activity, activity to transport oneself from one place to another, household chores, self-care, other-care, volunteer work, or any other activity other than complete body stillness.

Exercise is defined as 'physical activity that is planned, structured, repetitive, and purposive in the sense that improvement in one or more components of physical fitness is the objective.' Exercise can refer to a single bout or multiple bouts over a period of weeks, months, or years. The latter is commonly termed exercise training. This distinction between single bouts (acute exercise) and exercise training (chronic exercise) is important because the effects of acute and chronic exercise differ (e.g., blood pressure increased during acute exercise but resting blood pressure is lowered by chronic training). Exercise does not occur in all domains of physical activity. Exercise is confined to leisure time activities.

Health-related physical fitness is defined as 'the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure pursuits and to meet unforeseen emergencies.' This includes cardiorespiratory endurance, muscular strength, power,

speed, flexibility, agility, balance, reaction time, and body composition. Participation in many domains of physical activity is affected by one's physical fitness.

General population is defined as individuals without chronic or acute diseases, with one exception. With guidance from the Agency for Healthcare Research and Quality (AHRQ) and the National Cancer Institute (NCI), it was decided that studies with diabetic or obese participants would be included. The rationale was that the impact of behavioral interventions on individuals with the excluded diseases might differ from the impact on included individuals.

Cancer survivors are defined as 'any individual that has been diagnosed with cancer, from the time of discovery and for the balance of life', as suggested by the National Coalition for Cancer Survivorship.[10]

Effect size is defined as the standardized mean difference between the treatment and control group(s) and was calculated using the software ES.[11]

Negative Health Outcomes Associated with Physical Inactivity

There is consensus that regular physical activity is associated with decreased risk for a number of negative health outcomes, including coronary heart disease, cardiovascular disease, stroke, Type 2 diabetes, obesity, several forms of cancer, osteoporosis, depression, fall related injuries in the elderly, and all-cause mortality.[12] This consensus underscores the need for effective interventions for sustainable increases in physical activity. A review of the literature on the topic of physical inactivity and negative health outcomes is beyond the scope of this report. Readers interested in this research evidence are referred to the Surgeon General's Report on Physical Activity and Health.[12]

Physical Activity and Issues Facing Cancer Survivors

The number of cancer survivors is growing annually and is expected to continue to grow.[4] This makes a compelling case for the need to understand the unique needs of this population. A framework for examining physical activity across the cancer experience (Framework PEACE) has been proposed[13] based on the cancer control perspective. The proposed framework includes six possible cancer control outcomes after the point of cancer diagnosis, including buffering prior to treatment, coping during treatment, rehabilitation immediately post treatment, health promotion and survival for those with positive treatment outcomes, and palliation for those without positive treatment outcomes.

Buffering prior to treatment refers to the potential to improve cancer treatment outcomes by preparing the body through physical activity prior to cancer treatment. The outcomes of interest during this point in the cancer experience will likely be physiologic and fitness related, though psychological buffering may also be useful. For those coping with cancer treatment, primary outcomes of interest are likely to include physiologic fitness and quality of life indicators as well. The numerous possible adverse outcomes that can result from cancer treatments include reduced quality of life, depression, anxiety, fatigue, reduced cardiovascular function, bone and muscle wasting, and lymphedema. Exercise interventions for those who have completed treatment during the past year seek to assess whether these adverse outcomes may be favorably altered by physical activity. If cancer treatment is successful, physical activity becomes of interest for health promotion purposes after the rehabilitation stage is over, to reduce risk of chronic diseases

which may be more prevalent among cancer survivors, such as cardiovascular disease, diabetes, and osteoporosis.[8] Further, there is strong epidemiologic evidence that physical activity may prevent some types of cancer,[14, 15] so the potential for physical activity to serve as a modifiable risk factor for secondary prevention of cancers is of great interest as well. For those with advanced stage cancers that are untreatable or that do not respond to treatment, palliation of fatigue and pain may be an appropriate cancer control outcome for physical activity interventions.

One goal of this report is to present a balanced view of the outcomes related to cancer control in survivors who have volunteered to participate in a physical activity intervention at some point during the cancer experience. The goal of such interventions would be to improve physiologic and psychologic outcomes, yet the potential for harm must be acknowledged and examined. The cancer survivor portion of the report is informed by Framework PEACE, developed by Courneya and Friedenreich.[13]

Uniqueness of the Present Report

General population. There are several excellent recent reviews of the efficacy of behavioral interventions to alter physical activity behaviors in particular populations or settings.[16-27] The Agency for Healthcare Research and Quality (AHRQ) sponsored one such review on the efficacy of counseling by primary care physicians for improving physical activity.[16] The November 1998 issue of the *American Journal of Preventive Medicine* was devoted entirely to understanding the efficacy of behavioral interventions to promote physical activity. A recent systematic review of the literature on the effectiveness of interventions to increase physical activity by the Task Force on Community Preventive Services[17] formed an excellent starting point from which to develop unique goals for the present report. The Task Force on Community Preventive Services review concluded that there were two informational, three behavioral and social, and one environmental approach to promoting physical activity that could be recommended. These are listed below.

Recommended informational approaches to increasing physical activity:

- 'Point of decision prompts' for stair use
- Community-wide campaigns

Recommended behavioral and social interventions for increasing physical activity:

- School-based physical education
- Community-based social support
- Individually adapted health behavior change

Recommended environmental approach for increasing physical activity:

- Creation of or enhanced access to places for physical activity, combined with informational outreach

This same review found there was insufficient evidence to assess a variety of other intervention types.[17]

A review of prior systematic reviews on the efficacy of behavioral interventions to increase physical activity in general populations was undertaken.[17, 20-38] Based on this review, it became clear that several aspects of this literature have received less attention in prior reviews. First, the sustainability of increases in physical activity resultant to behavioral intervention has only been addressed in two prior reviews. In the Dishman and Buckworth 1996 review[30] it was noted that

only about 25 percent of the 127 intervention studies located reported effect sizes for followup. The mean effect was non-significant for the followup effects for self-reported physical activity and fitness; whereas effects for objective measures of attendance or observation were large. Similarly, in the Dishman et al., 1998 review[23] it was reported that eight of 26 worksite intervention studies located had effects at followup exceeding three months. The mean effect was small and not different from the effects of interventions without followup, but interventions using variations of exercise prescription yielded larger effects. Sustainability is of vital importance for physical activity behavior change interventions. Therefore, for the portion of the review that focuses on the general population, we chose to focus exclusively on interventions that had at least three months of followup data on physical activity behavior beyond the end of any intervention activities.

Second, it has been proposed that theoretically-based interventions would be more efficacious than nontheoretical interventions. Yet only one prior systematic review has examined whether this claim is supportable.[39] This review focused on older adults and reported that the seven of ten studies with theoretical frameworks showed improvements in physical activity behavior. This was compared to three of seven studies without theoretical frameworks. There has also been little focus on which theories are most commonly used. Therefore, in the context of this report, we outline which theories were applied (as reported by the authors), which theoretical constructs have been applied, and whether theory-based interventions are more efficacious at increasing physical activity than nontheory-based interventions.

Finally, only one prior review has examined the variables that mediate change in physical activity in the context of intervention studies. This review included only 12 studies.[35] This seems to indicate that few intervention studies examine the mediating variables for physical activity behavior change. Therefore, in the context of this report, we gathered data from the included intervention studies on mediators proposed, measured, and whether there was any analysis to examine whether the proposed, hypothesized mediators were influential in any observed change in physical activity behavior.

To guide our review process we worked with a Technical Expert Panel (TEP) to develop a logic model (Figure 1). The figure illustrates that intervention components can sometimes increase physical activity behavior directly, or through one to three targets for change: environmental, social or cultural, or personal factors. For this review, mediators are defined as constructs that are hypothesized by the interventionist to fall in the causal pathway between the intervention components (at any of the three levels labeled 'targets for change') and behavior. For example, provision of education to explain how to exercise or what it should feel like to exercise could be an intervention component that would mediate changes in physical activity or exercise behavior. Moderators are defined, for this review, as variables not targeted by the intervention and, in most cases, not expected to change, but which could influence the outcomes or interact with the intervention to change study outcomes. For example, if the intervention effect differed across gender, gender would be defined as an intervention moderator.

Cancer survivors. Reviews on the topic of physical activity in cancer survivors have also been conducted.[7, 13, 40-42] Some reviews have focused on specific outcomes, such as weight loss in breast cancer survivors[43] and fatigue[42] and include studies with a variety of interventions, not just physical activity. In the review on weight loss,[43] the review authors indicated that the effects of physical activity on weight change were mixed. A review on effects of physical activity interventions on fatigue indicated that physical activity may be a feasible intervention

'even for patients with advanced disease.'[42] Other reviews focus more specifically on physical activity and examine a broad variety of outcomes from physical activity interventions in cancer survivors.[7, 13, 40] All of these reviews noted that though completed studies consistently report improvements in quality of life, as well as variables related to physiological and psychologic well-being, many of the physical activity studies in cancer survivors suffer from methodologic weaknesses.[7, 40] In particular, the review authors felt that additional controlled trials were needed, preferably randomized. In an attempt to focus the present report on the best quality research, included studies were required to have a concurrent comparison group with results presented separately for treatment and comparison groups. However, because we acknowledge that some important studies in this area were conducted as pilot or feasibility studies with no control group, the discussion section includes a brief summary of results from fourteen studies excluded on the basis of not having a concurrent control group.

Chapter 2. Methods

We synthesized evidence from the scientific literature on the effectiveness of behavioral interventions to increase physical activity in the general population, as well as evidence of the effectiveness of physical activity interventions to improve psychosocial and physiologic outcomes for cancer survivors. The methods used for this process were developed by the project team at the Minnesota Evidence-based Practice Center (EPC), in conjunction with representatives from NCI and AHRQ. The Minnesota EPC was established by AHRQ to conduct systematic reviews and technology assessments of all aspects of health care. The Minnesota EPC performs research on improving methods of synthesizing the scientific evidence, developing evidence reports, and conducting technology assessments.

Project staff collaborated with the National Institutes of Health's National Cancer Institute's Division of Cancer Control and Population Sciences, the Task Order Officer at AHRQ, and the Technical Expert Panel for this review on issues related to review topic and methods used.

Scope of Work

The literature review process for this report was divided into two parts. The methodology was similar but not identical for these two parts and will be reported in subsections throughout the remainder of the methodology section.

The literature review process for key question #1, which related to the effectiveness of behavioral interventions to sustainably increase physical activity in the general population was carried out as follows:

- Establish criteria for inclusion of articles in review
- Identify sources of evidence in the scientific literature
- Extract study descriptions, data, and study quality data from studies meeting inclusion criteria
- Attempt to find data that could be synthesized quantitatively
- Summarize findings qualitatively
- Submit results to the technical expert peer reviewers for review
- Incorporate reviewers' comments into a final report for submission to AHRQ

The literature review process for the part of this report on the topic of physical activity in cancer survivors included:

- Establish criteria for inclusion of articles in review
- Identify sources of evidence in the literature
- Extract data from studies meeting the inclusion criteria
- Attempt to find data that could be synthesized quantitatively
- Summarize findings qualitatively
- Submit the results to peer reviewers
- Incorporate reviewers' comments into a final report for submission to AHRQ

Establishing the Technical Expert Panel

A Technical Expert Panel (TEP) was selected to guide the process of refining the key questions and developing the report. Representatives of NCI's Division of Cancer Control and Population Sciences and Minnesota EPC project staff both developed lists of individuals who had content area expertise. There was particular interest in including end users of the evidence report in the TEP. Appendix A lists the individuals who served on the TEP for this report, as well as their areas of expertise.

Developing the Key Questions

The ORIGINAL key questions put forth by AHRQ and NCI were later revised. The original key questions were as follows:

1. What is the evidence that physical activity interventions alone, or combined with diet modification or smoking cessation, are effective in helping individuals in the general population change their aerobic physical activity and maintain an active lifestyle?
    - What settings have been used to deliver behavioral interventions?
    - Are interventions in specific settings more effective than others (e.g., individuals or groups; organizational settings; community settings; public policy)?
    - To what extent have these interventions been delivered to minority or high-risk populations?
    - Is there evidence that effectiveness of interventions varies in minority or high-risk populations?
    - Determine the factors that mediate or moderate the success of these interventions (e.g., gender, race/ethnicity, intervention type, incentives, intervention dose, length of intervention, intervention mode of delivery, exercise setting, physical activity mode, physical activity intensity, research design, other).
2. Are interventions that use behavioral theories more effective in changing aerobic physical activity than those that do not?
    - What theories have been used to design physical activity interventions and to what extent have they been implemented?
    - Are interventions that use particular behavioral theories more effective than others in changing behaviors?
    - Do behavioral interventions have a significant impact on theoretically hypothesized mediators of physical activity?
    - Determine the factors that moderate the success of theoretical interventions (e.g., gender, race/ethnicity, intervention type, incentives, intervention dose, length of intervention, intervention mode of delivery, exercise setting, physical activity mode, physical activity intensity, research design, other).
3. What is the evidence that physical activity interventions, alone or combined with diet modification or smoking cessation, are effective in helping cancer survivors improve their psychosocial outcomes (e.g., anxiety, depression, fatigue, and quality of life) or physiological outcomes (e.g., cardiorespiratory fitness, obesity/total fat/visceral fat, insulin, Insulin-like Growth Factors (IGFs) and IGF binding proteins, and sex hormones steroids and binding proteins)?

Refining the Key Questions

Examining Past Systematic Reviews

A number of systematic reviews had previously been done examining different aspects of the preliminary key questions. It was the desire of AHRQ, NCI, and the Minnesota EPC that this report make a contribution to the literature. This required an understanding of the focus and conclusions of prior systematic reviews in this topic area. A search was undertaken to identify previous systematic reviews that overlapped with the preliminary key questions and to examine what key questions had been addressed in those reviews. A document outlining key questions addressed by prior reviews was prepared for the Technical Expert Panel for a face-to-face meeting in January 2003.

Meeting of the Technical Expert Panel and Refinement of the Key Questions

The Technical Expert Panel, representatives from NCI, AHRQ, and the Minnesota EPC met face to face on January 29, 2003, to discuss the refinement of the key questions and the development of the report. The group expressed interest in the role of mediators and moderators but did not at that meeting refine the questions further. A series of discussions between AHRQ, NCI, and the Minnesota EPC was held after the expert meeting and additional input was gathered from the Technical Expert Panel where appropriate. The issue was how to refine the key questions so that they would address an area not otherwise addressed in the literature and that would be achievable within the contract. The result of the discussions was that one key factor that had not been as completely addressed in previous reviews was whether interventions to increase physical activity had effects that lasted beyond the end of the intervention period itself. It was decided then that the review would be limited to studies that examined outcomes at least three months after the end of the intervention. At the January meeting, the TEP had suggested excluding studies that were done in the context of acute disease (such as cardiac rehabilitation) and this criterion was added to the exclusions. The revised and final key questions with inclusion and exclusion criteria were:

1. What is the evidence that physical activity interventions alone, or combined with diet modification or smoking cessation, are effective in helping individuals in the general population increase their aerobic physical activity or maintain adequate aerobic physical activity?
    a. Is the effectiveness of theoretically based interventions different?
    b. Do hypothesized moderators affect the results of these interventions?
    c. Do these interventions affect theoretically hypothesized mediators?
    d. In these interventions, is there a relationship between changes in theoretically hypothesized mediators and changes in physical activity?
2. What is the evidence that physical activity interventions, alone or combined with diet modification or smoking cessation, are effective in helping cancer survivors improve their psychosocial outcomes (e.g., anxiety, depression, fatigue, and quality of life) or physiological outcomes (e.g., cardiorespiratory fitness, obesity/total fat/visceral fat, insulin, IGFs and IGF binding proteins, and sex hormones steroids and binding proteins)?

We planned that in answering the first key question, we would also address the following subsidiary questions:

1. What theories have been explicitly used?
2. What theoretical constructs have been implemented within interventions explicitly based on a particular theory or theories?
3. To what extent have mediators been appropriately tested?

To be included, a study must meet the following inclusion criteria:

Key question #1.

- Study must include an intervention designed to increase physical activity
- Study must include a measure of whether physical activity is affected by the intervention. Fitness is an acceptable surrogate measure of physical activity if it was intended for that purpose.
- Study must include a concurrent comparison group (studies that instructed control group participants to avoid exercise were excluded on the basis that those studies were focused on physiologic outcomes, not changes in physical activity behavior)
- Studies with all age groups will be included
- Study must be published in the English language

Key question #2.

- Study must be focused on individuals who have been diagnosed with cancer
- Study must include an intervention designed to increase physical activity
- Study must include a concurrent comparison group
- Study must include adults
- Study must be published in the English language

Exclusion Criteria

Studies with the following characteristics will be excluded from the review:

Key question #1.

- Study has fewer than 75 subjects total between the intervention and comparison group
- Study reports less than three month post-intervention followup data
- Study targets specifically:
    - Individuals with acute disease of any kind
    - Individuals with coronary heart disease, peripheral vascular disease, or cerebrovascular disease
    - Individuals with cystic fibrosis
    - Individuals with osteoarthritis
    - Institutionalized individuals (nursing homes residents or prisoners)
- Studies of cardiac rehabilitation programs
- Studies of rehabilitation/physiotherapy interventions

The Technical Expert Panel discussed at length the advantages and disadvantages of including or excluding from key question 1 any studies that targeted individuals with chronic or acute diseases. After the TEP meeting in January, the Minnesota EPC was guided further by AHRQ and NCI to include studies with diabetic or obese individuals, but not studies with other chronic or acute diseases. The rationale was that the impact of behavioral interventions on individuals with the excluded diseases might differ from the impact on included individuals.

Key question #2.

- Studies with no intervention designed to increase physical activity
- Studies with no concurrent comparison group
- Studies conducted in children only
- Studies published in languages other than English

Definition of followup. Studies that reported less than three months of post-intervention followup data were excluded in the review for key question #1 only. The definition of this time interval is illustrated in Figure 2. The followup period was defined as starting when contact from the investigators intended to affect the physical activity of the subjects concluded. Contact for measurement was allowed. It should be noted that individual investigators may not have defined followup this way, so the length of followup reported by the investigators within the publications reviewed may not be the same as the length of followup within this report. For example, a physical activity intervention may be faded over time, such that an intensive intervention may last for six months, followed by a minimal maintenance intervention for 18 months. The investigators may consider the 18 month period after the end of the intensive intervention to be a followup period. By contrast, in this report, followup would not start until the end of the 18 months of minimal maintenance intervention.

Literature Search Design

Identification of Literature Sources

Potential evidence for the report came from online databases, reference lists of all relevant articles and reviews, and files of project staff and TEP members with specific expertise in behavioral physical activity interventions and/or research on physical activity in cancer survivors. MEDLINE® was used as the only online database. In the process of peer review, only one paper from the cancer survivor literature and no papers from the general population literature were identified as missing. This indicates that although the search was not repeated in additional online databases, the existing literature for the key questions to be addressed was comprehensively identified.

Search for key question #1. A MEDLINE® search was performed to identify trials of physical activity interventions. The specific search strategy is shown in Appendix B. The titles and, if necessary, the abstracts of the results of this search were reviewed by an expert in physical activity interventions to identify references that required full review. We also identified previous systematic reviews of physical activity interventions in the literature.[16, 19-25, 27-34, 36, 37, 44, 45] The titles and, if necessary, the abstracts of all of the references in those reviews were also reviewed by an expert in physical activity interventions to identify references that required full review. These two lists were combined and all references were reviewed to determine whether the studies met inclusion criteria.

Additional references were identified in two ways. The list of references meeting inclusion criteria was shared with the Technical Expert Panel. TEP members could then suggest references missed that should be included.

The second manner in which additional references were added was in the process of reviewing the papers for whether they met inclusion criteria. During this review, the abstractors

identified other references that should be reviewed. Abstractors primarily identified other references related to the study in the reference under review.

Search for key question #2. For the part of the review on physical activity interventions in cancer survivors, we conducted two MEDLINE® searches with separate search strategies to identify possible papers for inclusion in the review. The strategies for these searches are included in Appendix B. We limited our search to English language papers. The first of these searches, conducted on July 6, 2003, yielded 16 papers. In July we also reviewed the references of a recent review on the topic of exercise in cancer survivors[7] and identified 39 additional papers. The second MEDLINE® search was conducted on September 17, 2003, and yielded 73 papers. These lists were combined using the bibliographic software EndNote® and duplicates were deleted, yielding a total of 128 titles. These titles were reviewed by a representative at NCI, a member of the TEP with special expertise in physical activity and cancer research, and a member of the project team to see if there were any papers obviously missing. Several additional titles were suggested by the TEP member, and several were deleted as well, resulting in a total of 128 titles to be reviewed for inclusion. Two additional articles were identified during the process of reviewing the papers included in the review. In the process of peer review, 14 additional references were identified.

Evaluation of Evidence

Data Collection

Question 1: General population. A data collection form was developed using the Guide to Community Preventive Services data abstraction instrument as a template.[46] All information necessary to the review was collected on this form except for the specific outcome information (see below). This instrument was reviewed by the Technical Expert Panel and relevant changes were made. The instrument was then computerized as a Filemaker Pro database to allow computerized data entry. This instrument was then pilot tested by the data abstractors and a member of the project staff with expertise in physical activity interventions. Revisions were made to the Filemaker Pro data entry screens until entry could be efficiently and accurately accomplished.

One member of a team of four data abstractors reviewed each reference identified for full review. The data abstractors all had expertise in the area of physical activity research. Any reference that was felt to not meet inclusion criteria was reviewed by another member of the team and if there was disagreement, the reference was brought to the full group. Each included reference underwent a second full review by a senior member of the team and any questions were discussed with the full team.

A second data abstraction form was developed for the abstractions of the specific outcome data from the included studies. This abstraction was done in an Excel spreadsheet. The outcomes of the included studies were abstracted by one of two members of the team with significant experience in abstracting outcomes for systematic reviews. The specific outcomes to be abstracted from each reference were reviewed by the entire team. The outcomes were re-abstracted as a check by a senior member of the research team and where there were questions, discussed with the full team.

Question 2: Cancer survivors. Detailed information about all but the outcomes from each of the 24 included trials was collected on a specialized data collection instrument (the Cancer Abstraction Form) designed for this purpose. This Cancer Abstraction form (Appendix C) was developed in consultation with a representative of NCI (Louise Masse) and a member of the TEP with special expertise in exercise and cancer survivors (Kerry Courneya). We included questions about trial design, study quality, the number and characteristics of participants, participant recruitment information, and details on the intervention (such as dose of exercise and non-exercise components). The outcome data were initially abstracted by a member of the project staff in Excel, just to list outcomes. This listing was checked by a second member of the project staff. Then tables of study descriptions and outcomes were developed. These tables were reviewed and checked by a second project staff member as well. All abstraction was checked by a second project staff member, though independent double abstraction was not conducted.

Two project staff members, both trained in the critical analysis of scientific literature, independently reviewed each of the identified articles to determine eligibility. The data abstraction was first conducted by a research assistant who had been trained in data abstraction procedures; then each abstraction was checked by a PhD trained member of the project staff with content area expertise in physical activity and cancer research. From the 53 articles initially reviewed for eligibility, 29, representing 25 trials, were accepted for further study. During the process of peer review, an additional 14 papers were identified. One of the 25 studies initially included was deemed unacceptable by peer reviewers, since it focused on physiotherapeutic exercise to increase shoulder range of motion after mastectomy.[47] One additional paper that reported outcomes for the remaining 24 studies was identified during peer review. The remaining 13 papers identified during peer review were excluded and have been added to the final list of excluded papers.

All outcomes were acceptable for abstraction for this part of the report, as one of the goals was to assess what outcomes have been included in this literature. The 29 articles presented data on 24 trials. In five cases, there were two articles that presented information for a single trial. To be clear, a 'trial' refers to a controlled clinical trial; an 'article' refers to a published document. An article may present more than one trial, or a trial may be described in more than one article. Trial is the unit for summarizing the results of the review.

To evaluate the quality of the study design and execution of trials, we collected data in a format that was based on the abstraction form developed by the Guide to Community Preventive Services[46] and shared with this project staff by a TEP member who had worked on the exercise/physical activity portion of that task force. For each trial, 11 questions were answered in four categories related to description of the study and participants, study measurement quality, analytic approach, and interpretation of results.

Data Synthesis: General population

Developing a common metric. The original methodologic plan was to attempt to pool main effects across included studies as well as compare the effects of subgroups such as populations studied or intervention type. Such data pooling requires a common metric that can be applied to each study. Because the goal of each of the included studies is to increase physical activity, and physical activity requires energy expenditure, the hope was that the outcome of a significant portion of the studies could be expressed as energy expenditure. A subset of the studies reported

energy expenditure and an additional group of studies reported sufficient data to calculate energy expenditure (e.g. time spent exercising and exercise intensity).

We were able to calculate energy expenditure for less than 12 of the 47 included studies on the general population. In those studies where energy expenditure was given or could be calculated before and after intervention in both control and intervention groups, we sought to compute a common intervention effect estimate (IEE). The IEE we sought to calculate for studies that reported energy expenditure (or enough data to calculate energy expenditure) is more commonly termed the 'raw mean difference.'[48] IEE is calculated as follows:

IEE = (PostT - PreT) - (PostC - PreC), where T indicates treatment group and C indicates control group.

The variance of this measure is calculated as:

Var(IEE) = Var(PostT - PreT) + Var(PostC - PreC) =
Var(PostT) + Var(PreT) - 2*SQRT[Var(PostT)Var(PreT)]Cor(PreT,PostT) + Var(PostC) + Var(PreC) - 2*SQRT[Var(PostC)Var(PreC)]Cor(PreC, PostC).

Calculation of the above variance clearly depends on the pre-post correlation. This correlation was not routinely available in the articles in question, nor was a measure of the standard deviation of the difference in means. Therefore it was not felt to be possible to derive one common metric from which to calculate the IEEs.

Calculating effect size from all outcomes. Because the diversity of outcomes prevented derivation of a common measure of physical activity for all studies, we elected instead to calculate effect size (e.g. standardized mean difference) from the outcomes represented across the studies. We did this to aid the interpretation, as it may be easier to compare studies using a single outcome measure, effect size, than the diversity of outcomes reported in the included studies. However, the results still reflect different outcomes and different underlying measurement domains; therefore, it is not necessarily reasonable to directly compare the results of two individual studies without examining the outcome measure underlying the effect size. This issue, as it relates specifically to this literature, is discussed in more detail in the results section of this report.

The effect sizes were calculated using the software program ES.[11] Effect sizes (e.g. standardized mean differences between the treatment and control group(s)) were calculated from all outcomes where one of the following combinations of data was available. (Note: We quote here from the ES software manual[11]):

- "Raw score means, standard deviations, and sample sizes OR
- Dichotomous outcomes in two by two tables with cell frequencies OR
- Dichotomous outcomes in two by two tables with chi-square and total sample size OR
- Between-groups t-test on raw post test scores OR
- Raw means and sample sizes on three or more groups, with a t-statistic comparing one group to a combination of other groups OR
- T-test for two matched groups, sample sizes, correlation between groups OR
- Between-groups t-test on change scores with intraclass correlation OR

- Change-score means and change-score standard deviations with intraclass correlation OR
- Two-group between-groups oneway F-statistic on change scores with intraclass correlation OR
- Change score means and sample sizes on three or more groups, t-statistic comparing one group to a combination of the other groups OR
- Two-group between-groups F-statistic on raw posttest scores OR
- Probability level and sample size for groups OR
- Coding results described only as significant if sample size for groups is known."[11]

Assumptions were made regarding missing information where it was felt it could be reasonably assumed. One example is assuming sample size when an enrollment number was available and there were sufficient clues as to the number analyzed at followup even if it was not stated. When an exact p-value was not given for a statistically significant study, it was assumed to be 0.05. This may systematically bias the effect size downward. If the p-value were actually smaller, the effect size would be greater. Where the within-person repeated measures correlation coefficients (intraclass correlation coefficients) for the outcome variable were missing for studies that reported change scores, it was assumed to be 0.6. It should be noted that for some studies it was not possible to incorporate baseline values into the effect size calculation because of inadequate information regarding the correlation of repeated measures. If the intervention and control groups were different at baseline, this difference could bias the post effect size. Given the important issues with the calculation of the effect size, the reader should understand that what is reported gives a reasonable approximation of the effect of the studies but is inexact.

We elected not to perform any mathematical pooling of the results for the general population. The studies differed in terms of intervention type, study duration, patient populations, outcome measures, and clinical outcomes. Although it would have been mathematically feasible to perform a quantitative meta-analysis, it was not clear that the numbers obtained would have any meaning. We elected instead to present the effect size results themselves so that the reader could understand the distribution of effect sizes within the diverse populations rather than reducing that distribution to a point estimate of questionable validity. The other metric examined is whether a study had statistically significant positive results. This criterion likely underestimates the results of the studies but is able to provide an additional level of understanding to the report of the effect sizes alone.

Data Synthesis: Cancer Survivors

For the portion of the review on the topic of physical activity in cancer survivors, effect sizes were also calculated using the software program ES.[11] Effect sizes (e.g. standardized mean differences between the treatment and control group(s)) were calculated from all outcomes where one of the following combinations of data was available. (Note: We quote here from the ES software manual[11]):

- "Raw score means, standard deviations, and sample sizes at post intervention
- Between-groups t-test on raw post-test scores."[11]

No change score effect sizes were possible in this section of the report given lack of information regarding the correlation of pre- and post-intervention values for the wide variety of

outcomes assessed. For studies in which there were no between group differences at baseline, this post-test effect size is a more acceptable measure of the impact of the intervention on the outcome. However, unlike the general population section, effect size calculations were made regardless of whether there were between group differences at baseline. Comments on interpretation of effect sizes in the cancer survivor literature are provided in the results section.

Publication Bias

The great variations in populations, interventions, and outcomes make the usual techniques for detecting publication bias both impractical and unreliable. It would be difficult to conclude that variations in outcome seen with varying trial size was related to publication bias and not confounded by any of the many other ways that the trials differed from each other. We do present the effect sizes and statistical significance of studies by study size, which provides some information about the possibility of publication bias. Yet, this is limited by possible confounding by differences in the studies as well as the fact that negative studies may be more likely to not allow a calculation of effect size (as they are less likely to present variance estimates or exact p-values for non-statistically significant outcomes).

Chapter 3. Results

Search Results in the General Population

The details of the paper identification are outlined in Figure 3. The electronic search identified 6,790 possible references. After review of the titles and abstracts, 260 of these references were felt to possibly meet inclusion criteria. The search of the references used in the previous systematic reviews resulted in the identification of 428 possible references. After review of the title and abstracts, 263 references were felt to possibly meet inclusion criteria. Because of overlap, these two sources provided 477 references to be pulled for review of the entire paper.

In addition to the papers identified through the electronic search and the review of previous reviews, two additional references were suggested by the Technical Expert Panel. Further, in the process of reviewing the references, the abstractors identified 47 additional references from the reference lists of the papers. (These were primarily related to the study under review). In total 526 references were identified for full review.

From the references identified for full review, six could not be obtained. These were references that were not available from any library through interlibrary loan. One was a thesis, two were conference proceedings, and three were from journals that could not be obtained. Of the 520 remaining studies that underwent full review, 47 studies were identified that met inclusion criteria. Eighteen studies had important information found in multiple references and one reference contained two studies. In sum, 87 references were identified for inclusion in the study.

Figure 3 also shows the reasons for exclusion of the excluded references. Exclusion criteria were considered in the order presented so that in general a reference that was excluded for a reason lower in the list was felt to likely meet the criteria higher in the list. For example, references excluded because the last measure of physical activity was less than three months after the end of the intervention were felt to have met the criteria above that measure in the inclusion/exclusion list (e.g., ≥75 subjects).

Of the 433 excluded references, 40 did not contain behavioral or policy intervention to increase physical activity. One common study of this type was trials in which the outcome of interest was actually the effect of exercise and the control group was told not to change their physical activity. Any study in which the control group was told not to exercise was thus excluded. Forty-four of the references were excluded because they did not contain a concurrent control group. Insufficient study size (<75 subjects total enrolled) was the reason for exclusion of 75 references. The largest reason for exclusion was a lack of an outcome measure three months or more after the end of the intervention. Two hundred nineteen references, which were about half of those identified for full review, were excluded for this reason. This may be a small overestimate of the percent of the references that otherwise met criteria since attempts were not made to certify with a complete review that the other criteria were met when a clear exclusion was identified. Thus, for example, if the nature of the outcome was unclear (whether it was a physical activity outcome or not) but it was clear that there was inadequate followup time, the reference was excluded and no further attempt was made to adjudicate whether the outcome was a physical activity outcome. Because one exclusion is occasionally more obvious than another, it

is possible that a portion of the studies that appeared to meet all criteria applied before the length of followup criterion may have met other exclusion criteria if they underwent complete review.

Study Characteristics: General Population

Populations studied. The 47 studies identified addressed a variety of populations. Adults were studied exclusively in 41 of the studies, four exclusively studied children, and two included both. Of the studies of adults, eight included only women, whereas two included only men. In all but two of the studies where race was reported, white subjects were in the majority. Of the remaining two, one studied an exclusively black population and the other a population that was 50 percent black and 50 percent Hispanic (with the race of the Hispanic subjects not stated). The setting of recruitment also varied across studies with 16 from a healthcare setting, 12 from community, six in school, two from a government agency, eight from a worksite, two from an exercise center, and one from both the community and worksite.

Study characteristics. By the inclusion criteria, all of the studies had a concurrent comparison group. The intervention and comparison groups could be either randomly assigned or use some other method of assignment. Further, the assignment could be done either on an individual level or a group (e.g., clinic or school) level. Within the 47 studies, five were assigned non-randomly on the group level (though two of these were analyzed as if randomized at the individual level), five non-randomly at the individual level, 14 randomly at the group level, and 23 randomly at the individual level.

Intervention characteristics. Within the 47 studies there were 72 interventions examined (exclusive of the comparison or control intervention(s)). Thirty studies examined one intervention, 11 examined two, 4 examined three, and two examined four. A complete description of all of the interventions is given in Appendix D. Twenty-two of the studies delivered a physical activity intervention to the control group as well as the intervention group. These interventions are also described in Appendix D. Control interventions not designed to increase physical activity are excluded from Appendix D.

There was a great deal of diversity within the interventions and across studies (Table 1). Across the studies, the intervention occurred in nine different settings and some interventions occurred in more than one setting. The most common intervention setting was a health care facility, which was used in nearly one-third of the studies. The next most common sites were worksites (28 percent) and community (26 percent), with home and school each accounting for about 15 percent of the studies.

Many of the interventions were aimed at other behaviors in addition to physical activity. Slightly over half of the studies (25, or 53 percent) included an intervention aimed at diet and/or smoking in addition to the physical activity intervention.

Where the type or mode of physical activity that was targeted by the intervention was stated, the studies were rather uniform. All that specified a type of physical activity specified a type of aerobic activity, but 58 percent of the interventions did not specify the activity mode and 49 percent of the studies did not specify activity mode for any intervention. Where the physical activity intensity was noted, it also was rather uniform, with moderate intensity most common. However, over two-thirds of the interventions did not specify intensity and 60 percent of studies did not specify intensity.

The interventions and studies also differed as to whether there was any in-person contact. Three-fourths of the interventions and studies did include some sort of in-person contact, but that leaves a sizeable minority in which the only contact with the subjects was by mail and, occasionally, telephone.

Half of the interventions (50 percent) and 43 percent of studies were tailored to the individual subject in some way. Those means of tailoring are shown in Table 1. Nearly a quarter of the interventions were tailored to a "Stage of Change." Other means of tailoring that were used in more than five percent of the interventions included tailoring to an individual's risk factor status, fitness level or exercise preference, or individualized counseling.

A wide range of behavioral intervention components (which are often also theoretical constructs) were used. Some were commonly used—over two-thirds of the interventions (67 percent) employed 'education on the benefits of exercise' and a similar amount (46 percent) provided written and/or verbal feedback and/or encouragement. Yet there was also a great deal of diversity. There were 11 behavioral intervention components that were used in 13 to 43 percent of the interventions, and there were 14 behavioral intervention components that were employed in four or fewer interventions. Nearly 20 percent of the interventions did not specify any behavioral intervention components.

Like the other aspects of the interventions, there was diversity in whether the study authors elucidated a theory underlying the intervention tested. For half of the interventions and studies (51 and 49 percent, respectively) no theory was discussed as the basis of the intervention. For 11 interventions two theories were said to underlie the intervention, and for 24 of them one theory was said to underlie the intervention. There were a variety of theories used. The most common theory was the Transtheoretical or Stages of Change model that was said to underlie about a third of the interventions (29 percent). No other theory accounted for more than ten percent of the interventions where theory was reported.

Even in the most fundamental aspect of the overall intervention intensity, the studies differed widely. The intensity of the most intensive intervention in each study is shown in Table 2. The number of contacts with the study subjects over the course of the intervention varied quite widely from just one to over 200. Further, the length of the intervention varied from a single encounter to seven years. One-quarter of the interventions went on for over six months.

We combined the type of contact, frequency of contact, and length of the intervention to classify the studies into an ordinal intensity scale. Studies in which there was no in-person contact were scored as "1". If there was in-person contact, but less than a total of eight times, and the study was less than two years long, it was scored as a "2". Studies that had ten or more in-person contacts and/or were large community trials that had a number of environmental and media changes and lasted five to seven years (such as Minnesota Heart Health Program,[49] Pawtucket,[50] and UK Heart Disease Prevention Project[51]) were scored as "3". The remaining studies, one of which met four times weekly for four months and three of which had in-person contact three to five times weekly from one to three years, were scored as a "4". Using this scoring system, four studies were scored in the highest category, ten in the lowest, and the remainder closely split in the middle categories. It should be noted that the decision as to where to place large community trials in such a scale is somewhat arbitrary.

Outcomes examined. A range of different physical activity outcomes was found in the included studies, and many studies included more than one. Twenty-four studies had one

physical activity outcome, eight studies had two physical activity outcomes, 11 had three, one had five, two had six, and one had nine, for a total of 99 individual outcomes. No specific outcome was used as the primary outcome across studies. Further, what may have been considered the primary outcome domain in one study (such as a measure of leisure time activity) may have been a secondary domain in another study (where the primary outcome could have been overall activity).

The diversity of outcomes presents a significant challenge in comparing the results of different trials. Two possible conditions may exist: 1) the different outcome measures may be measures of the same underlying physical activity domain assessed in different ways (e.g., leisure activity measured by self-report and accelerometry); or 2) the measures, although both measures of physical activity, may be measuring different underlying domains (e.g., self-report of vigorous activity and self-report of total activity).

There are a number of examples in this literature of different outcome measures that are assessing the same underlying domain. For example, a number of measures attempt to assess the total activity an individual performs in a day. This underlying domain may be assessed with a log of all activities, an objective measure (e.g. accelerometer), or a survey of activities for a recent period of time. Each of these methods of measurement may be more or less valid and reliable but they all reflect measurement of total activity. An intervention that actually increases total activity would be expected to have a similar effect on all three of the measures. Therefore, it may be reasonable to compare these outcomes that have been converted to a standardized metric such as an effect size.

There are also many examples of different outcome measures that are assessing different underlying levels of intensity within one domain (vigorous versus total leisure time activity) or differing domains (leisure time activity versus household chores). One could imagine that an intervention could have one effect on total leisure time physical activity and a different effect on vigorous leisure time physical activity. For example, the CATCH trial[52,53] sought to increase the physical activity of school children. They found that children who underwent the CATCH intervention had a statistically significant *increase* in vigorous leisure time physical activity and a statistically significant *decrease* in total leisure time physical activity. If we were comparing two distinct studies in children, one of which reported a decrease in total leisure time physical activity and one that reported an increase in vigorous leisure time physical activity and we compared the reported effects of the two studies, we would conclude that one was harmful (as it had a statistically significant negative result) and one was beneficial (as it had a statistically significant positive result). In truth, both occurred in the same study, and interpretation of these findings is complicated. This example is intended to point out the caution required in comparing results that assess different underlying domains or differing intensities within the same domain.

It would be optimal if there were a common measured domain across the studies included in the review to facilitate comparison of the effects of the different interventions. We grouped the outcomes in two ways to attempt to assess the effects of interventions. Because guidelines have targets for both moderate and vigorous activity[2] we first classified outcomes as measures of vigorous, moderate, or total activities. Measures of exercise sessions, fitness activities, fitness and vigorous activities were grouped as "vigorous activities." Measures of walking activities, other moderate activities and leisure activities were grouped as "moderate activities." Finally measures of daily activities and total activities were grouped as "total activities." Measures that did not fit these categories were classified as "other." Of the 99 outcome measures in the studies,

23 (23 percent) were classified as "total activities," 50 (51 percent) were classified as "vigorous activities," 25 (25 percent) were classified as moderate activities, and 1 (1 percent) was classified as "other." Of the 47 studies 20 (43 percent) contained a measure of "total activity," 28 (60 percent) contained a measure of "vigorous activity," and 18 (38 percent) contained a measure of "moderate activity." Because, each of these are collections of measures, when presented in the results they will be referred to as "group." For example, the "moderate activities" will be referred to as "moderate activities group" so it is clear that it is not a measure of total moderate activities.

As discussed above, one potential problem with the above categorization is that to the extent that some of the measures assess only a portion of the domain, it is possible that changes could be seen in the measures that do not in actuality reflect changes within the complete domain. For example, it is possible that individuals in a walking program could substitute the activity in the program for physical activities they would otherwise do. One might then see an increase in walking but in reality there is no change in overall moderate activity. There is little literature on this point, although observations in this literature review such as the differences seen in CATCH in which the vigorous activity promoted in CATCH substituted for other activity to result in a net decrease in total activity (see above) and the study of Goran et. al. in which elderly subjects in exercise training reduced their activity in the rest of the day for no net change in activity suggest this is certainly possible.[54] We therefore attempted to create distinct domains of physical activity outcomes. Some of these are subsets of other domains (e.g., walking activity is a portion of total moderate activity). For example if two studies each attempted to increase walking but one measured walking as an outcome and one measured total moderate activity as an outcome, differences could result either from differences in the interventions or because the interventions affect walking but not total moderate activity. This issue would not exist if they both measured walking or both measured total moderate activity and further underscores caution in interpretation of results.

The domains examined are shown in Table 3. We do not claim these are unique domains. Determining whether they are unique would require empirical testing. However, they provide an attempt to classify the outcomes of the studies in these reviews. Unfortunately, no one outcome domain was measured by more that 40 percent of the studies, so it was not possible to select one domain to examine across all of the studies. This diversity of domains should be kept in mind, however, when interpreting the overall results.

An attempt was made to use all of the existing information in the studies to create a measure of overall energy expenditure but this failed (see Methods). We therefore elected to include all of the physical activity outcomes reported in the results that follow. The complete list of outcome measures can be found within the main evidence tables (Appendix E). As the results contain a variety of outcomes, caution must be used in comparing the effects across studies as differences may result from differences in the outcomes assessed rather than differences in the intervention effects.

Followup time. There was a significant range in time between the end of the intervention and the final outcome measurement ranging from three months to 11 years (Figure 4). Most studies did not report multiple followup times, so it was not possible to pick a followup interval that was comparable across studies. The distribution of followup times is little different when

one examines the first followup greater than or equal to three months following the end of the intervention. The followup point used is stated in each of the analyses that follow.

Assessment of Outcomes

Two criteria for a positive effect of the intervention on outcome were used throughout the results: effect size and statistically significant positive effect. Each has its strengths and weaknesses. Used together these two criteria give a fuller picture of the results of the interventions.

Effect size. Effect sizes (e.g. standardized mean differences) are frequently used in pooling studies so that the results of studies that use different measures for the same outcome can be examined together. They have great strength because whatever the outcome is, if sufficient information is provided, an effect size can be calculated for it. This then allows that outcome to be compared to the same outcome from a different study measured in a different way (and also converted to an effect size). Thus, for this review it is possible to use effect size to get a sense of the effects of diverse outcomes without needing to understand exactly the metric employed in the study.

The ability to convert the effects of the various studies to effect sizes, however, comes at a price. Because results of studies are on the same metric, it is tempting to make comparisons between studies that should not be made. As discussed above, the outcomes of these studies may be of different domains of physical activity or differing intensities within a single domain. An effect size in a measure in one domain may or may not be analogous to an effect size in another domain. Although we think it is useful to examine the range of effect sizes in the included studies, any assessment of the actual effectiveness of an individual study requires a closer examination of the specific outcome measured. This information is provided in the evidence tables.

One additional weakness of effect size as a measure of outcome is that it cannot be calculated for all of the outcomes and in some circumstances when it can be measured, the results are known to be biased (usually downward). We were unable to calculate an effect size for 13 (28 percent) of the included studies. In the presentation of the effect size results, effects that could not be calculated are noted. It should be noted that the inability to calculate some effect sizes may artificially inflate the overall results reflected by effect sizes because the manner of reporting results in statistically insignificant studies tends to be less detailed, leading to inadequate data for effect size calculation. For example, for statistically significant studies, a p-value is generally either reported or is stated to be 'less than 0.05', which is part of the information needed to calculate an effect size. However, in statistically insignificant studies, the p-value may just be reported as 'NS' for not-significant. Reasons that effect size calculation was not possible for individual studies included no available variance estimates, no significance levels, insufficient information about number analyzed, or missing correlation information in multinomial models. Specifics on data needed for calculations of the effect sizes are provided in the Methods section.

There are no criteria that could classify effect sizes as small, moderate, or large that would make sense across all studies. Some relatively small effects may have a large impact if applied across a large population. However, for the purpose of ready comparison here we provide reference lines in the graph for effect sizes of .2, .5, and .8. If one considers the mean of the

treated group as a percentile ranking of the control group, these guidelines correspond to a percentile ranking of 58, 69, and 79 respectively.[55] In the text that follows, these will be referred to as small, medium, and large effects with the caveat that small effects may in reality have large impacts in a population and the reader should examine the details of the measures and effects in the evidence tables.

Statistical significance. We also examine whether interventions have a statistically significant effect. The advantage of this metric is that, unlike the effect size metric, it supports whether changes seen are real or reflect random chance. However, examining whether an intervention has a statistically significant positive effect may underestimate the effect of the interventions because the study may not have been sufficiently powered to detect a meaningful effect. This issue can be overcome by pooling similar studies to provide greater power. After examining the diversity of populations, interventions, and outcomes it was decided that formal pooling of the effects from the studies to increase statistical power was not appropriate.

Level of assessment. Within the 47 studies there were 72 interventions examined and 99 outcomes. Six outcomes were reported by subgroup only. A total of 166 outcomes for interventions were examined. As discussed above, it was not possible to establish one "best" outcome to examine from each study. Further, there is benefit to examining multiple interventions within studies independently because a specific intervention within a study may have been effective, and this level of evaluation will allow for examination of intervention components that are effective versus ineffective. Finally, on the study level we are able to see the overall effect of the study as a whole.

Outcome level examination. The effect of the intervention on each unique outcome of the included studies is reported. Again many studies examined multiple unique outcomes. Wherever possible the results for the whole intervention and control groups were used. In a few studies results were reported by subgroup only. In these cases the subgroup analyses were used. All of the effect sizes that could be calculated are reported in the evidence tables and are used in the graphs of effect size on the outcome level.

An effect was considered a statistically significant positive outcome if a statistical test was performed that demonstrated that the intervention group had greater physical activity (however measured) than the control with a significance of $p<.05$. Where sufficient data were presented to perform a statistical test but the statistical test was not reported in the paper, that testing was done as part of the review and if $p<.05$ the outcome was reported as statistically significant. Where 95 percent confidence intervals were reported, an outcome was reported as statistically significant if the intervals were non-overlapping.

Intervention level examination. For each intervention there could be several outcomes reported. To report an effect size for an intervention it would be therefore necessary to calculate one effect size out of multiple effect sizes and do it consistently across studies. For studies that had only one intervention tested, the intervention level would be the same as the study level (see below). Although a mean of multiple effects may appear appealing as a means of calculating the effect of an intervention that had multiple outcomes, the fact that the number of effects presented is arbitrary may result in penalizing studies that more thoroughly report the results. This would occur if authors prejudiciously fail to report results of lesser effect over those of greater effect. Therefore, we assumed that authors may report the outcomes that show the greatest effect and used the largest effect to give the best comparison across interventions and studies. This may

bias the effect seen for the individual interventions and studies upward for the true effect but allows a greater degree of comparability across interventions.

An effect was considered a statistically significant positive intervention if any one of the outcomes examined within the intervention was statistically significant. The intention here is to convey a level of positivity of the results, not to perform a statistical test. Significance was not corrected for multiple tests so classifying an intervention as a statistically significant positive effect does not necessarily mean that the intervention was indeed significant at the .05 level.

Study level examination. When there were multiple interventions used in a study it was necessary to calculate one effect across the interventions to be able to report an overall effect of the study. The same reasoning was used to combine interventions as was used to combine outcomes within interventions (see above). Therefore, in combining the effects of studies with multiple interventions, we chose the largest effect to report as the study effect. Again, this may bias the effects on the study level upward but eliminates the role of number of outcomes reported on effect size.

A study was considered a statistically significant positive intervention if any one of the outcomes examined within the study was statistically significant. The intention here is to convey a level of positivity of the results, not to perform a statistical test. Significance was not corrected for multiple tests, so classifying an intervention as a statistically significant positive effect does not necessarily mean that the intervention was indeed significant at the .05 level.

Overall Effect

The overall effect sizes at the outcome, intervention, and study level are shown in Figure 5. There were 102 outcomes and 50 interventions within the 34 studies for which effect sizes could be calculated. Of the 102 outcomes, 7.8 percent (eight) had an effect size greater than .8, and 2.9 percent (three) had an effect size between .5 and .8. An additional 32.4 percent of the 102 outcomes (33 outcomes) had an effect size that exceeded our criteria for a small positive effect of .2. Of the 50 interventions for which we could calculate an effect size, 10 percent (five) had an effect size greater than .8 and 4 percent (two) had an effect size between .5 and .8. An additional 44 percent (22 interventions) had an effect size that exceeded our criteria for a small positive effect of .2. Finally, on the study level, 5.9 percent (two) of studies had an effect size greater than .8, and 5.9 percent (two) had an effect size between .5 and .8. An additional 47.1 percent (16 studies) had an effect size that exceeded our criteria for a small positive effect of .2. Overall, 58.8 percent of studies had an effect size that exceeded our guideline of small (.2).

There were only two studies exclusively of children for which an effect size could be calculated.[53,56] The overall effect size of these studies was similar to those of the other studies (.597 and .145). Arguments could be made either way as to whether it is reasonable to include studies of children with those of adults. We elected not to exclude these studies from the other analysis that follows. This decision has no effect on the conclusions derived from the results.

Approximately one-fourth of the outcomes reached statistical significance (see Table 4). Nearly a third of the interventions overall had at least one outcome that was significant at the .05 level. Nearly half of the studies (44.7 percent) had at least one outcome that was statistically significantly positive. Again, this is not corrected for multiple tests within studies.

Effect by outcome group. Because of the number of different outcomes examined in these studies it is possible to examine the range of effect sizes and percent statistically significant for the different outcome groups. One issue with examining whether the effects observed varied by outcome group is that some outcomes occur multiple times within an individual study because results may be reported for multiple interventions and subgroups. If this is not accounted for, the effect would be to overweight these outcomes in the examination of the distribution of effect sizes and statistical significance. Therefore, in examining the effect by outcome group, it is necessary to assign one effect to each of the 99 individual outcomes examined. To assign one effect to each outcome we used the greatest effect size observed for that outcome (if an effect size could be calculated) and if any of the observations for that outcome were statistically significant, the outcome was considered statistically significant. For example, if the outcome "walking sessions per week" was reported for two interventions in a study with an effect size of 0.1 and 0.2, we assigned the effect size of 0.2 to the outcome. Similarly, if the effect of "walking sessions per week" was statistically significant for the effect size of 0.2, we classified the outcome of "walking sessions per week" as statistically significant. The effect size for all outcomes by the outcome group is shown in Figure 6. The percent of each outcome group that was statistically significant is shown in Table 5.

Within the outcome groups, only the moderate activity group and the vigorous activity group had any outcomes that exceeded our guide of a large outcome of .8 (two moderate and one vigorous). Approximately 60 percent of moderate activity outcomes had an effect size greater than our guide of .2, whereas approximately 40 percent of the vigorous activity outcomes and total activity outcomes exceeded that threshold. A greater percentage of moderate activity outcomes was statistically significant compared to total activity outcomes (48 percent versus 13 percent; p=.008). The percentage of vigorous activity outcomes that was statistically significant fell between the other two outcome groupings, (28 percent) but was not statistically significantly different from either the moderate or total outcome groups.

Description of the Specific Effects

A more full understanding of the effects seen in this literature may be obtained by closer examination of the individual studies. For that reason, we describe in greater detail the interventions and results of those trials that meet the traditional measure of success and are statistically significant. For ease of understanding, they are discussed by the setting in which the intervention took place.

Health care. Bull et al. examined whether brief advice from a family practitioner combined with a mailed pamphlet would increase sedentary patients' physical activity.[57] Seven hundred sixty-three sedentary subjects were allocated to a control group, advice plus a standard pamphlet mailing or advice plus a tailored pamphlet mailing based upon the day of the week they attended the clinic. They found that six months after the intervention the percent of patients who were "now active," defined as any walking or exercise in the previous two weeks was greater in the combined intervention groups than the control group (38 percent vs. 30 percent; p not reported but stated to be significant). The difference at 12 months of followup was smaller and non-significant (36 percent vs. 31 percent). There were no statistically significant differences between the control and intervention groups in the number of exercise sessions in the previous two weeks at six months or 12 months, and there were no statistically significant differences between the two intervention groups.

In the "Change of Heart Study" Steptoe et al. examined the effect of behavioral counseling on coronary heart disease risk factors including exercise.[58] Eight hundred eighty-three men and women with one or more modifiable risk factors attending a general medical practice were given either routine counseling or behaviorally oriented counseling depending upon the clinic they attended. Behavioral counseling subjects received two or three counseling sessions depending upon their number of risk factors. They found that approximately eight months after the end of the intervention the intervention group had increased the average number of exercise sessions in the previous four weeks from 5.56 to 8.2, whereas the control group had decreased slightly from 4.82 to 4.3. This change in number of exercise sessions in the intervention group compared to the control group was statistically significant.

Halbert et al. examined the effect of physical activity advice given by an exercise specialist during three general practitioner appointments versus no advice.[59] Two hundred ninety-nine subjects over age 60 were randomly selected from two general practices in Adelaide, Australia. Approximately six months after the end of the intervention, intervention subjects were exercising more than control subjects on three of five measures of physical activity: walking sessions per week (median 3 vs. 2; $p<.05$), vigorous exercise sessions per week (median 2 vs. 0; $p<.05$), and minutes of vigorous exercise per session (median 20 vs. 0; $p<.05$). There were no significant differences in the minutes of walking per session or in energy expenditure as measured with an accelerometer although the latter was done only on a subset of 59 individuals so power may have been an issue (no data is presented to allow evaluation of power).

Kerse et al. examined the effect of educating general practitioners in health promotion (including increasing physical activity) for elderly people.[60] Forty-two Australian general practitioners were randomly assigned to either an education group or a control group and 267 of their patients were randomly selected from their practices. Approximately nine months after the physicians completed their educational program, the patients of intervention physicians were performing more physical activity on one of three continuous self-reported measures. The results are reported as net differences in the physical activity changes between treatment and control participants: minutes walking in the previous fortnight (88 minutes more in treatment than control participants; $p=.032$); as well as two of three categorical self-report measures: walking minutes per day on a five-point likert scale (.34, $p = .005$), walking minutes over previous fortnight on a three-point scale (.27, $p = .025$). There were no statistically significant differences in minutes walking per day as a continuous (8.4 minutes $p = .059$), total activity as a continuous measure (148 minutes, $p = .34$), or total activity total in the last fortnight on a five point scale (.23, $p = .30$).

Green et al. examined the effect on 316 primary care patients of three session of telephone based motivational counseling.[61] Using intention to treat analysis, intervention subjects were exercising more than controls approximately three months after the intervention as assessed using the Patient-centered Assessment and Counseling for Exercise (PACE) score, which is a self-report measure of both stage of change and level of exercise (5.37 vs. 4.98; $p=.049$). However, the change in PACE score from baseline was not statistically different between the two groups (.426 vs. .102; $p=.145$).

Stevens et al. examined the effect within 363 inactive subjects selected at random from 714 subjects recruited from two London general medical practices, of meeting with an exercise development officer followed by a personalized ten-week exercise program.[62] Eight months after the intervention participants reported more sessions for moderate physical activity (5.09 vs. 3.64

control; p<.05), more sessions of vigorous activity (.86 vs. .78 control; p<.05), and more overall episodes of physical activity (5.95 vs. 4.43 control; p<.05) in the four weeks prior to the end of followup.

Community. Gillett et. al. randomly assigned 182 sedentary obese 60-70 year old women recruited from newspaper ads to fitness education, fitness education with aerobic training, or a control group.[63] They examined fitness three months and six months following the intervention and found that overall the aerobic training group had a better VO2 max than the other two groups (at six months average VO2 max increased in aerobic training group 14.9 percent vs. education 1.8 percent vs. control -1.0 percent; overall group effect p<.001). However, the aerobic training group reported exercising fewer days per week at six months than the education group (2.3 vs. 3.3; p<.01). Results for the control group were not reported.

Pereira et al. reported on the exercise status of subjects ten years after the conclusion of a randomized controlled trial of a walking program to examine the effect of walking on bone mass.[64] Two hundred twenty-nine female postmenopausal subjects were randomly assigned to a control group (instructions to control group participants were not described) or a walking program consisting of 16 organized group walking sessions over eight weeks followed by either group walking sessions or walking on their own for the duration of the clinical trial (1982-1985). Ten years after the conclusion of the clinical trial, walking program subjects reported more weekly kilocalories (kcal) expenditure for total usual walking (median 1,344 vs. 924 control; p=.01) and more weekly kcal expenditure for usual walking for exercise (median 1,008 vs. 302; p=.01). There were no statistically significant differences in weekly kcal for sport and recreation, weekly kcal for past year exercise, Paffenbarger sport and recreation index, or Paffenbarger sport and recreation index with walking excluded.

School. Burke et al. examined the effect of a physical activity and nutrition program during two ten-week terms for 800 11-year olds in Australia.[65] Schools were randomly allocated to a physical activity program consisting of classroom lessons and fitness sessions (six standard intervention schools), the fitness program combined with an education enrichment program for high-risk children (seven enriched program schools) or no program (five control schools). Results were reported by gender and risk group. The results were reported graphically and significance was determined by non-overlapping confidence interval bars. Six months after the intervention six of the intervention groups had statistically significant improvements in fitness as measured by change from baseline in shuttle run time (measured in minutes) as compared to the comparable group at the control schools. Three of the groups that improved more than the comparable control schools were at the standard intervention schools (low-risk girls 9.5 vs. 1; high-risk girls 8 vs. 4; low-risk boys 8 vs. 5) and three in the enriched program schools (low-risk girls 9.25 vs. 1; high-risk girls 9.75 vs. 4; low-risk boys 10 vs. 5). In a second measure of fitness, time in minutes of a 1.6 km run, only high-risk boys at the enrichment schools had what appeared to be a borderline significant improvement (-1.1 min vs. -.4).

Dale et al. examined the effect of a "conceptual physical education" program for ninth grade students at one high school.[66] They were compared to students who moved to the school after the program started. They analyzed male and female students separately and two cohorts separately (the program was done in two subsequent years). Two, three, and four years after the intervention they assessed the percent of individuals who reported doing moderate activity five or more days per week and vigorous activity three or more days per week. From the 24 comparisons (two genders, two levels of exercise, three points in time, two cohorts) they found

two statistically significant differences. A larger percentage of men in one intervention cohort were doing moderate exercise compared to the control three years after the intervention (34 percent vs. 13 percent; p=.04 without correction for multiple comparisons) and a larger percentage of men in a different cohort were doing vigorous exercise four years after the intervention (65 percent vs. 29 percent; p=.01 without correction for multiple comparisons). There were no statistically significant differences in the other 22 comparisons.

Howard et. al. examined the effectiveness of a cardiovascular risk reduction program for children in grades four through six.[56] The study was conducted at one private parochial school. One class in each of the fourth through sixth grades was given the intervention and the other class within each grade served as the control group. The intervention included five sessions including "physiology of the heart, smoking, hypertension, diet, and physical activity" developed from materials from the American Heart Association. One year after the end of the intervention, the intervention group was exercising fewer times per week (for at least 30 minutes per time) than the control group (5.89 versus 10.4; p=ns) although the difference was not statistically significant. Further, there were no statistically significant differences in fitness between the intervention and control groups at followup as measured by the Canadian Aerobic Fitness test (4.17 intervention group versus 4.08 in control; p=ns). Yet the intervention group reported that a greater percentage of their exercise was running compared to the control group (68.7 percent versus 38.3 percent; p<.05).

Nader et al. reported on the post-intervention findings of the CATCH trial, which was a three-year cardiovascular health promotion program given to students in third through fifth grades at 56 randomly assigned schools in four states.[52] Outcomes were compared to students from 40 control schools. One year after the end of the intervention, intervention students reported doing more minutes of vigorous physical activity per day than control students (53.2 vs. 42.2 control; p=.001) but control students reported doing more total physical activity minutes per day (164.5 vs. 172.1 control ; p=.04). [Note: the text of the paper states that the direction of the total physical activity effect favored intervention students, but the table presented showed the opposite. The authors confirmed with us that the table is correct, which is the data presented here.] (Personal communication, Henry Feldman.) At three years following the intervention, intervention students still reported more vigorous physical activity minutes per day (30.2 vs. 22.1 control; p=.001), but the differences in total physical activity minutes were no longer significant (121.1 vs. 125.4 control; p=.59).

Worksite. O'Loughlin et al. examined the effect of workplace-based health screening on employees of eight elementary schools compared to eight matched comparison schools.[67] Screening was done for all the subjects at the school during one day in February. Two hundred nine subjects completed baseline information at the intervention schools and 177 at the control schools. Four months after the health screening, intervention subjects reported a greater increase in leisure time exercise behavior score (sessions per week x intensity weight per session) (4.6 vs. –0.4 p=.05).

Gemson et al. examined the effect amongst 161 financial services workers of a worksite based computerized health risk appraisal with counseling compared to just the computerized health risk appraisal.[68] Subjects were randomly allocated to get the intervention. Of the 56 percent of the subjects who followed up at six months, the intervention group reported a greater increase in episodes of physical activity per week (.33 vs. -.13; p<.05).

Lombard et al. examined the effect of telephone prompting to increase physical activity in 135 subjects recruited from faculty and staff at a southeastern university.[69] Four different telephone prompts were examined: high frequency low structure (HF/LS), high frequency high structure (HF/HS), low frequency high structure (LF/HS) and low frequency low structure (LF/LS). At three months after the end of the intervention, a larger percentage of each of the intervention groups except low frequency high structure were walking at least one day per week for 20 minutes (63 percent HF/LS vs. 63 percent HF/HS vs. 26 percent LF/LS vs. 22 percent LF/HS vs. 3.7 percent control; significance not reported but by t-test using data in paper $p<.05$ for all but LF/HS compared to control). Similar results were seen for percent of subjects meeting Centers for Disease Control/ American College of Sports Medicine (CDC/ACSM) criteria (52 percent HF/LS vs. 41 percent HF/HS vs. 11 percent LF/LS vs. 15 percent LF/HS vs. 3.7 percent control; significance not reported but by t-test using data in paper $p<.05$ for HF/LS and HF/HS compared to control).

Mutrie et al. examined the effect of distributing a "walk in to work out" pack (consisting of interactive materials based on the transtheoretical model of behavior change, local information about distance and routes, and safety information) to 145 employees randomly selected from 295 employees from three work places who expressed an interest in walking or cycling to work.[70] Six months after the intervention they found that the intervention subjects spent nearly twice as much time walking to work than did the controls (1.93 average relative increase in time compared to controls with 95 percent confidence intervals 1.06 to 3.52). There was no difference in time cycling to work (data not reported).

Linenger et al. examined the effect of multiple environmental interventions undertaken at the San Diego naval air station including new recreational facilities, paths, events, and equipment.[71] The fitness of residents was compared to a comparison naval air station and a random sample from the Navy as a whole. One year after the intervention, those in the intervention community had a greater average improvement in 1.5 mile run (intervention group 12.6 minutes baseline, 12.3 minutes one year; comparison groups 12.3 and 12.1 baseline, 12.2 and 12.2 one year; $p<.01$ time by group interaction). However, energy expenditures in kcals per week did not differ between the groups.

Other. Perkiö-Mäkelä examined the effect of 2.5 months of aerobic training and lectures on work issues on 62 female dairy farmers aged 25-45 with moderate musculoskeletal symptoms randomly selected from a group of 126.[72] At one-year followup, intervention subjects reported more leisure time physical activity than the control group ($\geq$2 times per week 34 percent intervention vs. 20 percent control; $p=.003$). At three years the control group was more active, but the difference between groups was not statistically significant.

Marcus et. al. examined whether a computerized report which gave motivation feedback, comparative feedback, and progress feedback increased physical activity more than standard self-help materials in 194 healthy adults recruited through newspaper advertisements.[73] Materials were provided at baseline, one, three, and six months. Six months after the last intervention materials more intervention subjects met CDC/ACSM criteria for physical activity (42 percent vs. 25 percent; $p<.05$) but there were no statistically significant differences in minutes walked per week (187 vs. 133; $p=.1$).

Belisle et al. did two studies among registrants to exercise groups at the University of Montreal sports center.[74] Intervention participants received a special health education program designed to increase awareness of obstacles to exercise and develop appropriate techniques for

coping with them in addition to the structured exercise program given to both intervention and control participants. Intervention subjects reported more exercise sessions per week in the three-month period following the intervention in both studies (4.2 vs. 3.68; $p<.01$ in study one and 4.24 vs. 2.68; $p<.01$ in study two).

Moderators of Effect

Moderators of the effect of a physical activity intervention are those characteristics of the subject or environment that alter the effect of the intervention in that subject or environment (i.e., the effect of the intervention is modified by the moderator). For example, if the same intervention had a different effect in men than women, then gender could be viewed as a moderator of the effect of the intervention. Similarly, if the same intervention had a different effect when undertaken in a workplace rather than a community center, the setting could be viewed as moderating the effect. Most characteristics of individuals that may affect how they respond to a physical activity intervention may be thought of as moderators.

The original hope was that sufficient studies would have similar interventions and comparable outcomes so that the effects of moderators across pooled studies could be studied (e.g., examine the effect of age within a group of pooled studies using meta-regression techniques). Unfortunately, as discussed above, the literature proved to be too heterogeneous and the outcomes could not be pooled. Therefore we restrict our examination of moderators to those with sufficient numbers that they can be examined across studies without pooling and those that were explicitly tested within studies. Within studies a moderator was considered to be explicitly examined if there was an explicit comparison of the effect of the intervention in two or more subgroups or if there was a multinomial model (e.g., ANOVA or multiple regression) that tested an interaction between a moderator and the intervention. We did not attempt to deduce a moderator effect when subgroups were reported but not compared or when multinomial models were presented but interactions were not tested.

Effect of Intervention Setting

An examination of the effect of intervention setting on outcomes is presented in Figures 7, 8, and 9 and Table 6. Examination of the effect size results at the study level is perhaps most informative as the distribution is not affected by the fact that some studies examined multiple outcomes or had multiple interventions. Two of the studies had effects greater than our guideline of .8; one in the community setting and one in the work setting. One school-based study had a moderate effect as did one study at a government agency. The numbers are too small to draw any conclusions about the percent of studies in each setting that had an effect size of at least .2. By setting, the criterion of an effect size of 0.2 or greater was met by: healthcare 54 percent (seven), home 33 percent (two), community 67 percent (six), school 50 percent (one), work 57 percent (four), government 100 percent (one), and other settings 75 percent (three). The range for statistically significant interventions has a similar magnitude ranging from a low of 28.6 percent for community-based interventions to a high of 100 percent for the government institution based intervention. However, the numbers are again small overall so it would be wrong to attempt to draw any firm conclusions. The differences seen could be random statistical variation.

Moderators within Studies

Although a large number of the studies examined measured baseline characteristics of the study subjects, only one used this information to examine whether baseline characteristics moderated the effect of the intervention to increase physical activity. Steptoe et al. investigated the effect of brief behavioral counseling in primary care.[75] They found a significant interaction effect between the intervention and measures of support from family and friends, having a partner who exercised, perceived greater benefits from exercise, and perceived lower barriers to exercise. This suggested that these factors were moderating the effect of the intervention. That is, subjects who possessed these characteristics were more likely to respond to the intervention than other subjects. They did not see an effect for a measure of stages of change. None of the studies reported explicitly testing the effects between subgroups of the population.

Mediators of Effect

Mediators of the effect of physical activity intervention are constructs that are hypothesized by the interventionist to fall in the causal pathway between the intervention components and behavior. For example, one reason individuals may not exercise is because they perceive barriers to exercising. If one intervenes to reduce those perceived barriers, subjects may then exercise more. A change in perceived barriers to exercising would then be considered a mediator of physical activity change. Support for the possibility that a factor is a mediator of an intervention is provided if the intervention is found to have a positive effect on the mediator. Further support is provided if changes in the mediator with the intervention are associated with changes in physical activity.

Like the examination of moderators, it was not possible to pool studies to examine the effect of mediators of physical activity because of the heterogeneity of the studies and the small number of these studies that examined mediators. We therefore examined the effect of mediators as described within studies.

Effect of intervention on hypothesized mediators. Eleven studies hypothesized mediators (Table 7). All 11 of them intervened on at least one of the hypothesized mediators. Nine of the studies measured the effect of the interventions on the hypothesized mediator although two[76,77] did not report any of the results.

The only statistically significant changes in mediators reported were for ‘greater intention to exercise,’ and this was reported in one study. In the other studies that reported results, there was either no effect or a nonsignificant change in mediators resultant to the physical activity interventions.

Effect of hypothesized mediators on physical activity. Only one study examined whether a hypothesized mediator affected the physical activity outcome.[78] They examined whether including the mediator in the overall model of the effect of the intervention on outcome would change the intervention effect. They found that including partner support and self-efficacy in the model attenuated the effect of the intervention seen. They therefore concluded that the effect may be acting through the hypothesized mediators.

Effect of Intervention Type on Outcome

Because of the heterogeneity of populations and outcomes it was not possible to closely examine the possible different effects of different types of interventions. We felt it was possible, however, to attempt to look at a gross level of how intensive the intervention was and whether that predicted the outcome of the intervention. The effect size seen in the studies by the intensity of the intervention is shown in Figure 10. The percent of the studies that were statistically significantly positive by intensity of the intervention is shown in Table 8. The intensity measure is described in greater detail above. Within this data there is not a clear effect of intensity of the intervention on the magnitude of the effect size. Seventy-one percent of the lowest intensity interventions had an effect size greater than .2, compared to 57 percent of the level two intensity studies, 45 percent of the level three intensity studies, and 50 percent of the highest intensity studies. Yet, the two studies with effect sizes greater than .8 were studies of intensity level three and four and none of the studies in intensity level one had an effect size larger than our guideline for a small effect size of .5. All four of the most intensive studies were statistically significant, but no clear trend of statistical significance was seen in the other intensity levels ranging from 33 percent statistically significant for level three studies to 44 percent significant for level two studies. Again, sample sizes are small so it is not possible to conclude whether there is an effect of intervention type on intervention success.

One possible limitation to physical activity is lack of access of places to exercise. Some interventions specifically address this issue by providing greater access for subjects to places to be physically active such as exercise facilities or parks. Figure 11 shows the effect size of studies that addressed access compared to those that did not. Of the nine studies that addressed accessibility, seven (78 percent) had an effect size greater than our guideline of .2, as opposed to 13 (52 percent) of those that did not address accessibility. This difference was not statistically significant. There were the same number of studies with moderate and large effects within the studies that addressed accessibility and those that did not (one in each category each).

Another way in which the studies differed was whether they addressed other health issues beyond physical activity. We examine specifically whether the studies combined the physical activity intervention with diet or smoking cessation interventions. Figure 12 shows the effect size of studies that had interventions that included smoking cessation and/or diet interventions and those that did not. Again, the numbers are small but there does not, in this set of studies, appear to be a notable difference. Twelve of the 19 studies (63 percent) that did not include a smoking cessation or diet intervention had an effect size that exceeded our guideline of .2, compared to eight of the 15 (53 percent) of the studies that did not have those components.

The other major variation in intervention type that we set out to test was whether theoretically-based interventions were more effective than those that do not explicitly use theory. In this review we accepted the authors' statements about whether an intervention was designed with the use of theory and which theory was used. The effect size by whether an intervention was theoretically based is shown in Figure 13. The four studies with the largest effect sizes were not based upon theory. Overall, 12 of the 18 studies that did not use theory (67 percent) had an effect size greater than our guideline of .2, whereas eight of the 16 studies (50 percent) that used theory exceed that criterion. Theory based interventions were less likely to be statistically significant when examined on the level of outcomes and interventions (Table 9). On the level of outcomes, 12 percent of theory based interventions were statistically significant compared to 28 percent of

those that did not explicitly use theory (p=.02). Similarly, on the intervention level 19 percent of theoretically-based interventions were statistically significant compared to 44 percent of those that did not use theory (p=.02). At the study level, a similar pattern was seen (57 percent versus 33 percent; p=.110) but it was not statistically significant. Although there are no clear differences in effect size between the theoretically based interventions and others, the results for statistical significance do not support that theoretically based interventions are more effective.

One point to keep in mind in examining these factors is that they most likely are not completely independent. That is, studies that use theory may have other characteristics in common that may also influence the results. Table 10 shows the relationship between the use of theory and intensity level. Although not statistically significant, there was a suggested trend in more intensive interventions to be less likely to be theory based. Hence, if more intensive interventions have greater effect, as was suggested by our non-significant finding that none of the lowest intensity interventions had an effect size greater .2, the apparent negative effect of theory may be a result of the intensity of the interventions rather than the effect of theory. The relatively small number of studies in the review does not allow further exploration of these questions as the number of studies in any category becomes quite small.

Time to Followup

One potentially confounding issue in this literature is the inconsistent length of followup. We used a criterion that studies must report followup data three months or more from the end of the intervention. Yet as was clear in the Study Characteristics discussion above and shown in Figure 4, there is a significant range of followup intervals. As one might expect that the effect may decrease over time, part of the difference in effects between studies may be related to the length of followup after the end of the intervention.

We examined the percent of studies that were statistically significant by the length of time to the first followup greater than or equal to three months after the intervention (Table 11). There is no clear effect of followup time on whether interventions were statistically significant ranging from 46 percent significant for those with the shortest time to 41 percent significant for those with the longest. Similarly, there is no clear pattern in effect size by the length of time between the end of the intervention and followup (Figure 14). There was no clear trend in the percent of studies with a small effect or greater, nor in those with a moderate or large effect.

The lack of clear effect of followup time seen looking across could be related to other differences between the studies other than length of time A more direct test which controls for this possibility is to examine the change in effect across time within studies. Unfortunately, few of the studies have measures of outcome at points in time short of the final outcome. We abstracted the effect of the interventions at the end of the intervention, a point greater than or equal to three months after the intervention and at the last followup point. Only 17 of the studies in the review provided sufficient data on effect size at more than one of these points in time.

The effect size by time from the end of the intervention for those 17 studies with more than one measurement is shown in Figure 15. Three quarters (73 percent) had an overall decrease in effect size over time with the average decrease in effect size per month of followup of .03 (range decrease of .14 per month to increase of .04 per month). Because of this effect, the length of followup should be taken into account when judging the individual effects in the evidence table.

Size of Study

The relationship between effect size, statistical significance, and the number of subjects analyzed is shown in Figure 16. A couple of observations may be made from this figure.

Although it is difficult to get a good measure of power of each of the studies because of insufficient variance estimates of outcomes, the measure of sample size is a reasonable surrogate looking across studies all examining a physical activity outcome or outcomes. The figure fails to show a clear positive relationship between sample size and statistical significance. Of the eight studies that analyzed over 700 subjects for which effect sizes could be calculated, only two were statistically significant compared with 44 percent of the studies overall Although there may well be interventions within this review that would have shown a statistically significant effect if they had had greater power, overall lack of sample size does not appear to be a major determining factor driving the differences seen in statistical significance between the studies.

It is difficult to assess publication bias with the diverse set of interventions and populations examined in this review. With a consistent literature, one expects to see a relationship between the distribution of effect sizes related to the size of the study (narrower at larger sample sizes) with the mean at each size the same. This sort of observation could be confounded by differences in the studies and populations at different study sizes. Nonetheless, it does appear that the smaller studies have larger effect sizes on average, suggesting that there may well be smaller negative studies missing from the literature.

Other Outcomes: Potential Harm

The entire purpose of the interventions examined in this review is to increase the physical activity of individuals to reduce their risk of adverse health outcomes. However, it is at least in theory possible that there could be adverse health outcomes associated with the interventions themselves. It is conceivable that this could be an important factor in the overall health impact of these interventions. In a most extreme example, it would not take too many elderly subjects falling and breaking a hip as a result of a fall in a walking program to outweigh the overall health benefits to the group. Yet, only one study examined potential harm of these interventions and that was simply a statement that no injuries were reported by study subjects.[79]

Measure Quality

Four means of measuring physical activity outcomes were used in the included studies: diary/log, patient recall on survey, accelerometry, and physiologic fitness measure. Of the 166 individual outcome results, 115 were obtained by survey, 16 by diary or log, two by accelerometer, and 33 were fitness measures. One concern about this literature is that the subjective measures may be more prone to bias. As these are unblinded studies one might expect that this may increase the effect size as individuals in the intervention groups report greater exercise than actually performed. More subjective measures could also act to decrease effect size by introducing random noise that may decrease the differences between groups. We examined the effect size by the type of measure (Figure 17). Again, each of the 99 individual measures was included just once in the analysis. There was little difference in effect size regardless of how physical activity was measured. Fifty three percent of survey measures had an effect size less

than .2 compared to 57 percent of diary/log and fitness measures. There was only one measure using an accelerometer and it also had an effect size less than .2.

Study Quality

Two measures of quality were used. The first was an adaptation of the quality measure from the Guide to Community Preventive Services.[46] The advantage of this measure is that it has been successfully applied to the physical activity literature previously. Further, the specific criteria within the measure may be applied to all of the studies in the review. One shortcoming of the measure is that it was not designed to evaluate randomized controlled trials and therefore omits criteria that may be important in evaluating these sorts of studies, specifically those criteria relating to randomization and blinding. As 49 percent of our studies had some sort of random assignment at the individual level, we elected to use an additional quality measure to examine those criteria related specifically to randomized trials.

Measure derived from the community guide. Eighteen criteria of study quality were examined. The results are shown in Table 12. On average, the studies met under half of the quality criteria (average 7.5) but there was a wide range from a low of three criteria met to a high of 16. There was considerable variation within the criteria in the percent of the studies that met the criteria (Table 13). For example, all of the studies met the criteria, "conducting statistical testing when appropriate," whereas only one study met the criteria "controlling for differential exposure to the intervention." There is a subjective element to the assessment of whether a study met a quality criterion and so these results cannot be viewed as definitive. However, it is still of note that the abstractors felt that important details of the study populations and the interventions were lacking.

The quality measure was not specifically designed to be used as a scale. Different criteria within the scale may have different weights if one were to consider aggregating them into one overall measure of study quality. This would be a particularly important issue if one were to attempt to compare individual studies where weighting differences of individual criteria may shift one study relative to another. Yet, it is probable that the overall pattern of study results from a simple aggregation will still have a relatively good reflection of the true underlying quality of the studies. That is, studies that meet few criteria likely are poorer than those studies that meet many which are likely to be poorer than those that meet most, even if the relationship is less than exact. We therefore feel it is reasonable to examine the count of criteria used against the effect size.

Figure 18 plots effect size against the number of quality criteria met. It does appear as though the poorest studies have on average a greater effect than better studies, as only two of the ten studies (20 percent) that met six or fewer quality criteria had an effect size less than our guideline of .2, versus 12 of the 24 studies (50 percent) that met seven or more quality criteria.

One important potential quality issue with this literature is the percent of participants who were available at followup. One could hypothesize that subjects who were less adherent to the exercise recommendations may also be more likely to be lost at followup. This loss to followup may then adversely affect the study in one of two ways. If all subjects for whom there is no followup data are treated as non-responders to the intervention (as was done in some trials) the results may be biased downward. If those lost to followup are ignored in the analysis, then the intervention will likely appear to have more of an effect than it really does. Clearly, the greater

the percent of subjects who are lost at followup, the greater the potential issue. Figure 19 examines the relationship in this literature between the percent of the enrolled population who are assessed at followup and the effect size. The hypothesized negative relationship (larger percentage of sample retained at followup causing smaller effect size) is not clearly borne out in this data. However, it also may be confounded by other factors that affect both quality and effect size. Therefore as a quality measure we used an arbitrary cut-off of 80 percent of subjects completing the trial as our criterion for good quality of study followup. Only 19 of the 47 studies (40 percent) met this criterion, suggesting that if followup is important, it is an issue with this literature.

Randomized controlled trial measure. To examine the additional quality dimensions specific to randomized controlled trials we used the scale of Chalmers et. al.[80] This scale was used because it contains specifically those elements that are relevant to randomized controlled trials that are missing in the community guide scale. Specifically, it examines the randomization of subjects, how withdrawals are dealt with, and blinding. The quality of the studies that randomized individual subjects is shown in Table 14.

Studies were given a rating of "one" for the method of treatment assignment if no details of randomization were given. Eighteen of the 23 studies that randomized individuals fell into this category. Three studies that provided information on randomization used methods rated as intermediate quality (such as opaque envelopes). Only one study described a randomization scheme that met the highest quality criteria on the scale.

The studies did little better on the measure of control of selection bias after treatment assignment. This measure assesses how withdrawals are treated in the analysis and what percent of the subjects were withdrawals. Studies in which more than 15 percent of the subjects randomized withdrew are given a rating of "zero." Eighteen of the 23 studies rated "zero" on this scale. Studies get the highest rating in this measure if the results are analyzed both as treatment assigned and treatment given and the withdrawals are further examined. None of the studies met this criterion. One study received a rating of "two" because withdrawals were examined and results were analyzed by original treatment assignment (but not treatment received).

The final criterion in the scale is blinding of participants and investigators. Uniformly the studies received a "one" for this criterion. In most cases this is due to the fact that these studies do not lend themselves well to blinding. Given the nature of the intervention, it is clear to both the subjects and the investigators what treatment has been assigned. Further, as the results are usually obtained from reports of the subjects, the measure of outcome is generally obtained from an unblinded observer (i.e., the subject). However, four of the studies used outcome measures that could possibly have been blinded, such as stress testing in which the individual conducting and reading the test could have been blinded to treatment assignment, but blinding was not used in any of these studies either. Hence, these studies also received a "one" for this criterion.

Figure 20 shows the effect size of individual studies by the rating of the study on the quality scale. The possible scale range is 0-9 with large numbers representing better quality. Most studies received a rating of "two," the highest rating amongst these studies was "five," which was obtained by only one study. There is no clear pattern between study quality and effect size.

Search Results for Cancer Survivors

The details of the process to identify eligible exercise intervention studies conducted in cancer survivors are outlined in Figure 21. There were two MEDLINE® searches undertaken, one in July, the second in September. References from identified papers from the earlier search and references from a recent review[7] were also included. This resulted in a total of 128 papers in an EndNote® file.

This EndNote® file was reviewed twice by a project staff member with content area expertise to ascertain whether the papers needed to be pulled for full review. Of the 128 papers, 77 were identified as not being exercise interventions on the basis of study title and or abstract contents and were not obtained. The remaining 51 papers were obtained and fully reviewed. Two additional papers were identified in reviewing these 51 papers. In the process of peer review, an additional 14 papers were identified. Of these, one was eligible for inclusion, one was an exercise intervention with no concurrent comparison group, and the remaining 12 were review papers.

Figure 21 also shows the reasons for excluding 26 papers from the review. The most common exclusion criterion was the lack of a concurrent comparison group (14 papers). There were also a small number of papers that were not interventions on cancer patients (four papers) and five that were reports of baseline data and design of studies currently underway. The final number of papers included was 29. These papers described 24 unique studies.

Study Characteristics

Populations studied. Table 15 includes a description of populations studied and the interventions employed. Of the 24 studies included in the review, 54 percent conducted interventions during active cancer treatment. The sample sizes were often small, with a range of four to 101 per group and a mean of 22 in the control groups and 23 in the treatment groups. The most common diagnosis included in the studies was breast cancer, with 83 percent of the studies reporting inclusion of breast cancer survivors. After breast, the two other most common diagnoses were lung cancer and sarcoma. All included studies had concurrent comparison groups, 83 percent of them were randomized controlled trials. The PEACE framework suggested by Courneya and Friedenreich[13] was described in detail in the introduction and the percentage of studies that fall within each of the post-diagnosis PEACE framework categories is also provided in Table 15. The majority of the studies focus on the time period during or immediately following active cancer therapy, as evidenced by 50 percent of studies in the coping category and 42 percent in the rehabilitation category.

Dropout rates ranged from 0 to 25 percent with a mean of 10.8 percent. Dropout rates tended to be higher in studies that focused on those who had completed treatment (11.5 percent average dropout rate) than patients currently undergoing treatment (10.3 percent average dropout rate).

Intervention Characteristics

The majority (79 percent) of the interventions were exercise only interventions, the remaining 21 percent including some dietary, psychological counseling, or other intervention elements. The interventions tended to be relatively short, compared with those described in the

other section of this evidence report. The majority of the interventions were between five weeks and three months long, with no followup after the end of the intervention. The longest intervention was 26 weeks. The vast majority (88 percent) focused on aerobic activity, 83 percent prescribed moderate to vigorous intensity activity, 88 percent prescribed physical activity three or more times per week. Fifty-eight percent of the interventions prescribed physical activity of less than 40 minutes per session, though 29 percent never specified a length of exercise session.

Of the 24 studies reviewed, 75 percent involved pre-planned exercise sessions, usually supervised, in an exercise or physical therapy facility, with the equipment and supervision provided at no cost to participants. These 18 studies cannot be evaluated with regard to the ability to change exercise behavior. By contrast, six studies (25 percent) intervened to change exercise behavior, did not tell the control group to stop exercising, and assessed whether the intervention resulted in behavior change (or some surrogate for behavior change). Based on these characteristics, these studies could be considered behavioral interventions. Further, there was one additional intervention in which an exercise prescription was given, but the program was done entirely independently, in the home, with no supervision.[81] We have identified studies as being either 'behavioral interventions' or 'pre-planned exercise' studies in each of the outcomes tables (Appendix F).

As required by the inclusion criteria, each of the 24 studies had a comparison group. The majority (17 studies) had two groups and the comparison group was a control group, in which no exercise or other treatment was prescribed. The only study to provide an intervention for non-exercising controls was the Group-Hope trial,[82, 83] in which non-exercise and exercise group participants were offered a group psychotherapy intervention.

There were seven studies with more than two groups. Segar et al. included an exercise only group, an exercise and behavior modification group, and a control group.[84] Cunningham et al. included a control group and two intervention groups.[85] One of the intervention groups received physical therapy three times weekly, the other received physical therapy five times weekly. Burnham and Wilcox et al. included a control group, a low intensity and a moderate intensity exercise group.[86] Segal et al. 2001 also included two intervention groups and a control group:[87] Intervention Group 1 had a home based self-directed exercise prescription, while Intervention Group 2 performed supervised exercise. Djuric et al. included four groups: a control group, a Weight Watchers only group, an individualized weight loss plan group, and a group that received a combination of the Weight Watchers and individualized weight loss plans.[81] MacVicar and Winningham[88] and Winningham and MacVicar[89] both included three groups: an aerobic exercise group, a placebo group that received equal attention but performed flexibility exercise, and a control group. In our outcomes tables (Appendix F), we have presented the placebo group as an exercise intervention group, because they did receive an exercise intervention (stretching), just not the same exercise intervention as the aerobic exercise group.

The loss to followup from these studies was relatively minimal, with an average of 10.8 percent overall, with a slightly lower dropout rate in studies of patients during treatment. These dropout rates should be viewed in context of the percent of cancer survivors approached regarding study participation who agree to participate or even to be screened for eligibility. The seven studies that provided data regarding the percentage of cancer survivors approached who agreed to participate or to at least be screened for study eligibility reported values of 28, 30.6, 32.5, 43, 68, 75, and 81 percent, with a mean of 51 percent.[83, 87, 90-94]

In addition to identifying the timing of the interventions with regard to whether they took place during or after treatment, each of the 24 studies has been placed into a category according to the PEACE framework proposed by Courneya and Friedenreich[13] described in the introduction section. The evidence tables (Appendix E) and the outcomes tables (Appendix F) identify whether the interventions focused on buffering (one study), coping (13 studies), rehabilitation (ten studies), health promotion (five studies), survival (one study), or palliation (zero studies). Further, five studies were found in multiple PEACE framework categories.

Outcomes examined. We grouped outcomes from the 24 studies into 16 categories and present these in Table 16, along with the number of studies that examine each of these categories or subcategories and the number of measurement tools that were used to examine a given construct. The measurement tools used to assess cardiorespiratory fitness, strength, flexibility, and body size, as well as all self-reported outcomes are described in Table 17. The two most common outcomes examined were cardiovascular fitness and fatigue or tiredness, which were examined in 12 of the 24 studies. Depression, anxiety, and quality of life were also commonly examined (ten studies), as well as body weight or body mass index (BMI) (eight studies).-

Outcome level examination. There are no subgroup analyses reported; only comparisons between treatment group(s) and control group were considered. There was one study for which there was a tremendous diffusion of effect, for which results were presented by exercise level, like a cohort analysis.[95, 96] At the level of outcome type there were three methods used to assess intervention effects. We calculated effect sizes, examined whether results were statistically significant, and assessed whether results were in the hypothesized direction, regardless of statistical results.

An attempt was made to examine effect size at post test only. If means and standard deviations were available for both groups at post intervention testing, an effect size was calculated. These post intervention effect sizes are more useful in studies with no baseline differences between groups, which is more likely in the larger randomized controlled trials than smaller and non-randomized controlled trials. Comments on between group differences at baseline have been included in the text in order to guide interpretation of effect sizes. Because of the potential for overestimating effects if there were pre-intervention between group differences, effect sizes are commented on individually within each outcome type rather than considering an effect size over a given value to be ‘large’ or ‘small.’

If insufficient data were available to calculate an effect size, the p-values for the outcomes were provided in the outcomes tables (Appendix F). An effect was considered to be statistically significantly positive if a statistical test was performed that demonstrated that the intervention group had greater improvement in the outcome of interest than the control group with an alpha value of 0.05. An effect was considered positive if the results were in the hypothesized direction but not statistically significant. This criterion was included because there is no clinically important threshold known for the wide variety of outcomes reported.

As discussed in the results from the non-cancer population, if all of the data were reported, the probability of a positive effect would be 50 percent if there was actually no effect of the intervention. Hence, a rate of 50 percent positive outcomes would be evidence of no effect of the interventions. The results here may be skewed below 50 percent where there is no effect because some of the studies that had small positive effects may have reported ‘no effect.’

Intervention level examination. The number of studies with positive and statistically significant effects, as well as the mean and range of calculable effect sizes are provided in Table 18 for each of the 16 outcome categories. The criterion for considering an intervention positive was if one or more of the outcomes in a given outcome category was positive. An effect was considered to be statistically significantly positive if any one of the outcomes examined within a category was statistically significant. The intention here is to convey a level of positivity of results, not to perform a statistical test. Significance was not corrected for multiple tests. The effect sizes reported are a comparison of between group means at post-intervention only, given that pre-post correlations for all 16 outcome categories was not available. The mean effect sizes are not corrected for sample size.

Overall Effect

The overall effect of interventions on all studies, within 16 outcome categories, is provided in Table 18. Categories with 100 percent positive findings include strength, flexibility, fatigue/tiredness, confusion, difficulty sleeping, self-esteem, psychosocial outcomes, body size (goal to reduce) vigor/vitality, immune parameters, and mental health quality of life.

The percent of studies reporting statistically significant results within the 16 categories ranged from zero percent for confusion and body size (goal to gain or avoid muscle loss) to 100 percent for flexibility and difficulty sleeping. There were eight categories with 75 percent of studies reporting at least one statistically significant finding: cardiorespiratory fitness, flexibility, fatigue/tiredness, quality of life, difficulty sleeping, psychosocial outcomes, physiologic outcomes, and immune parameters.

Mean effect sizes ranged from –0.055 for immune parameters to 2.93 for physical activity behavior. Outcome categories with effect sizes of 0.20 or greater include physical activity behavior, cardiorespiratory fitness, flexibility, fatigue/tiredness, body image/dissatisfaction, quality of life, confusion, vigor/vitality, symptoms/side effects, depression, anxiety, and the combined multiple constructs section of mental/emotional/psychological well-being.

The categories vary with regard to the appropriateness of combining results, thus, results are also presented for each outcome category in a later section.

Effect by Timing: During Versus Post Treatment

We further examined whether the results of studies would be more likely to be positive during versus post active cancer treatment. Table 19 presents the results again, divided by timing of intervention: during versus post treatment. For many categories, there are too few studies to compare the results across this timing variable. Exceptions include the negative effect size for immune parameter changes post-treatment versus the positive effect size during treatment and the larger positive effect sizes during treatment for quality of life, self-esteem, psychosocial outcomes, physiological outcomes, anger/hostility, and the multiple constructs section of the mental/emotional/psychological well-being category.

Effect by Outcome Category

Tables F-1 to F-16 in Appendix F provide descriptions of the studies as well as outcomes in each of the 16 categories defined earlier.

Physical activity behavior (Table F-1). There were six studies that could be considered behavioral interventions, defined as interventions designed to examine whether cancer survivors would adhere to an exercise prescription on their own, and in which the control group was not asked to stop exercising or avoid starting exercise. One of these studies[81] was a weight loss intervention that included an exercise component and no physical activity behavior data was provided. Therefore, this study is not included in Table F-1. One of these also included a pre-planned, supervised exercise group[97] and reported changes in physical fitness that can be used as a surrogate for physical activity behavior. All five behavioral interventions that reported a physical activity behavior outcome reported statistically significant increases in at least one physical activity behavior variable (or surrogate) as a result of the intervention. Only one study provided adequate information to calculate an effect size for post intervention between groups differences. The large effect size (2.93) is mostly due to pre-intervention between group differences in this small randomized controlled trial, though the Mann-Whitney U test for intervention effect on a categorical exercise level scale did have a p-value < 0.01.

Three of the behavioral studies came from one research group and the intervention for these three studies was identical.[84, 95, 96, 98, 99] In one of these studies,[84, 96] there was significant cross-over after randomization: Fifty percent of the usual care group was exercising at levels as high or higher than the level prescribed for the treatment group, one-third of the treatment group failed to do any exercise. The investigators analyzed the data as an observational cohort.

One of the 24 reviewed studies examined the psychosocial mediators of adherence to the exercise intervention[83, 94] and reported that past exercise and female gender were associated with exercise during the study, regardless of experimental condition.

Physical fitness: cardiovascular, strength, and flexibility (Table F-2). All 13 studies that examined the efficacy of physical activity interventions to increase one or more aspect of physical fitness reported fitness improvements. We were able to calculate effect size for cardiovascular fitness from seven studies with a range of effect sizes of 0 to 1.242, though this largest effect size is strongly influenced by large baseline differences. The range of post intervention effect sizes for cardiovascular fitness in the four studies with minimal baseline between group differences was 0.319 to 0.950, indicating a consistently positive effect on cardiovascular fitness. There were two studies that reported results regarding flexibility, both provided sufficient data to calculate post intervention effect sizes (0.024 and 0.666); neither study had between group differences in flexibility at baseline. Two studies reported results regarding muscular strength, both reported improvements, though only one of them reported a statistically significant improvement; neither provided sufficient data to calculate post intervention effect size.

Fatigue/tiredness (Table F-3). There were 12 studies that examined whether an exercise intervention would positively alter symptoms of fatigue or tiredness in cancer survivors. Of these, six were conducted post-treatment and six during active cancer therapy. All but one of the 12 studies reported a positive effect,[93] though the size of the effect varied. During active treatment, exercise interventions positively affected fatigue or tiredness in all six studies, with three reporting statistically significant improvements. Sufficient data was provided for the post intervention effect size calculation in one of the five studies conducted during active cancer treatment (Effect Size 0.130), this study reported no between group baseline differences for fatigue.[91]

Of the six studies conducted with survivors post treatment, five reported improvements in fatigue, though the magnitude of the improvement varied. Sufficient data were provided for post intervention effect size calculation in three of these studies and the effect size ranged from 0.031 to 0.645. The study with the largest effect size,[86] prescribed the lowest intensity exercise. None of these three studies reported baseline differences that would make these effect sizes an over estimation. In fact, in one study,[90] baseline differences make the effect size of 0.063 an underestimation of the intervention results. The p-value for the ANCOVA analysis of fatigue effects in this study was 0.006. Further, the smallest effect size of 0.031 was calculated for consistency with the other effect sizes in this report, which were all calculated with post intervention values only, given missing data on pre-post correlations for outcomes. However, in this study,[82] the authors report the post intervention minus pre intervention effect size[55] to be 0.28, much larger than what is observed using only post-test data.

As shown in Tables 19 and F-3, eight different instruments were used to assess the effect of exercise interventions on fatigue. Studies that used the Piper or Functional Assessment of Cancer Therapy (FACT) fatigue scales all reported statistically significant improvements in fatigue as a result of exercise participation.

Body image/dissatisfaction (Table F-4). There were four studies that reported outcomes related to body image or body dissatisfaction. All four studies included in Table F-4 included breast cancer patients and were conducted post treatment. One of these studies reported positive, statistically significant improvement in body image and dissatisfaction after a moderate intensity aerobic exercise intervention, 10-45 minutes per session, four to five days per week.[94] Adequate data were provided to calculate an effect size from one study.[99] For this study, the effect sizes for body image, measured on two separate scales, were 0.301 and 0.318. However, these effect sizes were mostly driven by between group differences at baseline and may reflect an overestimation of the impact of the exercise intervention on body image. Both of these positive studies[94, 99] were conducted in breast cancer survivors exclusively. The two non-positive studies included a variety of cancer diagnoses and the intensity and frequency of prescribed exercise was lower.

Quality of life (Table F-5). Ten studies examined the effects of exercise on quality of life (QOL) in cancer survivors. There were eight unique QOL instruments used in these ten studies (see Table 17). Six of these studies were conducted post-treatment and four during active cancer therapy. Three of the four studies conducted during active treatment reported statistically significant improvements in at least one measure of quality of life. Effect sizes of 0.168 and 1.155 were calculated for two of these studies;[95, 99] both of these studies observed between group differences at baseline that make these effect sizes likely underestimates. Health-related quality of life was consistently reported to be improved as a result of exercise interventions conducted during active cancer treatment. Three of the exercise prescriptions in these active treatment studies focused on aerobic activity of moderate to vigorous intensity, four to six days per week, with exercise sessions of ten to 45 minutes in duration. One of the studies focused exclusively on strength training, three times weekly.[91]

In the six studies conducted post cancer therapy, five reported statistically significant improvements in at least one measure of quality of life. Post intervention effect sizes ranging from zero to 1.689 were calculated for results of three studies. The two studies with smaller effect sizes[82, 83] observed baseline differences that likely make some of the post test effect sizes underestimates. Courneya et al.[82] reports effect sizes of 0.18 for physical well-being (compared to 0.02 in Table F-5), and 0.03 for functional well-being (compared to 0.049 in Table F-5). Our

calculations are based on data provided in the paper, while the effect sizes reported in the publication are based on pre-intervention values, post-intervention values, and the correlation between pre and post values. There was consistency in the positive direction if not the magnitude of changes observed. The exercise intervention in the post-treatment interventions all focused on aerobic activity, with intensity (where reported) ranging from 25-40 percent of heart rate reserve to 70-75 percent of maximal oxygen consumption, frequency of one to five days per week, and duration of 14 to 60 minutes per session.

Confusion (Table F-6). Two studies examined the effect of aerobic exercise on measures of confusion, one during and one post cancer treatment. Both reported small improvements in confusion as a result of an exercise intervention, though neither result was statistically significant. An effect size of 0.402 was calculated for the post treatment intervention in breast cancer survivors. Both studies prescribed aerobic activity of moderate to vigorous intensity, three days weekly, from 14 to 32 minutes per session.

Difficulty sleeping (Table F-7). The two studies that examined the effect of aerobic exercise on difficulty sleeping post treatment for breast cancer both reported statistically significant improvements after a program of moderate intensity aerobic activity four to five days a week for ten to 45 minutes per session. Insufficient data were provided to determine effect size for either study.

Self-esteem (Table F-8). Three studies examined whether moderate to vigorous intensity aerobic exercise three or more days per week would improve self-esteem in post treatment breast cancer survivors. All three observed improvements in exercise participants, though only one reported a statistically significant difference between groups. Differences between this study and the other two include higher intensity of exercise prescribed (70-75 percent of aerobic capacity versus 60 percent of age predicted maximal heart rate) and a longer intervention (15 weeks versus ten weeks). Effect sizes of 0.044 and 0.154 were calculated for two of the studies, and baseline differences indicate that the smaller of these two values is likely an underestimate.

Psychosocial outcomes (Table F-9). There were six studies that examined a variety of psychosocial outcomes, including activities in the community, activities in the home, change of lifestyle, participation in patient organizations, satisfaction about information provided as a patient, sick leave, work status, cognitive functioning, communication with clinic staff, information problems, happiness, social/family well-being, role limitations, social functioning, hope, and power. Only one of these studies neglected to show any positive or statistically significant effect of exercise on psychosocial outcomes. Multiple outcomes were measured in each of these studies, resulting in multiple comparisons within each study. There were 14 separate measurement tools used for a variety of constructs measured (see Table 17). Effect size was calculated for the effects of aerobic exercise on post treatment breast cancer survivors for happiness (ES = 0.302), social/family well-being (two ES calculations: 0.005 and 0.113), satisfaction with life (ES = 0.028), and spiritual well-being (ES = 0.00). Further, effect sizes of 0.280 and 0.612 were calculated for the buffering effects of pre-lung cancer surgery exercise effects on hope and power, respectively.

Physiologic outcomes (Table F-10). The three of the four studies that examined physiologic outcomes focused on the active cancer treatment time frame. Fairey et al.[100] examined the effects of aerobic exercise on insulin, glucose, and insulin-like-growth factor (IGF) variables (IGF-1, IGF-2, and two IGF binding proteins: IGFBP-1, IGFBP-3) in post treatment breast cancer survivors. Changes in the hypothesized direction were reported for IGF-1, IGFBP-1, IGFBP-3, and the IGF-

1:IGFBP-3 molar ratio, with effect sizes of 0.414, 0.025, 0.425, and 0.657, respectively. Other reported variables either did not change or changed in the opposite direction of what was hypothesized. Cunningham et al. examined the effect of three or five times weekly physical therapy exercises on muscle mass loss in acute leukemia bone marrow transplant receipients.[85] Results indicated a muscle sparing effect of exercise that was mostly too small to be detected statistically. Dimeo et al. also examined effects of exercise on physiologic parameters during bone marrow transplant, though the exercise prescription was aerobic activity in this study.[101] Effect sizes of 0.00 to 0.528 are reported in Table F-10 for the physiologic parameters assessed in Dimeo et al.,[101] indicating no harm of exercise for any these variables and significant improvement for a subset of physiologic outcomes, particularly number of in-hospital days (ES = 0.528). Dimeo et al. also examined the effects of high intensity walking post-hospital discharge for bone marrow transplant on cardiac function and hemoglobin.[102] An effect size of 0.822 for hemoglobin was calculated. The authors report a p-value of 0.04 for between group differences in hemoglobin after seven weeks of exercise training, though the actual values were 13.0 versus 12.0 g/dL in the treatment and control groups, respectively. Segal et al. examined whether resistance training in men undergoing androgen deprivation therapy for prostate cancer would result in increased PSA or testosterone levels.[91] The non-significant changes in both groups were reported by the authors to indicate the safety of resistance exercise for this population.

Body size (Table F-11). Ten studies examined the effect of exercise on some measure of body size. In Table F-11, these have been divided into two subsets according to whether the goal was to decrease body weight or body fat versus a goal of maintaining muscle mass, avoiding cachexia, or avoiding arm volume increases.

Of the six studies that examined whether exercise could decrease weight or body fat, alone or in combination with diet changes, four reported significant reductions in at least one body size related variable in the treatment group(s) when compared to changes in the control group(s). The only study to report a significant decrease in body weight in the treatment compared to the control group included a strong dietary intervention component.[81] Effect sizes for these studies, where calculable, ranged from 0.015 for body weight in Courneya et al.[90] to 0.636 for body weight in Burnham and Wilcox et al.[86] The large effect size from Burnham and Wilcox is mostly a reflection of large between group differences at baseline. In general, body size changes were small in all exercise interventions that stated goals of decreasing fat or weight, for studies conducted during as well as post treatment.

There were three studies that examined the effects of exercise on cancer survivors during either bone marrow transplant or androgen deprivation therapy that included a measure of body size. Cunningham et al.[85] and Dimeo et al.[102] examined whether physical therapy exercises[85] or aerobic activity[102] would prevent muscle wasting during bone marrow transplant. Both studies reported no muscle mass or body mass index change resultant to exercise training. Segal et al. examined whether strength training during androgen deprivation therapy would prevent muscle mass loss and reported no significant differences between groups after 12 weeks of strength training three times weekly at a relatively high intensity.[91]

Finally, one pilot study was conducted to assess the safety of upper body aerobic and resistance exercise in breast cancer survivors with lymphedema.[103] This pilot study reported no changes in arm volume. The effect sizes for both measures of arm volume were 1.642 and 1.262 mostly reflect between group differences at baseline. The arm volumes of control group participants were larger at baseline and stayed larger through out the eight-week intervention.

Pain (Table F-12). There were three studies that examined changes in self-reports of pain after an exercise intervention. None of these studies provided adequate information for calculation of effect sizes. One of these reported a statistically significant improvement in self-reported pain among post treatment survivors with a variety of cancer diagnoses after four weeks of low intensity aerobic activity and strength training at a frequency of one time weekly.

Vigor/vitality (Table F-13). Of the six studies that examined changes in vigor or vitality, five reported some positive effect. Effect sizes of 0.434 and 1.265 were calculated from one study conducted post-treatment and one study conducted during treatment, respectively. Neither study reported baseline differences between groups for vigor. Both of the studies conducted post-treatment showed improvements in vigor (ES = 1.265 for one and p = 0.023 for the other) and both prescribed aerobic exercise three days a week at moderate intensity, ranging from 14 to 60 minutes per session.

Three of the four studies conducted during active cancer treatment reported improvements (ES = 0.434 and p-values of 0.023, 0.00, and 'mean changes showed an increase in treatment group'). Of the four studies conducted during treatment three focused exclusively on breast cancer patients. The longest of these (a 26-week intervention) showed no effect on vitality. In contrast, a six-week intervention in breast cancer patients during treatment showed a significant improvement in vigor with a very similar exercise prescription (moderate intensity aerobic activity four to six days a week, 20-30 minutes per session).

Symptoms/side effects (Table F-14). There have been five studies that have examined whether exercise during or post treatment might improve patients' experiences of cancer treatment related symptoms and side effects. One was conducted post treatment and showed no effect of exercise training. Two of the four interventions that took place during treatment were specifically conducted in bone marrow transplant patients. Effect sizes for these two studies were 0.547 for somatization, 0.507 for diarrhea, 0.225 for severity of infection, -0.130 for mucositis, and 0.849 for severity of pain, indicating that exercise resulted in positive changes in most symptoms/side effects assessed in bone marrow transplant patients. The exercise intervention in both of these studies was 15 minutes of aerobic exercise seven days weekly, at 50 percent of the heart rate reserve. The other two interventions that took place during treatment focused on breast cancer patients, one of these showed significant improvements in vomiting and nausea resultant to ten weeks of moderate intensity aerobic activity three days a week.

Immune parameters (Table F-15). Of the four studies conducted to assess the effect of exercise on immune parameters, three took place during treatment. All three studies conducted during treatment showed statistically significant improvements in a variety of immune parameters, including T-cells, lymphocytes, white blood cells, and natural killer cell activity.[101, 104, 105] Insufficient data were provided to calculate effect sizes for two of the studies. For an intervention among bone marrow transplant recipients by Dimeo et al.,[101] effect sizes of 0.643 and 0.442 were calculated for duration of neutropenia and thrombopenia, respectively. All three interventions conducted during active treatment prescribed moderate intensity aerobic activity on three to seven days weekly for 15 to 90 minutes per session. For the only study conducted post treatment,[103] effect sizes were 1.047 and 0.636, for natural killer cell cytotoxicity (E:T20:1 and E:T40:1 respectively), indicating improved cytotoxicity. Effect sizes for lymphocytes, neutrophils, natural killer cells, t-cells, and total leukocytes were below zero and ranged from –0.417 to –7.99, suggesting less favorable values for immune parameters in exercise participants compared to controls at post-testing. There were differences between groups at baseline for the measures of

cytotoxity (which had positive effect sizes), but not for the other immune parameters. None of the effects in Nieman et al. were statistically significant.[103]

Mental/emotional/psychological well-being (Table F-16). The effect of physical activity has been assessed on a variety of mental health related parameters in cancer survivors. We review here the results related to anxiety, depression, anger or hostility, general mental health, and a comment on the remaining studies that have examined a broad variety of other mental health constructs. Overall, the majority of the nine studies conducted post treatment had at least one significant improvement in a parameter related to mental and emotional health. Half of the four studies conducted during treatment had at least one significant improvement in a parameter related to mental and emotional health.

Anxiety. Of the ten studies that have been conducted to assess the impact of exercise training on anxiety in cancer survivors, five were conducted post treatment. Of these post-treatment studies, three report statistically significant improvements in anxiety after exercise training. Effect sizes of 0.00 and 0.901 were calculated for two of the studies.[82, 86] Of the five studies conducted during treatment, four reported improvements in anxiety with exercise training and three reported statistically significant improvements. An effect size of 0.278 for anxiety, as a result of 15 minutes of daily aerobic exercise at 50 percent of heart rate reserve in an intervention conducted with bone marrow transplant patients.[106]

Depression. Of the ten studies that assessed effects of exercise training on depression during or post cancer treatment, five were conducted post treatment. Of these five post treatment studies, two report statistically significant improvements in depression after exercise training. Effect sizes of 0.005 and 1.279 were calculated for two studies that prescribed aerobic activity of moderate to vigorous intensity 14-32 minutes per session, three to five days weekly; both studies were small, neither of these effects were statistically significant as reported by the authors.[82, 86] All five studies conducted during treatment reported some improvement in depressive symptoms, though the magnitude of these improvements was often small and were only statistically significant in two studies. Effect sizes of 0.079 and 0.263 were calculated for the Profile of Mood States and Symptom Check List (SCL-90-R) assessments of depression in the only study that reported sufficient data to calculate an effect size.[106]

Anger/hostility. There were three studies that assessed changes in anger or hostility resultant to exercise training. Two of these studies were conducted during treatment, one post treatment. Both of the interventions conducted during treatment reported small improvements. In one study conducted in bone marrow transplant receipients,[106] effect sizes of 0.063 and 0.266 were calculated for the anger and/or hostility scales from the Profile of Mood States or the Symptom Check List (SCL-90-R) respectively. The study conducted post treatment showed a slightly negative effect size of –0.114 after 10 weeks of aerobic exercise. This negative effect size is mostly reflective of baseline differences between groups. The authors reported no statistically significant difference between groups for anger based on repeated measures ANOVA.[86]

Mental health. Two studies included a measure that was called 'mental health quality of life.' Both studies were conducted exclusively in breast cancer survivors, one during treatment, one post treatment. The post treatment intervention showed a significant increase;[107] the other did not.[87] The exercise intervention in the study with the significant increase included moderate intensity aerobic exercise and resistance training for 30 to 60 minutes three times a week and lasted eight weeks.

Other constructs related to mental health. Other constructs assessed included global psychologic distress, total mood disturbance, avoidance, fatalistic, fighting spirit, hopelessness, emotional well-being, trial outcome index score (a well-being score for breast cancer survivors), impact of medical illness on subject, and psychologic distress. These constructs were studied in survivors with a variety of cancer diagnoses, during treatment (three studies), and post treatment (three studies). There was no obvious pattern of findings to report.

Study Quality

Tables 20 and 21 provide information about study quality variables abstracted from each of the included studies. Of the 24 studies described, only two described the sample as to cancer diagnoses and treatment course, race/ethnicity, gender, and sociodemographic variables. The rest either neglected to provide these variables at baseline and/or provided some of these variables for those who completed the study only. This makes it difficult to determine who was recruited versus who was able to complete the study.

There were seven studies that described the exercise intervention with inclusion of exercise modality, intensity, frequency, duration per session, and progression of these variables throughout the intervention in a manner that would allow others to repeat what they had done. Only four studies failed to include information about the reliability and or validity of the measured outcomes of interests.

Of the 24 studies reviewed, only one did no statistical testing. In this very small feasibility study, the pre and post intervention mean values for oxygen uptake, mood disturbances, and Profile of Mood States scores were compared in exercising breast cancer patients (n=6) versus non-exercising breast cancer patients (n=4) and healthy non-exercising controls (n=6). The authors made qualitative statements regarding the results, with no statistical testing provided.

None of the included studies examined or controlled for differential exposure to the intervention in assessing treatment effects.

Each of the studies included measures repeated at least two time points (pre and post intervention). Approximately half of the studies (12) conducted analyses that were appropriate for repeated measures, such as ANCOVA or repeated measures regression analysis. The rest of the studies conducted tests that did not account for within person correlations between repeated measures.

Only two of the included studies adequately reported baseline values for all participants, including sociodemographic variables, race/ethnicity, age, gender, and cancer diagnosis and treatment. Half of the studies reported baseline values for all participants who started the study, as opposed to all participants who finished the study. The other half did not. This could introduce bias into the results if those who do not finish the study are in some way different from those who do. Of the 12 studies that did not report baseline values for all participants who started the study, two reported that the dropouts were lost prior to baseline measures.

Re-examination of outcomes in Tables F-1 to F-16 in Appendix F according to study quality variables in Table 20 revealed no obvious pattern of differences. For example, examination of results of studies that reported 80 percent of participants finishing the study compared to studies that suffered greater loss to followup did not reveal any pattern of differences in results. On the other hand, there are several examples in this literature of larger studies that met more of the 11

study quality criteria that differed from smaller, less well-conducted studies. First, Berglund et al.[92] included 30 participants per group and lost more than 20 percent of the sample, and did not report reliability or validity of measures. The results from this study often stand in sharp contrast to another paper from the same author[93] in which these study quality deficits were corrected and the sample size was larger (98 in the intervention group, 101 in the comparison group). Throughout the outcomes tables (Appendix F), the results of these two studies differ from one another, despite similarities of intervention. The larger, later study[93] is the better quality study and results from this study may be more likely to be accurate as a result. In addition, Mock et al.[99] can be compared to Winningham et al.[89, 108] for the specific outcome of nausea. Winningham's study was larger and met more of the study quality criteria evaluated for this report and reported a statistically significant improvement in nausea, despite very similar interventions in the two studies.

Adverse Events Issues

Of the 24 reviewed studies, 11 commented on the presence or absence of adverse events. In ten of the studies that commented on adverse events, the comments indicate that no harm was observed as a result of exercise during or after cancer treatment.[85-87, 91, 95, 101-104, 107] The exception was Courneya et al.[90] in which overall rates of adverse events were similar between groups of breast cancer survivors, but the rate of lymphedema in the exercise group was higher. The authors note that two of the three participants who developed lymphedema had had axillary irradiation, a strong risk factor for lymphedema. The authors commented that it was not clear whether the onset of lymphedema was due to the exercise. Further, a group of researchers in Edmonton, Alberta, Canada,[107] conducted a pilot study specifically to examine the safety of upper body exercise in breast cancer survivors with lymphedema and reported no increases in arm volume in the treatment as compared to the control group.

There were several studies that commented on issues related to the potential for harm from exercise in cancer survivors. For example, Nieman et al.[103] notes that there is evidence from animal studies that high intensity high volume physical activity in cancer patients can increase the spread of the disease.[109-111] The results of the reviewed studies do not allow for evaluation of this possibility in human subjects, but this animal data cannot be ignored in considering the appropriate exercise prescription for human cancer survivors.

Mock et al.[95] commented that self-reported data collection of worsening of side effects leaves open the possibility that survivors with more extreme side effects brought on by exercising may not have felt well enough to complete data collection at the end of the study. MacVicar and Winningham[112] noted that there are conditions during cancer treatment and recovery that preclude any physical activity, including chest pain, irregular pulse, acute vomiting, blurred vision, sudden onset dyspnea, bleeding, and extreme immune-compromised states. A balance of harm and benefit needs to be considered when prescribing activity for cancer survivors.

Caveats: Measurement Limitations, Quality of the Literature

Cancer Survivors. All but four of the studies reported some information on the reliability and validity of outcomes measured. However, the broad variety of measurement tools used for each construct (see Table 17) makes it difficult to compare results across studies. Combine this limitation with the broad variety of timing with regard to treatment and populations and the potential for quantitative analysis all but disappears.

All 24 included studies used convenience samples, as would be expected in this patient population. The source of patients recruited into these studies and flow of subjects from recruitment to study end was generally not well explicated. There are a few notable exceptions. Courneya et al. started with the Alberta Cancer Registry and provides a flowchart of recruitment, intervention, and measurement subject participation.[90] Segal et al. provide a similar flow chart, but does not indicate how or where the original 378 patients were found.[87]

Further, none of the interventions had any followup beyond the end of the intervention to assess whether the physical activity behaviors or the other outcomes of interest were maintained. The sample sizes of the included studies was relatively small (average control group = 22, average treatment group = 23 subjects) and study quality requires improvement in the future, given that of the 24 studies reviewed, half the studies (or more) failed to meet six of 11 study quality criteria applied.

Chapter 4. Discussion

General Population

Overview

Many Americans are inactive. Three-fourths of adults and over a third of children and adolescents do not meet national recommendations for physical activity. Understanding how to make us more active and stay active is therefore an important task. Interventions that increase activity while individuals are within the intervention but have no ability to keep people exercising when the intervention is concluded will not solve this problem. Therefore, in this systematic review we chose to focus on the effects of interventions sometime (i.e., three months) after the intervention was concluded. Three months was chosen not because it is clear that physical activity at three months post intervention is predictive of long-term maintenance. Rather we felt that it was a reasonable interval for a first look at this question of whether physical activity interventions alone, or in combination with diet modification or smoking cessation, are effective in helping individuals increase their aerobic physical activity or maintain adequate physical activity.

Overall, the completed research on promoting physical activity has not focused on measurement of physical activity behavior after the end of the intervention. Proof of this lies in the observation that 'lack of 3 month followup' was the most common exclusion criteria for this review, accounting for 50 percent of the exclusions. The more common approach in promoting physical activity has been to 'fade' an intervention, moving from higher to lesser intervention intensity (e.g. interventionist contacts) over time. Though this is important work, it could be argued that it will never be possible to intervene on a constant basis, even minimally, across an entire population. Therefore, interventions that alter physical activity behavior in a way that results in long term maintenance are of great public health interest. We do not claim that this review answers the question of what intervention components will result in long-term physical activity behavior changes in the general population. In fact, our review points out the lack of research attention to this important question. Perhaps the most important outcome of this review is the empirical statement regarding the paucity of data on how physical activity behavior is maintained after the end of a behavior change intervention.

In all of the discussion that follows it is important to keep in mind the diversity of this literature. The major criteria for exclusion from this review were size of the study, a concurrent control group, and followup of greater than or equal to three months (see Figure 2). Hence, the review contained studies that varied on many other important dimensions including demographics of the subjects, settings and types of interventions, and outcomes measured. With this many important variables and only 47 studies, conclusions about the role of specific factors on the outcomes of interventions are clearly limited. Any one dimension that is examined is still likely to contain significant variation that cannot be subdivided due to small numbers. For example, even when the analysis is limited to one setting such as healthcare, the studies still have important differences in populations examined, types of interventions, and outcomes measured. Therefore, all of the results should be interpreted as the distribution of effects within the group rather than as some specific or average effect. For this reason, further mathematical analysis, such as meta-analysis, was not done.

Key Questions

What is the evidence that physical activity interventions alone, or combined with diet modification or smoking cessation, are effective in helping individuals in the general population change their aerobic physical activity and maintain an active lifestyle?

Overall results at the study level. We did find evidence that it is possible to intervene on subjects to increase their physical activity in a manner that can be at least partly maintained for at least three months after the intervention stopped. However, the majority of the studies we examined did not demonstrate any effect on physical activity at the first followup three months or more after the end of any intervention activities. This does not bode well for the long-term maintenance of physical activity behaviors after the end of interventions as they are currently designed.

Of the studies examined, 45 percent demonstrated a positive effect (significance level of less than 0.05) of at least one physical activity outcome from at least one intervention at a followup time point at least three months after the end of interventions. However, the overall magnitude of the effects found was generally modest. Only four of the studies had an effect size greater than 0.5 at followup. In one of these studies, an effect size of 0.932 at six months post intervention translates into a 15 percent higher maximal aerobic capacity (compared to controls) in older women. This was observed six months after the end of a four month community-based intervention that included health education and supervised exercise.[63,79,115] This study was clearly a success from a public health standpoint. In the second study, the effect size of 0.597 was reported 12 months after a five-session school-based health education intervention in children. The outcome for which the effect size was 0.597 was related to the percentage of treatment versus control children who reported that most of their physical activity was running one year after the end of the intervention.[56] It should be noted that there was no intervention effect on self-reported frequency of physical activity or the fitness measure in this same study.[56] Therefore, despite a large effect size for one outcome, this intervention is of questionable value for public health interests. In the third study, an effect size of 1.84 at three months post intervention translates into an increase of 50 percent of participants meeting the current CDC/ACSM guidelines for physical activity, in an adult worksite based intervention group that received frequent phone calls compared to a 50 percent decrease in the comparison group.[69] Further, this third study showed consistent improvements for all reported physical activity outcomes. Like the successful intervention in older women described above, this study can also be considered successful, at least at three months followup.

Finally the fourth study[72] showed an increase in leisure time physical activity (with an effect size of .527 at 12 months) for female farmers who underwent two and a half months of aerobic physical training. This study, although successful, had an effect size of only .103 when the subjects were assessed at a 36 month followup.

The diversity of settings, interventions, populations, and outcomes in this set of three physical activity behavior interventions with large effect sizes underscores the difficulty of translating the results from the 47 included studies into something that can be said to have (or not have) public health significance. Greater standardization of reporting time frames and outcomes measured in the physical activity literature is needed to facilitate comparison across studies, settings, interventions, and populations.

Results at the intervention and outcome levels. Within the 47 studies reviewed, there were 72 interventions and 166 outcomes. We envisioned the possibility of variability of success of unique interventions within studies that might be informative regarding specific intervention components that would be associated with increased physical activity behavior. As it turned out, the variability of intervention success was far greater across than within study. For example, in the study described above with an effect size of 1.84 at three months post intervention,[69] the effect sizes for the four interventions ranged from 0.65 to 1.84. Though this is a wide range, all four of the interventions from this study were more successful than interventions from any other study for which effect sizes could be calculated (except for one[115, 63, 79]). We also envisioned the possibility of variance across outcomes within interventions, but found that variability of outcome success was far greater across than within study. Therefore, the remainder of this discussion will focus on the study level results.

Are interventions that use behavioral theories more effective in changing aerobic physical activity than those that do not?

One surprising finding of the review was that there did not appear to be an effect of the use of theory in the effect of the interventions. Interventions that used theory did not appear to be any more effective than those that did not explicitly use theory. One cannot necessarily conclude that the use of theoretical constructs is ineffective. The studies varied in multiple critical areas that may influence the effects of the intervention. It is very possible that we do not observe an effect of theory because other aspects of the studies confound any possible effect. It also may be that theory based interventions differ from other interventions in other important ways that affect outcome apart for the use of theory itself. For example, it appears as though there may be a relationship (not statistically significant in this review) between the intensity of interventions and whether they used theory. Such differences could obscure any effect of a theoretical underpinning to the intervention.

Do hypothesized moderators affect the results of these interventions? Do these interventions affect theoretically hypothesized mediators? In these interventions, is there a relationship between changes in theoretically hypothesized mediators and changes in physical activity?

These three questions were among the originally proposed key questions. The goal was to examine the role of moderators and mediators of the effects of the physical activity interventions within studies as well as across studies. Unfortunately, this literature did not prove to be particularly rich in this information. Only one study included in this review examined a moderating variable within study.[75] The results showed that self-reported baseline levels of support from family and friends, having a partner who exercised, and perceiving greater benefits and fewer barriers to exercise moderated the effects of the intervention. There were nine studies that examined the effect of an intervention on a hypothesized mediator. Only one reported a statistically significant effect on a hypothesized mediator (intention to exercise).[116] Only one study examined whether a hypothesized mediator affected the physical activity outcome. This study reported that partner support and self-efficacy mediated the intervention effect of the physical activity intervention.[78] This paucity of results within the current review does not mean that these questions have not been examined in the physical activity literature, only that they have not been well addressed within the subset of the literature that examines physical activity behavior three months or more after the intervention. Further, none of the studies used robust methods for examining mediation, such as structural equation modeling. It is important that more

attention be paid to this area, as there is no guarantee that what might be understood as a mediator of physical activity behavior during an intervention would hold up as a mediator after the end of an intervention.

Moderators across studies.

Setting. Within this literature we found that it is possible to intervene in a number of different settings and successfully increase physical activity. Because of the small numbers of studies and the variations in specific interventions and populations, it was not possible to isolate the effect of setting to conclude that one was better than another. In all of the settings only a quarter of the trials resulted in a statistically significant increase in physical activity on at least one measure three or more months after the end of the intervention. There was no clear pattern of effect sizes within the different settings, but this analysis is limited by the small number of studies within each setting and the diversity of the interventions themselves.

Population. Most of the studies in this literature intervened on adult men and women. Although a few focused on children (four studies) or older adults (three studies) these numbers were too small to make any meaningful comparisons of outcomes by population and therefore all of the studies were examined together. None of the conclusions would have changed by excluding the studies of these populations.

Outcome type. We found that outcomes that fit into the moderate outcome group were more likely to be statistically significant than outcomes that assessed total activity. Although the comparison did not reach statistical significance, more moderate outcomes than vigorous outcomes were statistically significant. This may well reflect an order effect within the outcomes. That is, if one has increased total activity group, one has also, by necessity, had an increase in some moderate activity. However, the reverse is not necessarily true. One can increase a moderate activity, such as walking, without increasing total activity by reducing activity in some other way. Hence, it would be expected that interventions would change moderate activity before they change total or vigorous activity as observed here.

Intervention intensity. It was not necessary to have an intensive intervention to get an effect. A wide range of intervention types were included in this review. The intervention intensity varied widely, everything from one mailing to multiple personal interactions per week for years. We found that there were successful interventions at all levels of intensity; in fact there was not a clear trend that more intensive interventions were more successful. Even a number of the least intensive interventions had at least one statistically significant outcome at followup. This suggests that it may be possible to increase physical activity with relatively modest efforts. There also was not a clear pattern in the size of the effect with the intensity of the intervention.

Length of followup. Physical activity behaviors are difficult to maintain after the end of an intervention. Approximately 25 percent of the studies with data at one year or more reported statistically significant increases in physical activity. It is not possible from these data to get an accurate assessment of how long the behavior change may last, but some studies, such as Periera et al. in which statistically significant differences in physical activity behavior were evident ten years after at intervention, suggest that long-term changes may be possible.[64] The limited data that is available from this literature on effect size over time is perhaps more sobering. Three-quarters of the studies for which an effect size could be calculated at two points in time showed a decrease in effect size from first to last followup. This data is not sufficient to accurately

understand the pattern or magnitude of the changes over time, but it is clearly an important issue to be addressed if interventions are to achieve long-term benefit in populations.

Combined interventions and access to physical activity. We examined other possibly important intervention factors, including whether interventions addressed issues with access and whether interventions combined with diet and smoking cessation had different effects on physical activity. Again, we were not able to show that the effect sizes differed in meaningful ways when comparing studies that intervened on physical activity only versus physical activity with diet and/or smoking cessation. There were also no differences in the results of studies that did versus did not address the issue of access to physical activity equipment, facilities, or classes. As said before, the issues with this literature means this cannot be taken as firm evidence that these are not important factors.

Study quality. We found the quality of this literature to be extremely variable. Some of the issues with quality may be very difficult to address; for example, it is difficult to blind subjects to the intervention. Yet more could be done to blind the outcome assessment such as using accelerometers with blinded reading. In these studies, even when some other measure of outcome was used besides self report, there was never any indication of blinding of that assessment.

Other quality issues may be difficult to address but unlike blinding may be possible. A large number of the studies suffered from attrition, which may bias the results either positively (if only those who stay in the trial are analyzed) or negatively (if all of those who withdraw are assumed not to change). This can be partially addressed by looking at the results both ways but would be of most benefit if means could be devised to reduce the attrition in these trials. Finally, some pervasive quality issues such as poor attention to the specifics of randomization could and should be easily addressed.

Adverse events. Understanding the overall benefits of these interventions requires an accounting of any harms that they may cause. It is certainly plausible that the risk of injury may increase as one becomes more active. Given the relatively small effects noted from the majority of these studies, it would not take many significant injuries to outweigh any health benefits that may occur. Unfortunately, there was almost no information in this literature on adverse events.

Future Direction

After this exhaustive review of the physical activity literature, it is still not possible to answer the question of what works and what does not work to increase individuals' physical activity and have them continue to be active at least three months later. Further we are even less able to judge the net benefits of programs to increase physical activity because harms have rarely been examined. To be able to answer this important question in the future, a number of issues need to be addressed:

- Examine longer outcomes
- Standardize followup intervals
- Standardize the domains of physical activity measured
- Standardize, if possible, the outcome measures
- Use, where possible, blinded measures of outcome rather than self-report
- Reduce attrition from studies
- Standardize reporting of study results

- Use appropriate statistical methodology to examine moderators and mediators of effect
- Examine harms

Examine longer outcomes. We could be criticized for the fact that the majority of the physical activity literature was excluded by our modest criteria of followup three months after the end of the intervention. Yet, as the ultimate goal is to help people change their lives and become more active, one could be equally critical of a literature that has largely ignored what happens to the subjects when the intervention ceases. This significantly limits the conclusions that can be drawn. Obviously, looking at followup after the end of the intervention adds to the time and complexity of studies, but it is time and resources that would be well spent. Further, there may be natural opportunities to identify and follow up on past intervention trials such as was done by of Periera et al.[64] and MacKeen et al.[157] If we are ultimately going to be able to improve the physical activity habits of the American people, we are going to need to have a better idea of what works over time.

Standardize followup interval. Making sense of this literature also suffers from a lack of standard followup intervals. As we showed, the effects of the interventions do seem to decrease over time. Therefore, one important factor in the results of any study will be the length of time since the intervention ended. To be able to compare interventions in the future, it would be beneficial to have standardized followup intervals. We do not have firm recommendations as to what these intervals should be; this could be defined through consensus of experts in the field, although both a shorter interval of a few months and a longer interval of a year or more would be most informative as to the true effect of the interventions.

Standardize the domains of physical activity measured. We attempted in this review to define some domains of physical activity. We do not claim that these particular categories are the best at capturing the true underlying domains of physical activity measurement. Yet, they are illustrative of two important principals. First is that the domain measured is the only domain measured. For example, a measure of leisure time activity is not a measure of total activity. An intervention that increases leisure time activity may, at the same time, decrease total activity. So, if one is interested in total activity, it must be measured, as it cannot necessarily be extrapolated from other measures. This leads to the second principal. In order to compare two studies they need to be measuring the same underlying domain, so, in order to fully understand the effect of these interventions, some standardization of the domains to be assessed needs to occur, as well as means for assessing each domain.

Standardize the outcome measures. Examining the results across studies would be most comparable if the same outcome measure is used across studies. This is less important than assuring that the domains are the same, but would further enhance the comparison of future studies.

Use blinded measures rather than self-report. We do not have any independent evidence from this review that the use of almost exclusively unblinded self-report as an outcome measure biases the results, but the possibility cannot be excluded. There are circumstances where other blinded measures could be used and should be considered.

Reduce attrition from studies. This may be easier said than done, but many of these studies failed usual criteria for attrition (80 percent followup with one of our quality measures and 85 percent with our other quality measure). Clearly, improving this would strengthen the conclusions that could be drawn from the studies.

Standardize reporting of study results. Accurate effect sizes could not be calculated for many of the studies in this review. Frequently what was missing was a variance estimate or an exact p-value. Occasionally the problem was that only a multivariate model was presented without enough information to assess the independent effect of the variable of interest. To the extent that it would be beneficial to compare studies, providing sufficient information (means, variance estimates, and correlations) would be beneficial.

Use appropriate statistical methodology to examine moderators and mediators of effect. Although a number of studies made some attempt to examine mediators of effect, none of them used techniques that can account for the complexity of relationships between the variables such as Structural Equation Modeling. This is important because any one model or combination of individual models can miss important relationships between the interventions, mediators, and outcomes.

Examine harms. Ignoring whether subjects suffer any harm from these interventions leaves open the question of the overall benefit of the interventions. Addressing this deficiency in the literature will allow a better accounting of the full effects of these interventions.

With attention to these areas, there is hope that we may learn how we may intervene to increase individuals' physical activity in a manner that can be maintained after costly intervention activities have ended.

Cancer Survivors

Magnitude of Effects by Outcome

The presentation of mean effect sizes for each outcome category (Tables 18 and 19) allows for discussion of the relative impact on each outcome category of physical activity interventions on cancer survivors. However, because the effect sizes were calculated based on post intervention between group differences only, interpretive caution is urged. For example, the mean effect size of 2.93 for physical activity behavior is mostly driven by between group differences that existed at baseline and persisted to the end of the intervention.[99] Other categories for which effect sizes may be overestimates include body image/dissatisfaction and body size (goal to reduce), since both of these are also reflective of baseline between group differences from studies that showed large effect sizes. By contrast, there are several categories for which the mean effect sizes reported in Table 18 may be underestimates, including quality of life, self-esteem, and anger/hostility. In all three of these categories, the mean effect sizes were influenced by between group differences at baselines: the treatment groups started out worse than the control group in several studies that included these outcomes. Thus, the intervention effect was larger than what can be reflected by a post-intervention comparison of groups. Finally, there are three outcome categories for which values for more specific individual variables might be more useful than the mean effect size for the entire categories: physiological outcomes, immune parameters, and the 'multiple constructs' portion of the mental/emotional/psychological well-being category. These three categories are discussed in greater detail below. Beyond these caveats, the conclusions that can be drawn from a review of the literature on the efficacy of physical activity interventions to positively impact physiologic and psychosocial outcomes are outlined below.

Controlled trials in cancer survivors consistently report mean post test effect size $\geq$ 0.2 and consistent (five or more studies) positive effects of physical activity (usually aerobic exercise) on the following outcomes:

- Vigor and vitality (effect size 0.850)
- Cardiorespiratory fitness (effect size 0.647)
- Quality of life (effect size 0.427)
- Depression (effect size 0.418)
- Anxiety (effect size 0.333)
- Fatigue/tiredness (effect size 0.217)

The outcomes with the greatest consistency across the cancer experience are cardiorespiratory fitness and fatigue/tiredness. The exercise prescription associated with these positive outcomes in cancer survivors was generally moderate to vigorous intensity aerobic activity on three or more days per week, for 10-60 minutes per session. For many of the other variables there are too few studies to evaluate whether the findings differ for survivors during compared to post treatment. The findings for some categories, such as cardiovascular fitness, strength, flexibility, body size, and anxiety and depression parallel results reported from exercise interventions in generally healthy populations.[12] For example, the lack of weight loss associated with exercise only interventions parallels the results in generally healthy populations. Studies designed to produce weight loss are typically designed differently than studies designed to test the independent effect of exercise on physiologic or psychosocial outcomes. Further, physical activity has been shown to improve symptoms of mild to moderate depression in generally healthy adults.

Other variables for which there is either consistent evidence that is either less strong or results from fewer studies include:

- Confusion (effect size 0.402)
- Symptoms/side effects (effect size 0.400)
- Psychosocial outcomes (effect size 0.191)
- Body size (goal to reduce) (effect size 0.187)
- Self-esteem (effect size 0.100)
- Mental health quality of life (no effect size available)
- Strength (no effect size available)

Variables for which there is less consistent evidence include:

- Body image/dissatisfaction (effect size 0.310)
- Anger hostility (effect size 0.070)
- Physical activity behavior (no valid effect size estimate available)
- Body size (goal to gain or avoid muscle mass loss) (no effect size estimate available)
- Pain (no effect size estimate available)

In addition, there is an assortment of mental/emotional/psychological well-being variables (e.g., emotional well-being, impact of medical illness on subject, psychological distress, well-being with breast cancer, global psychological distress, total mood disturbance, avoidance, fatalism, fighting spirit, hopelessness) that have each been measured in one or two studies, and this group of variables shows a mean effect size of 0.356. One perspective might be to note that these constructs are all related to anxiety and depression, which have mean effect sizes of 0.333 and 0.418, respectively. To the extent that these constructs are similar to anxiety or depression, this might be further consistent evidence that physical activity has a consistent and positive effect

on anxiety and depression among cancer survivors. Another possible interpretation would be that these variables differ from anxiety and or depression enough to require further studies prior to interpretation.

Physiologic Outcomes

The nine studies that measured non-fitness and non-anthropometric physiologic outcomes were placed into one of three categories: immune parameters, symptoms/side effects, or physiologic outcomes. The last category was created for physiologic variables that did not fit into the first two. The outcomes from studies with outcomes in these three categories were disparate and reflected goals of evaluating the safety of exercise during active cancer treatment, the efficacy of exercise to prevent muscle loss or assist patients in recovering from active cancer treatment, and two studies specifically interested in whether exercise could favorably alter physiologic parameters hypothesized to be associated with breast cancer etiology.[100, 103] Given the broad variety of potential physiologic variables that may be of interest for cancer survivors across the cancer experience, nine studies is too few to enable a summary or to draw any conclusions beyond the general statement that the majority of the reviewed studies reported changes in the hypothesized direction. This area of research has just begun to develop.

Important Early Studies in the Area of Physical Activity Interventions in Cancer Survivors

The inclusion criteria for this report included a requirement that each study must have a concurrent comparison group. This resulted in the exclusion of important early research in this area. In acknowledgement of the importance of these excluded studies, a brief overview of the studies and results of the 14 studies excluded as a result of no-concurrent comparison group[5, 214-226] is given below. Followed by a brief comparison of results from these excluded studies to the results from the 24 studies reviewed more completely for this report.

Of the 14 studies excluded as a result of no-concurrent comparison group, ten included breast cancer survivors, seven focused exclusively on breast cancer survivors. Other diagnoses were mixed, similar to the included studies. All of these studies were pre-post examinations in convenience samples of survivors with sample sizes ranging from five to 78 participants, with a mean of 27. The length of the interventions ranged from 28 days to seven months. Twelve of the 14 studies had intervention lengths between six and 16 weeks. Six of the 14 studies focused exclusively on survivors during treatment, five included survivors during as well as post treatment, and three focused exclusively on post-treatment survivors. Twelve of the 14 studies were exercise only interventions; one included a dietary component and another included an educational component regarding cancer survivorship issues. All of the excluded studies included aerobic activity, two included strength training as well. The exercise intensity ranged from 40 to 85 percent of maximal heart rate, which can be considered a range of moderate to vigorous. Exercise frequency ranged from two to seven times weekly, with exercise sessions lasting from 15 to 60 minutes. There were five studies in which all exercise took place in an exercise facility or hospital, all of these included or focused on survivors undergoing treatment. The ten studies that asked people to exercise at home or on their own (or in combination with visits to an exercise facility) included seven studies with survivors undergoing treatment.

The outcomes examined in these studies included fitness (ten studies); quality of life (six studies), fatigue (five studies each); symptoms/side effects, body size (body weight or fat), and depression (three studies each); vigor, functional ability, strength, and anxiety (two studies each); and sleep, pain, blood pressure, hormones, and immune function were each assessed in one study each. A summary of these findings is provided in Table 22. Notable findings include that the only study that did not report fitness improvements was conducted on bone marrow transplant recipients with acute leukemia.[219] Further, one study[215] performed a mediation analysis that indicated that changes in fatigue mediated the exercise induced QOL improvements. Four of the studies on QOL and fatigue were performed by one researcher.[215-218]

The 14 excluded studies can also be placed into the PEACE framework suggested by Courneya and Friedenreich[13] and described in the introduction of this report. Eight of the 14 excluded studies focused on coping during treatment,[215-219, 221, 223, 224] seven focused on rehabilitation after cancer treatment,[5, 220-224, 226] two focused on health promotion in survivors at least one year post-treatment,[214, 221] and one focused on palliation of fatigue in advanced cancer patients.[225] Three studies focused on cancer survivors in multiple PEACE framework categories.[221, 223, 224]

A comparison of Table 18 and Table 22 suggests that few changes in conclusions for each of the outcome categories would result from inclusion versus exclusion of studies with no comparison group. Exceptions are largely for outcomes examined in few studies of any design, such as sleep. With regard to the timing of exercise within the cancer survivor experience, the balance was similar across included and excluded studies with the vast majority of studies focusing on the coping and rehabilitation periods of cancer survivor experience. There were two notable exceptions. First, there was only one study on buffering prior to cancer treatment,[213] which is included as a study with a concurrent comparison group. Finally, there was only one study on palliation of symptoms in advanced cancer patients, which was not included, as it did not have a control group.[225]

Is Physical Activity Safe in Cancer Survivors?

For physical activity to be recommended for cancer survivors, it is important to first understand the potential for adverse outcomes. The results of the reviewed studies generally indicate that it is safe for cancer survivors to be physically active, even during bone marrow transplant procedures and high dose chemotherapy. Given the small number of studies reviewed, several questions regarding the safety of physical activity across the cancer survivor experience remain, including the potential for bias in self-reported worsening of symptoms or side effects, risk for the development of lymphedema, and worsening of some immune parameters.

Self-report of worsening of symptoms or side effects in cancer survivors can result in bias if physical activity results in such worsening of symptoms that study participants drop out or fail to complete data collection. Therefore, though no studies reported worsening of symptoms due to physical activity, future studies should explore other means for collecting the same data, potentially including medical chart review or proxy interviews with next of kin.

One reviewed study reported onset of lymphedema (swelling of the arm or torso due to lymph system insufficiency) in breast cancer survivors at greater rate in the exercise than comparison group.[90] This finding was confounded by between group differences in risk factors for lymphedema (e.g., radiation of the axilla). The same research group conducted a pilot study

to examine the effect of upper body aerobic and resistance training on women with lymphedema and reported no adverse effects on arm volume.[107] Other controlled and uncontrolled studies have also reported no adverse effects of upper body exercise on breast cancer survivors at risk for lymphedema.[227, 228] Current clinical guidelines from multiple sources (The National Cancer Institute, the National Lymphedema Network, the Susan G. Komen Foundation, and the American Cancer Society) include recommendations to breast cancer survivors to avoid lifting anything heavier than five to 15 pounds for the balance of life. This recommendation has negative health promotion and quality of life implications. There is too little research on this topic thus far to appropriately and safely prescribe physical activity for breast cancer survivors at risk for (or with a diagnosis of) lymphedema. Lymphedema is one of the most common late effects of breast cancer treatment, with close to 50 percent of breast cancer survivors reporting at least one lymphedema symptom in the 20 years following treatment.[229, 230] Further research on this topic is needed to guide the more than two million breast cancer survivors alive in the United States today.[231] Future studies should be specific as to timing of physical activity across the cancer survivor experience, as well as physical activity mode, frequency, intensity, and duration.

The studies that examined the impact of physical activity on immune parameters in cancer survivors reported a mixed set of results. Some parameters worsened, particularly among survivors who had completed treatment (effect sizes ranged from –0.799 to 1.047). Given the animal data that high intensity, high volume exercise can exacerbate the spread of cancer throughout the body,[109-111] it is important to understand further the effects of physical activity on immune parameters. In generally healthy adults, moderate intensity physical activity is associated with improvement in immune parameters, while high intensity, high volume physical activity is associated with a temporary worsening of immune function.[12] Additional studies are needed to clarify the effects on specific immune parameters with specificity as to timing across the cancer experience as well as physical activity mode, frequency, intensity, and duration.

Future Direction

The process of conducting this review has revealed numerous potential areas for future research on the efficacy of physical activity to positively alter physiologic and psychosocial outcomes in cancer survivors across the cancer experience. The small number of studies for each outcome category underscores the need for an expansion of research on a broad spectrum of cancer control outcomes. Therefore, rather than focus the need for further research on specific outcomes, below is a presentation of broader themes and methodologic issues to be addressed as well as recommendations for efficient forward progress toward greater understanding of the effects of physical activity in cancer survivors.

The PEACE framework outlined by Courneya and Friedenreich[13] provides an overview into the specific potential for the use of physical activity to benefit cancer control outcomes across the cancer experience. Using this framework, the current review indicates that the majority of completed studies have focused on coping during active cancer therapy or rehabilitation immediately following cancer treatment. There are many unanswered questions regarding these time frames and additional studies are needed to explicate the mode, frequency, intensity, and duration of physical activity prescriptions needed for particular populations, treatment modalities, and cancer control outcomes. That said, there are many fewer physical activity interventions that focus on buffering cancer survivors prior to treatment, palliation of symptoms at the end of life, or health promotion or survival. The results from these time periods are too

scant to draw any conclusions as yet. Therefore, additional research on the effect of physical activity on cancer control outcomes prior to treatment, as well as for health promotion, survival, and palliation is needed. A convening of researchers interested in this field to develop consensus regarding priority areas with regard to specific outcomes and timing would result in greater efficiency in moving the field forward.

For each outcome assessed in the literature on physical activity interventions in cancer survivors, the methods used differed across multiple studies. This increases the difficulty of comparing results beyond the challenge of comparisons across cancer diagnoses, severity of disease, and timing of intervention across the cancer experience. The methods for reporting these results also differed. For comparison across studies, means and standard deviations at each measurement time point within each group would need to be reported, as well as within person correlations between the measures across time. In particular, measurement of physical activity that includes mode, intensity, frequency, and duration of activity sessions would allow for greater comparison across studies than is currently possible. Standardization of methods for measuring and reporting cancer control outcomes of greatest interest would also assist the field in reaching consensus more efficiently. A conference of researchers interested in this topic to discuss and reach consensus regarding recommended measures for specific constructs would assist toward this goal.

Of the reviewed studies, the average sample size per group was 22 to 23. This indicates small studies that may not be adequately powered to assess the outcomes of interest. The large effect sizes in some studies, despite small sample sizes and statistically insignificant results, indicate the potential for powerful effects of physical activity on some cancer control outcomes. Increased funding for studies adequately powered to assess the impact of physical activity on cancer control outcomes across the cancer survivor experience is needed.

Subject recruitment for physical activity intervention studies, particularly during active cancer therapy, is challenging at best. Recruitment through registries is most desirable to obtain a generalizable sample. Development of cancer registries requires infrastructure. Infrastructure requires funding and organization of researchers to develop useful registries from which cancer survivors can be recruited for many types of studies, including physical activity interventions. Until such registries become common, and for those with limited resources, it is likely that many researchers will continue to use convenience samples to recruit cancer survivors post treatment. Further, for those with advanced cancer, becoming more physically active may not be a high priority. For these and other reasons, convenience sampling may be the only feasible way to conduct research during active treatment. Whether samples are from registries or result from convenience sampling, greater detail in reporting how the subjects were recruited and who they are (sociodemographics, age, gender, race/ethnicity, and cancer diagnosis and treatment course) would assist in evaluation of generalizability of results.

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Listing of Excluded Studies—General Population

(reason for exclusion is provided in italics following each reference)

1. Effectiveness of health checks conducted by nurses in primary care: final results of the OXCHECK study. Imperial Cancer Research Fund OXCHECK Study Group. BMJ. 1995;310(6987):1099-104.
   No physical activity intervention

2. Cardiovascular disease prevention for women attending breast and cervical cancer screening programs: the WISEWOMAN projects. The WISEWOMAN Workgroup. Prev Med. 1999;28(5):496-502.
   No physical activity or fitness outcome

3. The Diabetes Prevention Program. Design and methods for a clinical trial in the prevention of type 2 diabetes. Diabetes Care. 1999;22(4):623-34.
   No physical activity or fitness outcome

4. Effects of physical activity counseling in primary care: the Activity Counseling Trial: a randomized controlled trial. Jama. 2001;286(6):677-87.
   Less than 3 months followup

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   No concurrent control group

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   Fewer than 75 subjects total

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    Fewer than 75 subjects total

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    No concurrent control group

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Less than 3 months followup

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No concurrent control group

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Fewer than 75 subjects total

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Less than 3 months followup

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No physical activity or fitness outcome

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308. Perri MG, Anton SD, Durning PE, et al. Adherence to exercise prescriptions: effects of prescribing moderate versus higher levels of intensity and frequency. Health Psychol. 2002;21(5):452-8.
Less than 3 months followup

309. Perri MG, Martin AD, Leermakers EA, et al. Effects of group- versus home-based exercise in the treatment of obesity. J Consult Clin Psychol. 1997;65(2):278-85.
Fewer than 75 subjects total

310. Perri MG, McAdoo WG, McAllister DA, et al. Enhancing the efficacy of behavior therapy for obesity: effects of aerobic exercise and a multicomponent maintenance program. J Consult Clin Psychol. 1986;54(5):670-5.
Less than 3 months followup

311. Perry C, Klepp K, Halper A. Promoting healthy eating and physical activity patterns among adolescents: a pilot study of "Slice Of Life". Health Educ Res. 1987;1:93-103.
Less than 3 months followup

312. Perry CL, Stone EJ, Parcel GS, et al. School-based cardiovascular health promotion: the child and adolescent trial for cardiovascular health (CATCH). J Sch Health. 1990;60(8):406-13.
No physical activity or fitness outcome

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No concurrent control group

314. Petchers MK, Hirsch EZ, Bloch BA. A longitudinal study of the impact of a school heart health curriculum. J Community Health. 1988;13(2):85-94.
No physical activity or fitness outcome

315. Peterson KE, Sorensen G, Pearson M, et al. Design of an intervention addressing multiple levels of influence on dietary and activity patterns of low-income, postpartum women. Health Educ Res. 2002;17(5):531-40.
No physical activity or fitness outcome

316. Peterson TR, Aldana SG. Improving exercise behavior: an application of the stages of change model in a worksite setting. Am J Health Promot. 1999; 13(4):229-32, iii.
Less than 3 months followup

317. Petrella RJ. Moderate aerobic exercise to increase fitness in older adults. Clin J Sport Med. 2000;10(4):307.
No physical activity intervention

318. Petrella RJ, Bartha C. Home based exercise therapy for older patients with knee osteoarthritis: a randomized clinical trial. J Rheumatol. 2000;27(9):2215-21.
Less than 3 months followup

319. Petrella RJ, Wight D. An office-based instrument for exercise counseling and prescription in primary care. The Step Test Exercise Prescription (STEP). Arch Fam Med. 2000;9(4):339-44.
No physical activity or fitness outcome

320. Petrini MF. Postmenopausal women and walking. Arch Intern Med. 12 1999;159(7):756-7.
No physical activity intervention

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Less than 3 months followup

322. Pinto BM, Goldstein MG, DePue JD, et al. Acceptability and feasibility of physician-based activity counseling. The PAL project. Am J Prev Med. 1998;15(2):95-102.
Less than 3 months followup

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Less than 3 months followup

324. Pohjonen T, Ranta R. Effects of worksite physical exercise intervention on physical fitness, perceived health status, and work ability among home care workers: five-year follow-up. Prev Med. 2001;32(6):465-75.
No physical activity intervention

325. Pollock ML, Carroll JF, Graves JE, et al. Injuries and adherence to walk/jog and resistance training programs in the elderly. Med Sci Sports Exerc. 1991;23(10):1194-200.
Fewer than 75 subjects total

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Less than 3 months followup

327. Pritchard JE, Nowson CA, Wark JD. A worksite program for overweight middle-aged men achieves lesser weight loss with exercise than with dietary change. J Am Diet Assoc. 1997;97(1):37-42.
Less than 3 months followup

328. Boileau R, E M, D D, et al. Aerobic exercise training and cardiorespiratory fitness in older adults: a randomized controlled trial. J Aging and Physical activity. 1999;7:374-85.
Less than 3 months followup

329. Ravussin E, Valencia ME, Esparza J, et al. Effects of a traditional lifestyle on obesity in Pima Indians. Diabetes Care. 1994;17(9):1067-74.
No physical activity intervention

330. Ready AE. Walking program maintenance in women with elevated serum cholesterol. Behav Med. 1996;22(1):23-31.
Fewer than 75 subjects total

331. Reger B, Cooper L, Booth-Butterfield S, et al. Wheeling Walks: a community campaign using paid media to encourage walking among sedentary older adults. Prev Med. 2002;35(3):285-92.
Less than 3 months followup

332. Reid EL, Morgan RW. Exercise prescription: a clinical trial. Am J Public Health. 1979 1979;69(6):591-5.
No concurrent control group

333. Rejeski W, Brawley L. Shaping active lifestyles in older adults: a group-facilitated behavior change intervention. Ann Behav Med. 1997;19(suppl):S106.
Fewer than 75 subjects total

334. Rejeski WJ, Focht BC, Messier SP, et al. Obese, older adults with knee osteoarthritis: weight loss, exercise, and quality of life. Health Psychol. 2002;21(5):419-26.
Less than 3 months followup

335. Resnick B. Testing the effect of the WALC intervention on exercise adherence in older adults. J Gerontol Nurs. 2002;28(6):40-9.
Fewer than 75 subjects total

336. Resnicow K, Davis M, Smith M, et al. Results of the TeachWell worksite wellness program. Am J Public Health. Feb 1998;88(2):250-7.
Less than 3 months followup

337. Resnicow K, Jackson A, Braithwaite R, et al. Healthy Body/Healthy Spirit: a church-based nutrition and physical activity intervention. Health Educ Res. 2002;17(5):562-73.
No concurrent control group

338. Resnicow K, Yaroch AL, Davis A, et al. GO GIRLS!: results from a nutrition and physical activity program for low-income, overweight African American adolescent females. Health Educ Behav. 2000;27(5):616-31.
Less than 3 months followup

339. Rikli RE, Edwards DJ. Effects of a three-year exercise program on motor function and cognitive processing speed in older women. Res Q Exerc Sport. 1991; 62(1):61-7.
No physical activity or fitness outcome

340. Rippe JM, Price JM, Hess SA, et al. Improved psychological well-being, quality of life, and health practices in moderately overweight women participating in a 12-week structured weight loss program. Obes Res. 1998;6(3):208-18.
Fewer than 75 subjects total

341. Robbins S, Coogle C, Link-Mullison M. The utility of brief health promotion workshops. Health Ed. 1987; Aug./Sep.:36-8.
Less than 3 months followup

342. Roberts K, Dench S, Minten J, et al. Community response to leisure centre provision in Belfast. London UK: Sports Council. 1989.
No concurrent control group

343. Robison JI, Rogers MA, Carlson JJ, et al. Effects of a 6-month incentive-based exercise program on adherence and work capacity. Med Sci Sports Exerc. 1992;24(1):85-93.
Less than 3 months followup

344. Rosenfeld O, Tenenbaum G, Ruskin H, et al. Behavioural modifications following a physical activity programme in the Israeli pharmaceutical industry. AUstralian Journal of Sports Science. 1990;22:93-6.
No physical activity or fitness outcome

345. Rowland D, DiGuiseppi C, Gross M, et al. Randomised controlled trial of site specific advice on school travel patterns. Arch Dis Child. Jan 2003;88(1):8-11.
No physical activity intervention

346. Rowley KG, Daniel M, Skinner K, et al. Effectiveness of a community-directed 'healthy lifestyle' program in a remote Australian aboriginal community. Aust N Z J Public Health. 2000;24(2):136-44.
No concurrent control group

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No physical activity intervention

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No concurrent control group

349. Russell WD, Dzewaltowski DA, Ryan GJ. The effectiveness of a point-of-decision prompt in deterring sedentary behavior. Am J Health Promot. 1999;13(5):257-9, ii.
No concurrent control group

350. Sahota P, Rudolf MC, Dixey R, et al. Evaluation of implementation and effect of primary school based intervention to reduce risk factors for obesity. BMJ. 2001;323(7320):1027-9.
Less than 3 months followup

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Less than 3 months followup

352. Sallis JF, Calfas KJ, Nichols JF, et al. Evaluation of a university course to promote physical activity: project GRAD. Res Q Exerc Sport. 1999;70(1):1-10.
Less than 3 months followup

353. Sallis JF, Haskell WL, Wood PD, et al. Physical activity assessment methodology in the Five-City Project. Am J Epidemiol. 1985;121(1):91-106.
Less than 3 months followup

354. Sallis JF, McKenzie TL, Alcaraz JE, et al. The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. Sports, Play and Active Recreation for Kids. Am J Public Health. 1997;87(8):1328-34.
No physical activity intervention

355. Segal R, Evans W, Johnson D, et al. Structured exercise improves physical functioning in women with stages I and II breast cancer: results of a randomized controlled trial. J Clin Oncol. 2001;19(3):657-65.
Targeted patients with acute disease

356. Sevick MA, Dunn AL, Morrow MS, et al. Cost-effectiveness of lifestyle and structured exercise interventions in sedentary adults: results of project ACTIVE. Am J Prev Med. 2000;19(1):1-8.
Less than 3 months followup

357. Sharpe PA, Connell CM. Exercise beliefs and behaviors among older employees: a health promotion trial. Gerontologist. 1992;32(4):444-9.
Less than 3 months followup

358. Sharpe PA, Jackson KL, White C, et al. Effects of a one-year physical activity intervention for older adults at congregate nutrition sites. Gerontologist. 1997;37 (2):208-15.
Less than 3 months followup

359. Shaw LW. Effects of a prescribed supervised exercise program on mortality and cardiovascular morbidity in patients after myocardial infarction. The National Exercise and Heart Disease Project. Am J Cardiol. 1981;48(1):39-46.
Targeted patients with acute disease

360. Shephard R, Lavallee H. Impact of enhanced physical education in the prepubescent child: Trois Rivieres revisited. Pediatr Exerc Sci. 1993;5:177-89.
Less than 3 months followup

361. Shephard RJ. Twelve years experience of a fitness program for the salaried employees of a Toronto life assurance company. Am J Health Promot. 1992;6(4): 292-301.
Less than 3 months followup

362. Shephard RJ, Jequier JC, Lavallee H, et al. Habitual physical activity: effects of sex, milieu, season and required activity. J Sports Med Phys Fitness. 1980;20 (1):55-66.
Less than 3 months followup

363. Shore G, Prasad P, Zroback M. Metrofit: A cost-effective fitness program. Fitness in Business. 1989;4:146-53.
No concurrent control group

364. Siegel J, Manfredi T. Effects of a ten-month fitness program on children. Physician Sportsmed. 1984;12:91-7.
Less than 3 months followup

365. Simkin-Silverman L, Wing RR, Hansen DH, et al. Prevention of cardiovascular risk factor elevations in healthy premenopausal women. Prev Med. 1995;24(5):509-17.
No physical activity or fitness outcome

366. Simkin-Silverman LR, Wing RR, Boraz MA, et al. Maintenance of cardiovascular risk factor changes among middle-aged women in a lifestyle intervention trial. Womens Health. 1998;4(3):255-71.
Less than 3 months followup

367. Simmonds G, Naylor P, Riddoch C, et al. Stage-based counseling for exercise in primary care: A controlled trial. Journal of Sport Sciences. 1996;14:45-6.
No physical activity or fitness outcome

368. Simmons D, Fleming C, Voyle J, et al. A pilot urban church-based programme to reduce risk factors for diabetes among Western Samoans in New Zealand. Diabet Med. 1998;15(2):136-42.
Less than 3 months followup

369. Simons-Morton BG, Parcel GS, Baranowski T, et al. Promoting physical activity and a healthful diet among children: results of a school-based intervention study. Am J Public Health. 1991;81(8):986-91.
Less than 3 months followup

370. Simons-Morton DG. The context of the Activity Counseling Trial. Med Sci Sports Exerc. 1998;30 (7):1084-5.
Less than 3 months followup

371. Simons-Morton DG, Hogan P, Dunn AL, et al. Characteristics of inactive primary care patients: baseline data from the activity counseling trial. For the Activity Counseling Trial Research Group. Prev Med. 2000;31(5):513-21.
Less than 3 months followup

372. Simpson JM, Oldenburg B, Owen N, et al. The Australian National Workplace Health Project: design and baseline findings. Prev Med. 2000;31(3):249-60.
Less than 3 months followup

373. Singh RB, Rastogi SS, Ghosh S, et al. The diet and moderate exercise trial (DAMET): results after 24 weeks. Acta Cardiol. 1992;47(6):543-57.
Less than 3 months followup

374. Singh RB, Singh NK, Rastogi SS, et al. Effects of diet and lifestyle changes on atherosclerotic risk factors after 24 weeks on the Indian Diet Heart Study. Am J Cardiol. 1993;71(15):1283-8.
Less than 3 months followup

375. Sinha DP. Project lifestyle: developing positive health lifestyles for schoolchildren in Antigua. J Sch Health. 1992;62(10):449-53.
No physical activity or fitness outcome

376. Slava S, Laurie D, Corbin C. Long-term effects of a conceptual physical education program. Res Q Exerc Sport. 1984;55:161-8.
Less than 3 months followup

377. Smolander J, Blair SN, Kohl HW, 3rd. Work ability, physical activity, and cardiorespiratory fitness: 2-year results from Project Active. J Occup Environ Med. 2000;42(9):906-10.
Less than 3 months followup

378. Snyder KA, Donnelly JE, Jabobsen DJ, et al. The effects of long-term, moderate intensity, intermittent exercise on aerobic capacity, body composition, blood lipids, insulin and glucose in overweight females. Int J Obes Relat Metab Disord. 1997;21(12):1180-9.
Fewer than 75 subjects total

379. Song T, SHephard R, Cox M. Absenteeism, employee turnover and sustained exercise participation. J Sports Med Phys Fit. 1981;22:392-9.
Less than 3 months followup

380. Sorensen G, Thompson B, Glanz K, et al. Work site-based cancer prevention: primary results from the Working Well Trial. Am J Public Health. 1996;86(7):939-47.
Less than 3 months followup

381. Sorensen M. Maintenance of exercise behavior for individuals at risk for cardiovascular disease. Percept Mot Skills. 1997;85(3 Pt 1):867-80.
Less than 3 months followup

382. Speck BJ, Looney SW. Effects of a minimal intervention to increase physical activity in women: daily activity records. Nurs Res. 2001;50(6):374-8.
Fewer than 75 subjects total

383. Spilman MA, Goetz A, Schultz J, et al. Effects of a corporate health promotion program. J Occup Med. 1986;28(4):285-9.
No physical activity or fitness outcome

384. Spink K, Carron A. The effects of team building on the adherence patterns of female exercise participants. J Sport Exerc Psychol. 1993;15:39-49.
Less than 3 months followup

385. Stamler R, Stamler J, Gosch FC, et al. Primary prevention of hypertension by nutritional-hygienic means. Final report of a randomized, controlled trial. JAMA. 1989;262(13):1801-7.
No physical activity or fitness outcome

386. Stamler R, Stamler J, Gosch FC, et al. Primary prevention of hypertension--a randomized controlled trial. Ann Clin Res. 1984;16 Suppl 43:136-42.
Less than 3 months followup

387. Stevens VJ, Corrigan SA, Obarzanek E, et al. Weight loss intervention in phase 1 of the Trials of Hypertension Prevention. The TOHP Collaborative Research Group. Arch Intern Med. 1993;153(7):849-58.
Less than 3 months followup

388. Stewart A, Verboncoeur C, McLellan B, et al. Preliminary outcomes of CHAMPS II: a physical activity promotion program for seniors in a Medicare HMO setting. In: Research CIfA, ed. Specialty Conference on Physical Activity Interventions; 1997:31.
Reference unobtainable

389. Stewart AL, Mills KM, Sepsis PG, et al. Evaluation of CHAMPS, a physical activity promotion program for older adults. Ann Behav Med. 1998;19(4):353-61.
No concurrent control group

390. Stewart AL, Verboncoeur CJ, McLellan BY, et al. Physical activity outcomes of CHAMPS II: a physical activity promotion program for older adults. J Gerontol A Biol Sci Med Sci. 2001;56(8):M465-70.
Less than 3 months followup

391. Stone WJ, Rothstein DE, Shoenhair CL. Coronary health disease risk factors and health related fitness in long- term exercising versus sedentary corporate executives. Am J Health Promot. 1991;5(3):169-72.
Fewer than 75 subjects total

392. Stucky-Ropp RC, DiLorenzo TM. Determinants of exercise in children. Prev Med. 1993;22(6):880-9.
No physical activity intervention

393. Suter E, Marti B. Predictors of exercise adoption and adherence of middle-aged sedentary men in a randomized controlled trial. Clin J Sports Med. 1992;2:261-7.
Fewer than 75 subjects total

394. Swinburn BA, Walter LG, Arroll B, et al. Green prescriptions: attitudes and perceptions of general practitioners towards prescribing exercise. Br J Gen Pract. 1997;47(422):567-9.
No physical activity or fitness outcome

395. Swinburn BA, Walter LG, Arroll B, et al. The green prescription study: a randomized controlled trial of written exercise advice provided by general practitioners. Am J Public Health. 1998;88(2):288-91.
Less than 3 months followup

396. Taggart AC, Taggart J, Siedentop D. Effects of a home-based activity program. A study with low fitness elementary school children. Behav Modif. 1986;10(4):487-507.
Fewer than 75 subjects total

397. Tell G, Vellar O. Noncommunicable disease risk factor intervention in Norwegian adolescents: The Oslo Youth Study. In: Hetzel B, Berenson G, eds, eds. Cardiovascular risk factors in childhood: Epidemiology and prevention.: Elsevier Science Publishers: Amsterdam.; 1987.
Less than 3 months followup

398. Tessaro IA, Taylor S, Belton L, et al. Adapting a natural (lay) helpers model of change for worksite health promotion for women. Health Educ Res. 2000;15(5):603-14.
No physical activity or fitness outcome

399. Thomas-Dobersen DA, Butler-Simon N, Fleshner M. Evaluation of a weight management intervention program in adolescents with insulin-dependent diabetes mellitus. J Am Diet Assoc. 1993;93(5):535-40.
Fewer than 75 subjects total

400. Thompson C, Wankel L. The effects of perceived activity choice upon frequency of exercise behavior. J Appl Soc Psychol. 1980;10:436-43.
Fewer than 75 subjects total

401. Toobert DJ, Glasgow RE, Radcliffe JL. Physiologic and related behavioral outcomes from the Women's Lifestyle Heart Trial. Ann Behav Med. 2000;22(1):1-9.
Fewer than 75 subjects total

402. Toobert DJ, Strycker LA, Glasgow RE, et al. Enhancing support for health behavior change among women at risk for heart disease: the Mediterranean Lifestyle Trial. Health Educ Res. 2002;17(5):574-85.
No physical activity or fitness outcome

403. Trost SG, Pate RR, Saunders R, et al. A prospective study of the determinants of physical activity in rural fifth-grade children. Prev Med. 1997;26(2):257-63.
No physical activity intervention

404. Tudor-Smith C, Nutbeam D, Moore L, et al. Effects of the Heartbeat Wales programme over five years on behavioural risks for cardiovascular disease: quasi-experimental comparison of results from Wales and a matched reference area. BMJ. 1998;316(7134):818-22.
Less than 3 months followup

405. Tworoger SS, Yasui Y, Ulrich CM, et al. Mailing strategies and recruitment into an intervention trial of the exercise effect on breast cancer biomarkers. Cancer Epidemiol Biomarkers Prev. 2002;11(1):73-7.
No physical activity intervention

406. Uusitupa M, Louheranta A, Lindstrom J, et al. The Finnish Diabetes Prevention Study. Br J Nutr. 2000;83 Suppl 1:S137-42.
Less than 3 months followup

407. Uusitupa MI. Early lifestyle intervention in patients with non-insulin-dependent diabetes mellitus and impaired glucose tolerance. Ann Med. 1996;28 (5):445-9.
No physical activity or fitness outcome

408. Vandongen R, Jenner DA, Thompson C, et al. A controlled evaluation of a fitness and nutrition intervention program on cardiovascular health in 10- to 12-year-old children. Prev Med. 1995;24(1):9-22.
Less than 3 months followup

409. Wadden TA, Vogt RA, Andersen RE, et al. Exercise in the treatment of obesity: effects of four interventions on body composition, resting energy expenditure, appetite, and mood. J Consult Clin Psychol. 1997;65(2):269-77.
Fewer than 75 subjects total

410. Wadden TA, Vogt RA, Foster GD, et al. Exercise and the maintenance of weight loss: 1-year follow-up of a controlled clinical trial. J Consult Clin Psychol. 1998;66(2):429-33.
Fewer than 75 subjects total

411. Wallace J, Buchner D, Grothaus L, et al. Implementation and effectiveness of a community based health promotion program for older adults. under review. [1998 - under review].
Less than 3 months followup

412. Walter HJ. Primary prevention of chronic disease among children: the school-based "Know Your Body" intervention trials. Health Educ Q. 1989;16(2):201-14.
No physical activity or fitness outcome

413. Walter HJ, Hofman A, Connelly PA, et al. Coronary heart disease prevention in childhood: one-year results of a randomized intervention study. Am J Prev Med. 1986;2(4):239-45.
No physical activity or fitness outcome

414. Walter HJ, Hofman A, Vaughan RD, et al. Modification of risk factors for coronary heart disease. Five-year results of a school-based intervention trial. N Engl J Med. 1988;318(17):1093-100.
Less than 3 months followup

415. Wankel L, Thompson C. Motivating people to be physically active: self-persuasion vs. balanced decision making. J Appl Soc Psychol. 1977;7:332-40.
Less than 3 months followup

416. Wankel LM, Yardley JK, Graham J. The effects of motivational interventions upon the exercise adherence of high and low self-motivated adults. Can J Appl Sport Sci. 1985;10(3):147-56.
Fewer than 75 subjects total

417. Webber LS, Osganian SK, Feldman HA, et al. Cardiovascular risk factors among children after a 2 1/2-year intervention-The CATCH Study. Prev Med. 1996;25(4):432-41.
No physical activity or fitness outcome

418. Weber J, Wertheim H. Relationships of self-monitoring, special attention, body fat percent, and self-motivation to attendance at a community gymnasium. J Sport Exerc Psychol. 1989;11:105-14.
Fewer than 75 subjects total

419. Wier LT, Jackson AS, Pinkerton MB. Evaluation of the NASA/JSC Health Related Fitness Program. Aviat Space Environ Med. 1989;60(5):438-44.
Less than 3 months followup

420. Wiesemann A, Metz J, Nuessel E, et al. Four years of practice-based and exercise-supported behavioural medicine in one community of the German CINDI area. Countrywide Integrated Non-Communicable Diseases Intervention. Int J Sports Med. 1997;18 (4):308-15.
Targeted osteoarthritis patients

421. Wiggam J, French R, Henderson H. The effects of a token economy on distance walked by senior citizens in a retirement center. Am Corr Ther J. 1986;40:6-12.
No concurrent control group

422. Wild B, Smith C, Martin J, et al. Worksite and community health promotion/risk reduction project: Virginia, 1987-1991. MMWR. 1992;41:55-7.
No concurrent control group

423. Wimbush E, MacGregor A, Fraser E. The effects of a national mass media campaign on walking in Scotland. Health Promot Int. [in press - 1998].
No concurrent control group

424. Wing RR, Jeffery RW, Pronk N, et al. Effects of a personal trainer and financial incentives on exercise adherence in overweight women in a behavioral weight loss program. Obes Res. 1996;4(5):457-62.
Fewer than 75 subjects total

425. Wing RR, Venditti E, Jakicic JM, et al. Lifestyle intervention in overweight individuals with a family history of diabetes. Diabetes Care. 1998;21(3):350-9.
Less than 3 months followup

426. Winkleby MA, Taylor CB, Jatulis D, et al. The long-term effects of a cardiovascular disease prevention trial: the Stanford Five-City Project. Am J Public Health. 1996;86(12):1773-9.
Less than 3 months followup

427. Wold B, Anderssen N. Health promotion aspects of family and peer influences on sport participation. Int J Sport Psychol. 1992;23:343-59.
Fewer than 75 subjects total

428. Wood E, Olmstead C, Craig J. An evaluation of lifestyle risk factors and absenteeism after two years in a worksite health promotion program. Am J Health Promot. 1989;4:128-33.
Less than 3 months followup

429. Woods C, Mutrie N, Scott M. Physical activity intervention: a transtheoretical model-based intervention designed to help sedentary young adults become active. Health Educ Res. 2002;17(4):451-60.
Less than 3 months followup

430. Woollard J, Beilin L, Lord T, et al. A controlled trial of nurse counselling on lifestyle change for hypertensives treated in general practice: preliminary results. Clin Exp Pharmacol Physiol. 1995;22(6-7):466-8.
No physical activity or fitness outcome

431. Writing Group of the PCRG. Effects of Comprehensive Lifestyle Modification on Blood Pressure Control: Main Results of the PREMIER Clinical Trial. JAMA. 2003;289(16):2083-93.

432. Yanek LR, Becker DM, Moy TF, et al. Project Joy: faith based cardiovascular health promotion for African American women. Public Health Rep. 2001;116 Suppl 1:68-81.
Less than 3 months followup

433. Yarvote PM, McDonagh TJ, Goldman ME, et al. Organization and evaluation of a physical fitness program in industry. J Occup Med. 1974;16(9):589-98.
Less than 3 months followup

434. Young DR, Appel LJ, Jee S, et al. The effects of aerobic exercise and T'ai Chi on blood pressure in older people: results of a randomized trial. J Am Geriatr Soc. 1999;47(3):277-84.
Fewer than 75 subjects total

435. Young DR, Haskell WL, Taylor CB, et al. Effect of community health education on physical activity knowledge, attitudes, and behavior. The Stanford Five-City Project. Am J Epidemiol. 1996;144(3):264-74.
Less than 3 months followup

436. Young DR, King AC, Sheehan M, et al. Stage of motivational readiness: predictive ability for exercise behavior. Am J Health Behav. 2002;26(5):331-41.
Less than 3 months followup

437. Zakarian JM, Hovell MF, Hofstetter CR, et al. Correlates of vigorous exercise in a predominantly low SES and minority high school population. Prev Med. 1994;23(3):314-21.
No physical activity intervention

438. Zoltick J, Karch R, Newton D, et al. Health promotion in a military/corporate setting. Med Sci Sports Exerc. 1990;22:S44 (abstract).
Abstract only

Listing of Excluded Studies—Cancer Population

(reason for exclusion is provided in italics following each reference)

1. Astrup A. Physical activity and weight gain and fat distribution changes with menopause: current evidence and research issues. Medicine & Science in Sports & Exercise. 1999;31(11 Suppl):564-7.
   not an exercise intervention

2. Baldwin MK, Courenya K. Exercise and Self-Esteem in Breast Cancer Survivors: An Application of the Exercise and Self-Esteem Model. Journal of Sport & Exercise Psychology. 1997;19:347-58.
   not an exercise intervention

3. Beger HG, Schwarz A, Bergmann U. Progress in gastrointestinal tract surgery: the impact of gastrointestinal endoscopy. Surgical Endoscopy. 2003;17(2):342-50.
   not an exercise intervention

4. Bensenor IM, Cook NR, Lee IM, et al. Active and passive smoking and risk of colds in women. Annals of Epidemiology. 2001;11(4):225-31.
   not an exercise intervention

5. Berger K, Ajani UA, Kase CS, et al. Light-to-moderate alcohol consumption and risk of stroke among U.S. male physicians. New England Journal of Medicine. 1999;18(341):1557-64.
   not an exercise intervention

6. Blanchard CM, Courneya KS, Laing D. Effects of acute exercise on state anxiety in breast cancer survivors. Oncology Nursing Forum. 2001; 28(10):1617-21.
   not an exercise intervention / examined effect of an acute bout of exercise

7. Bremer BA, Moore CT, Bourbon BM, et al. Perceptions of control, physical exercise, and psychological adjustment to breast cancer in South African women. Annals of Behavioral Medicine. 1997;19(1):51-60.
   not an exercise intervention

8. Brown JK. Nutrition and Physical Activity During and After Cancer Treatment: An American Cancer Society Guide for Informed Choices. CA Cancer J Clin. 2003;53:268-91.
   review

9. Caan BJ, Flatt SW, Rock CL, et al. Low-energy reporting in women at risk for breast cancer recurrence. Women's Healthy Eating and Living Group. Cancer Epidemiology, Biomarkers & Prevention. 2000;9(10):1091-7.
   not an exercise intervention

10. Cerulli J, Malone M. Outcomes of pharmacological and surgical treatment for obesity. Pharmacoeconomics. 1998;14(3):269-83.
    review

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Table 1. Selected intervention characteristics (Number of interventions or studies and percent)

	Intervention Characteristic	Interventions N (%)	Studies N (%)
Site of intervention:	Health care setting	24 (33%)	14 (30%)
	Home	12 (17%)	7 (15%)
	Community	17 (24%)	12 (26%)
	School	8 (11%)	7 (15%)
	Worksite	20 (28%)	13 (28%)
	Government institution	2 (3%)	2 (4%)
	Child care	1 (1%)	1 (2%)
	Religious institution	1 (1%)	1 (2%)
	Exercise center	7 (10%)	4 (9%)
Additional components:	Diet	10 (14%)	6 (13%)
	Smoking cessation and diet	29 (40%)	19 (40%)
Physical activity mode:	Aerobic	22 (31%)	17 (36%)
	Aerobic and non-aerobic	8 (11%)	7 (15%)
	Not specified	42 (58%)	23 (49%)
Exercise level	Moderate	20 (28%)	16 (34%)
	Vigorous	4 (6%)	3 (6%)
	Not clearly specified	48 (67%)	28 (60%)
Intervention mode	Mail	31 (43%)	20 (43%)
	In person	54 (75%)	36 (77%)
	Telephone	12 (17%)	8 (17%)
	Mass media	1 (1%)	1 (2%)
	Unspecified	3 (4%)	3 (6%)
Theoretical constructs:	Education on the benefits of exercise	48 (67%)	33 (70%)
	Written and/or verbal feedback and/or encouragement	33 (46%)	23 (49%)
	Benefits and barriers	31 (43%)	21 (45%)
	Self-monitoring	28 (39%)	20 (43%)
	Goal setting	26 (36%)	19 (40%)
	Problem solving	19 (26%)	17 (36%)
	Education on normal response to exercise	19 (26%)	14 (30%)
	Social support	18 (25%)	14 (30%)
	Incentives and contracts	14 (19%)	12 (26%)
	Education on where and/or how to exercise	13 (18%)	11 (23%)
	Skill building	12 (17%)	9 (19%)
	Relapse prevention	12 (17%)	9 (19%)
	Self efficacy	9 (13%)	9 (19%)
	Modeling	4(6%)	4 (9%)
	Provision of equipment	4 (6%)	4 (9%)
	Self-reinforcement	4 (6%)	3 (6%)
	Decisional balance/outcome expectancies	2 (3%)	2 (4%)
	Social advocacy/marketing	2 (3%)	2 (4%)
	Self-talk strategies	2 (3%)	2 (4%)
	Awareness of abstinence violation effect	2 (3%)	1 (2%)
	Stimulus control	2 (3%)	1 (2%)
	Capacity building	1 (1%)	1 (2%)
	Assessment of motivation and confidence	1 (1%)	1 (2%)
	Maintenance strategies	1 (1%)	1 (2%)
	Resuming exercise safely after time off	1 (1%)	1 (2%)
	Injury concerns	1 (1%)	1 (2%)
	Self-evaluation	1 (1%)	1 (2%)
	Not specified	14 (19%)	10 (21%)

Table 1. Selected intervention characteristics (Number of interventions or studies and percent) (continued)

	Intervention Characteristic	Interventions N (%)	Studies N (%)
Tailoring of intervention:	None	36 (50%)	20 (43%)
	Stage of change	17 (24%)	12 (26%)
	Risk factor status	10 (14%)	7 (15%)
	Individualized counseling	9 (13%)	8 (17%)
	Fitness level or exercise preference	8 (11%)	5 (11%)
	Language	2 (3%)	2 (4%)
	Other psychological variables	2 (3%)	2 (4%)
	Disability status	1 (1%)	1 (2%)
	Enthusiasm	1 (1%)	1 (2%)
	Health	1 (1%)	1 (2%)
	Reading level	1 (1%)	1 (2%)
	Schedule/time preference	1 (1%)	1 (2%)
Theory used:	None	37 (51%)	23 (49%)
	Transtheoretical model	21 (29%)	13 (28%)
	Social learning theory	7 (10%)	6 (13%)
	Motivational interviewing	5 (7%)	2 (4%)
	Social cognitive theory	4 (6%)	3 (6%)
	Health belief model	2 (3%)	2 (4%)
	Relapse prevention model	2 (3%)	2 (4%)
	Precaution adoption process model	2 (3%)	1 (2%)
	Behavior change theory	1 (1%)	1 (2%)
	Diffusion of innovation theory	1 (1%)	1 (2%)
	Kanfer's model of self-control & self-change model	1 (1%)	1 (2%)

Table 2. Measures of intensity of the most intensive intervention in each of 47 studies

Number of Subject Contacts Over Intervention Period	Median = 4 (range 1 to >200)
Total length of intervention	
Less than 2 weeks	15 (32%)
2+ weeks to 6 months	20 (43%)
6 months to 3 years	9 (19%)
Over 3 years or more	3 (6%)
Overall intensity*	
1	10 (21%)
2	18 (38%)
3	15 (32%)
4	4 (9%)

* Studies in which there was no in-person contact were scored as "1". If there was in-person contact, but less than a total of eight times, and the study was less than two years long, it was scored as a "2". Studies that had ten or more in-person contacts and/or were large community trials that had a number of environmental and media changes and lasted five to seven years (such as Minnesota Heart Health Project,[49] Pawtucket,[50] and UK Heart Disease Prevention Project[51]) were scored as "3". The remaining studies, one of which met four times weekly for four months and three of which had in-person contact three to five times weekly from one to three years were scored as a "4".

Table 3. Percent of different outcome types found in included studies

	Percent of All Outcome Measures (n)	Percent of Studies with Outcome Type (n)
Daily activities	1.0% (1)	2.1% (1)
Exercise sessions	23.2% (23)	36.2% (17)
Fitness activities	1.0% (1)	2.1% (1)
Fitness	15.2% (15)	21.3% (10)
Leisure activity	13.1% (13)	19.1% (9)
Moderate activity	3.0% (3)	6.4% (3)
Other	4.0% (4)	8.5% (4)
Total activity	19.2% (19)	38.3% (18)
Vigorous activity	8.1% (8)	12.8% (6)
Walking	12.1% (12)	14.9% (7)

Table 4. Percent of outcomes, interventions, and studies that were statistically significant

	Statistically Significant Positive Effect
Studies	44.7% (21/47)
Interventions	31.9% (23/72)
Outcomes	22.3% (37/166)
Outcome Group	
Total activity group	8.3% (3/36)
Vigorous activity group	22.9% (19/83)
Moderate activity group	33.3% (15/45)
Other activity group	0% (0/2)

Table 5. Percent of individual outcomes that were statistically significant by outcome group

	Statistically Significant Positive Effect
Outcome Group	
Total activity group	13% (3/23)
Vigorous activity group	28% (14/50)
Moderate activity group	48% (12/25)[†]
Other activity group	0% (0/1)

[†] p=.008 versus Total activity group. Other two-way tests between Outcome groups not statistically significant.

Table 6. Statistically significant positive effects by setting of intervention delivery

	Healthcare	Home	Community	School	Worksite	Government	Other†
Study	(5/14) 35.7%	(2/7) 28.6%	(4/12) 33.3%	(4/7) 57.1%	(4/13) 30.8%	(2/2) 100%	(3/6) 50.0%
Intervention	(4/24) 16.7%	(2/12) 16.7%	(4/17) 23.5%	(5/8) 62.5%	(6/20) 30.0%	(2/2) 100%	(3/9) 33.3%
Outcome	(8/54) 14.8%	(2/22) 9.1%	(5/38) 13.2%	(10/39) 25.6%	(8/36) 22.2%	(2/3) 66.7%	(5/19) 26.3%

†children's center, exercise facility, and religious institution

Table 7. Hypothesized mediators (H), whether they were intervened on (I), measured (M), and results found

Study	Hypothesized Mediators	Effect of Intervention on Mediator
Bull & Jamrozik, 1998[113] Bull et al., 1999[57]	Barriers to exercise **H, I, M**	Although reported as measured, no results given
Miller et al., 2002[78]	Self-efficacy **H, I, M** Partner support **H, I, M**	Non-significant but positive effect on self-efficacy in the print plus community development intervention (compared to control or print alone) **Attenuation of overall effect seen when partner support and self-efficacy were added to the model suggesting they may be acting as mediators**
Bock et al., 2001[114] Marcus et al., 1998[73]	Self-efficacy **H, I, M** Decisional balance (benefits and barriers combo) **H, I, M** Benefits (pros) **H, I, M** Barriers (cons) **H, I, M** Cognitive processes **H, I, M** Behavioral processes **H, I, M** Mood depression (CES-D) **H, I, M** Mood positive and negative affect (PANAS) **H, I, M**	No statistically significant changes in mediators
Blalock et al., 2000[76]	Self-efficacy **H, I** Barriers to change **H, I**	Mediators not measured
Caserta & Gillett, 1998[115] Gillett et al., 1996[63] Gillett & Caserta, 1996[79]	Perceived importance of exercising with peers **H, I, M** Structural features of exercise programs **H, I, M** Experience of companionship and support during exercise **H, I, M** Perceived benefits of exercise **H, I, M**	No difference at 18 months in perceived importance of exercise, peer group factors, and companionship and support.
Godin et al., 1987[116]	Intention to exercise **H, I, M**	Greater intention to exercise at three months in the group that received physical fitness evaluation and health hazard appraisal compared with control. No differences in the groups that received only the physical fitness evaluation or health hazard appraisal.
Graham-Clarke & Oldenburg, 1994[117]	Intention to change **H, I, M**	No difference in progression of "intention to change" at 12 months between groups
Edmundson et al., 1996[118] Luepker et al., 1996[53] Nader et al., 1999[52] Perry et al., 1997[119] Simmons-Morton et al., 1997[120] Stone et al., 1996[121] Nader et al., 1996[122] McKenzie et al., 2001[123] McKenzie et al., 1996[124] McKenzie et al., 1994[125] Hearn, 1992[126]	Knowledge **H, I** Self-efficacy **H, I, M** Perceived social reinforcement and support **H, I, M** Intentions **H, I**	No statistically significant difference between control and intervention groups in perceived physical activity positive support, perceived physical activity negative support, and physical activity self-efficacy at end of trial)

Table 7. Hypothesized mediators (H), whether they were intervened on (I), measured (M), and results found (continued)

Study	Hypothesized Mediators	Effect of Intervention on Mediator
McKenzie et al., 1995[127]		
Mutrie et al., 2002[70]	Processes of change **H, I, M**	No change in mediators
Nader et al., 1986[128] Nader et al., 1989[129]	Family structure **H** Demographics **H** Family adaptability and cohesion **H, I, M** Perceived social support **H, I, M** Acculuration **H**	No results for family structure, demographics, family adaptability and cohesion, perceived social support and acculuration reported although it appears they were measured
Owen et al., 1987[77]	Self-efficacy for exercise **H, I**	Not reported by intervention group

Table 8. Study outcomes by intensity score of most intensive intervention in study

Intensity Score	Statistically Significant Study
1	4 (40.0%)
2	8 (44.4%)
3	5 (33.3%)
4	4 (100.0%)

Table 9. Statistically significant positive effects by whether intervention was theory based

	No Theory Used	Theory Used
Study	(13/23) 56.5%	(8/24) 33.3%
Intervention	(16/36) 44.4%	(7/36) 19.4%[†]
Outcome	(30/108) 27.8%	(7/58) 12.1%[†]

[†]p=.02

Table 10. Percent of studies theory based by intensity level of the study

Intensity Level	Percent Theory Based
1 (lowest)	70% (7/10)
2	50% (9/18)
3	47% (7/15)
4	25% (1/4)

Chi-Square not statistically significant

Table 11. Percent (n) statistically significant studies by length of followup
First followup ≥3 months

Time of Measurement	Statistically Significant Study	
	No	Yes
≥3 months and <6 months	(7) 53.8%	(6) 46.2%
≥6 months but <12 months	(9) 52.9%	(8) 47.1%
≥12 months	(10) 58.8%	(7) 41.2%

Table 12. Quality criteria met by studies

Study	Description		Sampling			Measurement					Analysis					Results		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Hillsdon et al., 2002[97]	✓		✓	✓		✓			✓		✓	✓					✓	✓
Bull & Jamrozik, 1998[113] Bull et al., 1999a[57]		✓	✓			✓					✓	✓					✓	✓
Miller et al., 2002[78]	✓	✓	✓	✓	✓						✓	✓				✓	✓	✓
Hilton et al., 1999[130] Steptoe et al., 1999[58] Steptoe et al., 2000[75] Steptoe et al., 2001[131]	✓	✓				✓			✓	✓	✓	✓	✓		✓		✓	✓
Halbert et al., 1999[132] Halbert et al., 2000[59]	✓	✓							✓	✓	✓	✓				✓	✓	✓
Kreuter et al., 2000[133] Bull et al., 1999b[134]				✓		✓					✓	✓			✓			✓
Harland et al., 1999[135]	✓		✓			✓					✓	✓	✓			✓	✓	✓
Kerse et al., 1999[60]			✓			✓					✓	✓	✓		✓	✓	✓	✓
Burke et al., 1998[65]											✓	✓	✓		✓		✓	✓
Eckstrom et al., 1999[136]				✓	✓						✓	✓	✓		✓		✓	✓
Bauer et al., 1985[51] Rose, 1970[137] Rose et al., 1980[138]				✓							✓	✓					✓	
Gomel et al., 1993[139] Gomel et al., 1997[140]	✓			✓							✓	✓	✓		✓	✓	✓	✓
Carlaw et al., 1984[141] Jacobs et al., 1986[142] Luepker et al., 1985[143] Luepker et al., 1994[49] Mittelmark et al., 1986[144]						✓	✓	✓			✓	✓	✓		✓		✓	✓
Bock et al., 2001[114] Marcus et al., 1998[73]									✓	✓	✓	✓					✓	
Belisle et al., 1987[74]		✓				✓					✓	✓	✓		✓		✓	✓
Belisle et al., 1987[74]		✓				✓					✓	✓	✓		✓		✓	✓
Blalock et al., 2000[76]			✓								✓	✓	✓		✓			✓
Caserta & Gillett, 1998[115] Gillett et al., 1996[63] Gillett & Caserta, 1996[79]						✓			✓	✓	✓	✓	✓				✓	✓

Table 12. Quality criteria met by studies (continued)

Study	Description		Sampling			Measurement					Analysis					Results		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Chen et al., 1998[145]	✓					✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
Dale et al., 1998[146] Dale & Corbin, 2000[66]				✓					✓	✓	✓	✓						
Edye et al., 1989[147]				✓		✓			✓	✓	✓	✓					✓	
Elder et al., 1995[148] Elder et al., 1994[149]	✓					✓	✓	✓		✓	✓	✓	✓				✓	✓
Gemson & Sloan, 1995[68]											✓		✓				✓	✓
Godin et al., 1987[116]										✓	✓	✓	✓					
Graham-Clarke & Oldenburg, 1994[117]									✓	✓	✓	✓						✓
Green et al., 2002[61]	✓	✓			✓	✓			✓	✓	✓	✓	✓			✓	✓	✓
Howard et al., 1996[56]				✓							✓	✓						
Keyserling et al., 2002[150]	✓					✓			✓	✓	✓	✓	✓			✓	✓	✓
Knutsen & Knutsen, 1989[151] Knutsen & Knutsen, 1990[152] Knutsen & Knutsen, 1991[153] Thelle et al., 1976[154]			✓	✓	✓					✓	✓	✓				✓		✓
Kreuter & Strecher, 1996[155]	✓			✓							✓	✓	✓			✓	✓	
Linenger et al., 1991[71]									✓	✓	✓	✓	✓				✓	
Lombard et al., 1995[69]		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓				✓	✓
Lovibond et al., 1986[156]									✓	✓	✓	✓	✓			✓		✓
Edmundson et al., 1996[118] Luepker et al., 1996[53] Nader et al., 1999[52] Perry et al., 1997[119] Simons-Morton et al., 1997[120] Stone et al., 1996[121] Nader et al.,[122] McKenzie et al., 2001[123] McKenzie et al., 1996[124] McKenzie et al., 1994[125] Hearn, 1992[126] McKenzie et al., 1995[127]	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MacKeen et al., 1985[157] Remington et al., 1978[158] Taylor et al., 1973[159]					✓				✓	✓	✓	✓					✓	✓

Table 12. Quality criteria met by studies (continued)

Study	Description		Sampling			Measurement					Analysis					Results		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Mutrie et al., 2002[70]				✓					✓	✓	✓	✓	✓					
Nader et al., 1986[128] Nader et al., 1989[129]						✓			✓	✓	✓	✓	✓			✓	✓	✓
O'Loughlin et al., 1996[67]						✓			✓	✓	✓	✓	✓				✓	✓
Ostwald, 1989[160]				✓							✓	✓				✓	✓	
Owen et al., 1987[161]		✓				✓					✓							
Owen et al., 1987[77]						✓					✓	✓	✓			✓	✓	✓
Kriska et al., 1986[162] Pereira et al., 1998[64]						✓			✓	✓	✓	✓	✓			✓	✓	✓
Perkio-Makela, 1999[72]						✓			✓	✓	✓	✓				✓	✓	
Sherman et al., 1989[163]											✓	✓				✓	✓	
Smith et al., 2000[164]						✓			✓	✓	✓	✓				✓		✓
Stevens et al., 1998[62]			✓	✓		✓					✓	✓					✓	
Carleton et al., 1987[165] Carleton et al., 1995[166] Eaton et al., 1999[50] Marcus et al., 1992[167] Levin et al., 1998[168] McGraw et al., 1989[169]		✓			✓	✓				✓	✓	✓			✓		✓	✓

Quality Measures

Description

1. Was the study sample well described?
2. Was the intervention well described (what, how, who, where)?

Sampling

3. Did the authors specify the sampling frame or universe of selection for the study sample?
4. Was the sample that served as the unit of analysis the entire eligible sample or a probability sample at the point of reference?
5. Are there other selection bias issues not otherwise addressed? [note: Check in table for "no"]

Measurement

6. Did the authors attempt to measure exposure to the intervention?
7. Was the exposure variable valid?
8. Was the exposure variable reliable (consistent and reproducible)?
9. Were the outcome and other independent (or predictor) variables valid?
10. Were the outcome and other independent (or predictor) variables reliable (consistent and reproducible)?

Table 12. Quality criteria met by studies (continued)

Analysis

Did the authors conduct appropriate statistical testing by:

11. conducting statistical testing (when appropriate)?
12. reporting which statistical tests were used?
13. controlling for repeated measures in samples that were followed over time?
14. controlling for differential exposure to the intervention?
15. using a model designed to handle multi-level data when they included group-level and individual covariates in the model?

Results

16. Did at least 80 percent of enrolled participants complete the study?
17. Did the authors assess if the units of analysis were comparable prior to exposure to the intervention?
18. Did the authors institute study procedures to limit bias appropriately (e.g. randomization, restriction, matching, stratification or statistical adjustment)?

Table 13. Percent of studies meeting individual quality criteria

	Percent of Studies Meeting Criterion
Description	
Was the study sample well described?	26%
Was the intervention well described (what, how, who, where)?	23%
Sampling	
Did the authors specify the sampling frame or universe of selection for the study sample?	19%
Was the sample that served as the unit of analysis the entire eligible sample or a probability sample at the point of reference?	32%
Are there other selection bias issues not otherwise addressed?	13%
Measurement	
Did the authors attempt to measure exposure to the intervention?	55%
Was the exposure variable valid?	11%
Was the exposure variable reliable (consistent and reproducible)?	11%
Were the outcome and other independent (or predictor) variables valid?	47%
Were the outcome and other independent (or predictor) variables reliable (consistent and reproducible)?	53%
Analysis	
Did the authors conduct appropriate statistical testing by conducting statistical testing (when appropriate)?	100%
Did the authors conduct appropriate statistical testing by reporting which statistical tests were used?	96%
Did the authors conduct appropriate statistical testing by controlling for repeated measures in samples that were followed over time?	55%
Did the authors conduct appropriate statistical testing by controlling for differential exposure to the intervention?	2%
Did the authors conduct appropriate statistical testing by using a model designed to handle multi-level data when they included group-level and individual covariates in the model?	26%
Results	
Did at least 80 percent of enrolled participants complete the study?	40%
Did the authors assess if the units of analysis were comparable prior to exposure to the intervention?	77%
Did the authors institute study procedures to limit bias appropriately (e.g. randomization, restriction, matching, stratification or statistical adjustment)?	70%

Table 14. Quality of studies with random treatment assignment at the individual level using criteria of Chalmers et. al.[80]

Author/Year	Method of Treatment Assignment	Control of Selection Bias After Treatment Assignment	Blinding of Participants and Investigators
Hillsdon et al., 2002[97]	2	0	1
Halbert et al., 2000[59]	2	2	1
Kreuter et al., 2000[133]	1	0	1
Harland et al., 1999[135]	2	1	1
Marcus et al., 1998[73]	1	0	1
Blalock et al., 2000[76]	1	0	1
Caserta & Gillett, 1998[115]	1	1	1
Chen et al., 1998[145]	1	0	1
Edye et al., 1989[147]	1	0	1
Elder et al., 1995[148]	1	0	1
Gemson & Sloan, 1995[68]	1	0	1
Godin et al., 1987[116]	1	0	1
Green et al., 2000[61]	1	0	1
Keyserling et al., 2002[150]	2	0	1
Knutsen & Knutsen, 1991[153]	1	0	1
Kreuter et al., 2000[133]	1	1	1
Lombard et al., 1995[69]	1	0	1
Lovibond et al., 1986[156]	1	0	1
MacKeen et al., 1985[157]	1	0	1
Mutrie et al., 2002[70]	3	0	1
Ostwald, 1989[160]	1	0	1
Pereira et al., 1998[64]	1	1	1
Stevens et al., 1998[62]	1	0	1

Table 15. Description of the interventions

Characteristic of Study or Intervention		Percent of Studies with this Characteristic or Mean Value
Timing	During treatment	54%
	Post treatment	46%
Framework PEACE category	Buffering	4%
	Coping	50%
	Rehabilitation	42%
	Health promotion	21%
	Survival	4%
	Palliation	0%
	Multiple categories in one study	21%
Sample size	Average sample size per control group	22.3 (mean) 4-98 (range)
	Average sample size per intervention group	23 (mean) 6-101 (range)
Cancer diagnoses included	Breast	83%
	Colon	4%
	Lung	13%
	Ovarian	8%
	Leukemia	8%
	Lymphoma	13%
	Testicular	4%
	Sarcoma	17%
	Stomach	4%
	Prostate	4%
	Other	21%
Behavioral intervention	Yes	25%
	No	75%
Study design	Randomized Controlled Trial (RCT)	83%
	Non-randomized	17%
Exercise only (versus exercise plus other intervention components)		79%
Intervention length	One month or less	8%
	5 weeks to 3 months	71%
	More than 3 months	4%
	Not clear/reported	17%
Exercise mode	Aerobic (alone or combined with other modes)	88%
	Only non aerobic	8%
	Not specified	4%
Exercise intensity	Light	4%
	Moderate to vigorous	83%
	Not specified	12.5%
Exercise frequency	3+ times per week	88%
	Less than 3 times per week	8%
	Not specified	4%
Exercise duration	40+ minutes per session	13%
	Less than 40 minutes per session	58%
	Not specified	29%
Percent lost at followup	All studies	10.8%
	During treatment	10.28%
	Post treatment	11.46%

Table 16. Outcomes reported in cancer and physical activity interventions in cancer survivors

Outcome Category	Construct Assessed	Number of Studies	Number of Measurement Tools
Physical activity behavior	Physical activity behavior	6	4
Physical fitness	Cardiovascular fitness	12	5
	Strength	2	2
	Flexibility	2	1
Fatigue/tiredness	Fatigue/tiredness	12	6
Mental/emotional/psychological well-being	Anxiety/worry/tension	10	8
	Depression	10	7
	Anger/hostility	3	3
	Mental health QOL	2	1
	Multiple constructs ¥	9	11
Other psychosocial outcomes	Happiness/hope	2	2
	Social functioning	2	1
	Multiple other constructs*	5	5
Body image/dissatisfaction	Body image/dissatisfaction	4	4
Quality of life	Quality of life	10	8
Confusion	Confusion	2	2
Difficulty sleeping	Difficulty sleeping	2	1
Self-esteem	Self-esteem	3	2
Physiologic outcomes	Multiple constructs	5	23
Body size	Fatness measures (%, absolute, waist circumference, skinfolds)	5	2
	Body weight or BMI	8	1
	Other (arm volume, arm muscle area, lean body weight)	3	3
Pain	Pain	3	2
Vigor/vitality	Vigor/vitality	6	3
Symptoms/side effects	Multiple constructs**	5	3
Immune parameters	Multiple constructs***	4	18

¥ Including: Avoidance, fatalistic, fighting spirit, hopelessness, emotional well-being, total mood disturbance, impact of medical illness on subject, psychologic distress

* Including: Cognitive functioning, role limitations, activities in the community, activities in the home, change of lifestyle, satisfaction about information given, sick leave, work status, communication with staff, satisfaction with life, and power

** Including: Aversions, mixed symptoms, mucous membrane disturbances, sexual problems, surgery effects, breast cancer subscale, somatization, severity of diarrhea, severity of infection, severity of mucositis, severity of pain, nausea, vomiting

*** Including: Duration of neutropenia, duration of thrombopenia, T-cells, lymphocytes, white blood cells, natural killer cells, mononuclear cells, neutrophils, leukocytes

Table 17. Instruments used

Outcome Category	References
Physical Activity Behavior	
Godin Leisure-Time Exercise Questionnaire	Godin et al., 1986[170] Godin & Shepard, 1985[171]
Exercise Level Rating Scale	Mock et al. 1994[99] Mock, et al. 1997[94]
Self-report Diary	Mock et al. 2001[95] Pickett et al. 2002[96] Segal et al., 2001[87]
Cardiorespiratory Fitness, Strength, and Flexibility	
Balke Treadmill Test	American College of Sports Medicine, 2000[172]
Cycle ergometer test with metabolic measurements and ECG and/or heart rate measures	MacVicar et al., 1989[88] Bhambhani and Singh, 1985[173] Courneya et al., 2003[90] MacVicar et al., 1986[112]
12 Minute Walk Test	McGavin et al., 1976[174]
6 Minute Walk Distance	Nieman et al., 1995[103]
Modified Canadian Aerobic Fitness Test (mCAFT)	Jette et al., 1994[175]
Standard Load Test	Invergo et al., 1991[176]
Kin Com computerized testing station	Nieman et al., 1995[103]
Sit and Reach	Baumgartner & Jackson, 1995[177]
Fatigue / Tiredness	
Unknown Scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
Linear Analog Self-Assessment Measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al., 1988[178]
Functional Assessment of Cancer Therapy-Fatigue (FACT-F)	Yellen et al., 1997[179]
Profile of Mood Status measure (POMS)	Shacham, 1983[180] CIPS, 1981[181] McNair et al., 1971[182]
Personal interview	Dimeo et al., 1997[102]
Piper Fatigue Scale	Piper et al., 1998[183]
Body image / Dissatisfaction	
Unknown scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
Linear Analog Self-Assessment Measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al., 1988[178]
Body Image Visual Analogue Scale (BIVAS)	Mock, 1988[184] Mock, 1993[185]
Physical Self Subscale of the Tennessee Self-Concept Scale (TSCS)	Roid & Fitts, 1988[186]
Quality of Life	
Unknown scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
QOL Index for Cancer Patients	Padilla et al., 1983[187]
Functional Assessment of Cancer Therapy-General FACT-G scale	Cella et al., 1993[188]
Functional Assessment of Cancer Therapy-Breast FACT-B scale	Brady et al., 1997[189]
FACT-B Breast cancer subscale	Brady et al., 1997[189]
Medical Outcomes Trust 36-Item Short Form Survey (SF-36)	Ware et al., 1993[190] Ware & Sherbourne, 1992[191]
Karnofsky Performance Status scale (KPS)	Mor et al., 1984[192]
Functional Assessment of Cancer Therapy-Prostate (FACT-P)	Cella, 1997[193]

Table 17. Instruments used (continued)

Outcome Category	References
Confusion	
Linear Analog Self-Assessment measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al., 1988[178]
Profile of Mood Status measure (POMS)	Shacham, 1983[180] CIPS, 1981[181] McNair et al., 1971[182]
Difficulty Sleeping	
Linear Analog Self-Assessment measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al., 1988[178]
Self-Esteem	
Rosenberg Self-Esteem Scale	Rosenberg, 1995[194] Curbow & Somerfield, 1991[195]
Tennessee Self-Concept Scale (TSCS)	Roid & Fitts, 1988[186]
Psychosocial Outcomes	
Unknown scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
Happiness Measure	Fordyce, 1988[196]
Functional Assessment of Cancer Therapy-Breast FACT-B scale	Brady et al., 1997[189]
Satisfaction with Life Scale (SWLS)	Diener et al., 1985[197]
Functional Assessment of Cancer Therapy-General FACT-G scale	Cella et al., 1993[188]
Medical Outcomes Trust 36-Item Short Form Survey (SF-36)	Ware et al., 1993[190] Ware & Donald-Sherbourne, 1992[191]
Herth Hope Index (HHI)	Herth, 1992[198]
PKPCT VII- Semantic Differential Test	Barrett, 1987[199]
Body Size	
Body Mass Index/Body weight/ height	Measured by all studies
Body fat via Skinfolds	Durin & Womersley, 1974[200] Grant, 1979[201] Barale et al., 1981[202]
Arm fat/muscle area	Frisancho, 1981[203]
Arm volume	Farncombe et al., 1994[204]
Waist circumference	American College of Sports Medicine, 2000[172]
Pain	
Unknown scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
Medical Outcomes Trust 36-Item Short Form Survey (SF-36)	Ware et al., 1993[190] Ware & Donald-Sherbourne, 1992[191]
Vigor/Vitality	
Linear Analog Self-Assessment measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al.,[178]
Profile of Mood Status measure (POMS)	Shacham, 1983[180] CIPS, 1981[181] McNair et al., 1971[182]
Medical Outcomes Trust 36-Item Short Form Survey (SF-36)	Ware et al., 1993[190] Ware & Donald-Sherbourne, 1992[191]
Symptoms/Side-Effects	
Unknown Scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
Symptom Check List (SCL-90-R)	Derogatis, 1977[205]
Linear Analog Self-Assessment Measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al., 1988[178]

Table 17. Instruments used (continued)

Outcome Category	References
Mental /Emotional / Psychological Well-being	
Modified Hospital Anxiety and Depression (HAD) scale	Berglund et al., 1993[92] Berglund et al., 1994[93] Zigmond & Snaith, 1983[206]
Linear Analog Self-Assessment measure (LASA) or Symptom Assessment Scales (SAS)	Sutherland et al., 1988[178]
Centre for Epidemiological Studies Depression (CES-D) scale	Radloff, 1977[207]
State-Trait Anxiety Inventory (STAI)	Spielberger et al., 1970[208]
Functional Assessment of Cancer Therapy-General FACT-G scale	Cella et al., 1993[188]
Functional Assessment of Cancer Therapy-Breast FACT-B scale	Brady et al., 1997[189]
Trial Outcome Index (TOI)	Courneya et al., 2003[90] Fairey et al., 2003[100]
Mental Adjustment to Cancer Scale (MAC)	Greer & Watson, 1987[209]
Physical Symptoms Related to Breast Cancer Scale	Berglund et al., 1993[92] Berglund et al., 1994[93]
Symptom Check List (SCL-90-R)	Derogatis, 1977[205]
Profile of Mood Status measure (POMS)	Shacham, 1983[180] CIPS, 1981[181] McNair et al., 1971[182]
Medical Outcomes Trust 36-Item Short Form Survey (SF-36)	Ware et al., 1993[190] Ware & Donald-Sherbourne, 1992[191]
Psychological Adjustment to Illness Scale	Derogatis, 1986[210]
Brief Symptom Inventory	Derogatis & Spencer, 1993[211]
Beck Depression Inventory	Beck, 1972[212]

Table 18. Positive findings and statistically significant findings

Outcome Type	Positive Effect	Statistically Significant Positive Effect	Mean Effect Size	# of Studies for which Effect Size was Calculated	Effect Size Range
Physical activity behavior	3 (50%)	3 (50%)	2.93	1	Only 1 effect size
Physical fitness					
Cardiorespiratory fitness	10 (83%)	9 (75%)	0.647	6	0.00 – 1.242
Strength	2 (100%)	1 (50%)	Not calculable	0	-
Flexibility	2 (100%)	2 (100%)	0.345	2	0.024 – 0.666
Fatigue/tiredness	12 (100%)	10 (83%)	0.217	4	0.031 – 0.645
Body image/dissatisfaction	3 (75%)	1 (25%)	0.310	1 (2 outcomes from one study)	0.301 – 0.318
Quality of life	9 (90%)	8 (80%)	0.427	5	0.00 – 1.689
Confusion	2 (100%)	0 (0%)	0.402	1	Only 1 effect size
Difficulty sleeping	2 (100%)	2 (100%)	None calculable	0	-
Self-esteem	3 (100%)	1 (33%)	0.100	2	0.044 – 0.154
Psychosocial outcomes	6 (100%)	5 (83%)	0.191	3	0.00 – 0.612
Physiological outcomes	4 (80%)	4 (80%)	0.173	3	-0.475 – 0.822
Body size					
(goal to reduce)	6 (100%)	2 (33%)	0.187	3	0.015 – 0.636
(goal to gain or avoid muscle mass loss)	1 (25%)	0 (0%)	None calculable	0	-
Pain	2 (67%)	1 (33%)	None calculable	0	-
Vigor/vitality	6 (100%)	3 (50%)	0.850	2	0.434 – 1.265
Symptoms/side effects	4 (80%)	3 (60%)	0.400	2	-0.130 – 0.849
Immune parameters	4 (100%)	3 (75%)	-0.055	2	-0.799 – 1.047
Mental/emotional/ psychological well-being					
Depression	9 (90%)	4 (40%)	0.418	3	0.005 – 1.279
Anxiety	9 (90%)	6 (60%)	0.333	3	0.00 – 0.901
Anger/hostility	2 (67%)	1 (33%)	0.070	2	-0.114 – 0.266
Mental health quality of life	2 (100%)	1 (50%)	None calculable	0	-
Multiple constructs	6 (86%)	3 (43%)	0.356	4	0.00 – 0.896

Table 19. Positive effects by timing (during versus post treatment)

Outcome Type	During Treatment				Post Treatment			
	Positive	Statistically Significant	Effect Size Mean	Effect Size Range	Positive	Statistically Significant	Effect Size Mean	Effect Size Range
Physical activity behavior	2 (50%)	2 (50%)	2.93	Only 1 effect size	1 (50%)	1 (50%)	None calculable	
Physical fitness:								
Cardiorespiratory fitness	6 (85.7%)	5 (71.4%)	.781	0.319 – 1.242	4 (80%)	4 (80%)	.602	0.00 - .950
Strength	1 (100%)	1 (100%)	Not calculable		1 (100%)	0 (0%)	Not calculable	-
Flexibility	-	-	-	-	2 (100%)	2 (100%)	.345	0.024 – 0.666
Fatigue/tiredness	6 (100%)	5 (83%)	0.130	Only 1 effect size	6 (100%)	4 (67%)	0.246	0.031 – 0.645
Body image/dissatisfaction	2 (100%)	1 (50%)	0.310	0.301– 0.318	1 (50%)	0 (0%)	None Calculable	-
Quality of life	4 (100%)	3 (75%)	.662	0.168 – 1.155	6 (100%)	5 (83%)	.360	0.00 – 1.689
Confusion	1 (100%)	0 (0%)	Not calculable	-	1 (100%)	0 (0%)	0.402	Only 1 effect size
Difficulty sleeping	2 (100%)	2 (100%)	Not calculable	-	-	-	-	-
Self-esteem	1 (100%)	0 (0%)	.154	Only 1 effect size	2 (100%)	1 (50%)	0.044	Only 1 effect size
Psychosocial outcomes	2 (100%)	1 (50%)	0.446	0.280 – 0.612	4 (100%)	4 (100%)	0.093	0.00 – 0.302
Physiological outcomes	2 (67%)	2 (67%)	0.275	0.00 – 0.528	2 (100%)	2 (100%)	0.105	-0.475 – 0.822
Body size:								
(goal to reduce)	2 (100%)	1 (50%)	Not calculable	-	4 (100%)	1 (25%)	0.187	0.015 – 0.636
(goal to gain or avoid muscle loss)	0 (0%)	0 (0%)	Not calculable	-	1 (50%)	0 (0%)	1.442	1.262 – 1.642
Pain	1 (100%)	0 (0%)	Not calculable	-	1 (50%)	1 (50%)	Not calculable	-
Vigor/vitality	4 (100%)	1 (25%)	0.434	Only 1 effect size	2 (100%)	2 (100%)	1.265	Only 1 effect size
Symptoms/side effects	4 (100%)	3 (75%)	0.400	-0.130 – 0.849	0 (0%)	0 (0%)	None calculable	-
Immune parameters	3 (100%)	3 (100%)	0.543	0.442 – 0.643	1 (100%)	0 (0%)	-0.226	-0.799 – 1.047
Mental/emotional/ psychological well-being								
Depression	5 (100%)	2 (40%)	0.079	Only 1 effect size	4 (80%)	2 (40%)	0.665	0.005 – 1.279
Anxiety	3 (50%)	3 (50%)	0.216	0.154 – 0.278	3 (60%)	3 (60%)	0.451	0.00 – 0.901
Anger/hostility	2 (100%)	1 (50%)	0.165	0.063 – 0.266	0 (0%)	0 (0%)	-0.114	Only 1 effect size
Mental health QOL	-	-	-	-	2 (100%)	1 (50%)	Not calculable	-
Multiple constructs	4 (100%)	2 (50%)	0.521	0.253 – 0.896	2 (67%)	1 (33%)	0.192	0.00 – 0.375

Table 20. Quality criteria met by studies

Study	Description		Measurement		Analysis				Results		
	1	2	3	4	5	6	7	8	9	10	11
Berglund et al., 1993[92]					✓	✓	✓			✓	✓
Berglund et al., 1994[93]			✓	✓	✓	✓	✓		✓	✓	✓
Burnham and Wilcox 2002[86]					✓	✓	✓		✓	✓	✓
Chen 1999[47]					✓	✓					✓
Courneya et al., 2002[82] Courneya et al., 2003[83]		✓	✓	✓	✓	✓	✓		✓	✓	✓
Courneya et al., 2003[90] Fairey et al., 2003[100]		✓	✓	✓	✓	✓	✓		✓	✓	✓
Cunningham et al., 1986[85]		✓	✓	✓	✓	✓					✓
Dimeo et al., 1999[106]			✓	✓	✓	✓					✓
Dimeo et al., 1997[101]			✓	✓	✓	✓				✓	✓
Dimeo et al., 1997[102]		✓	✓	✓	✓	✓			✓		✓
Djuric et al., 2002[81]					✓	✓					✓
Hayes et al., 2003[104]			✓	✓	✓	✓	✓			✓	
MacVicar et al., 1989[88]			✓	✓	✓	✓	✓				✓
MacVicar et al., 1986[112]			✓	✓							
McKenzie et al., 2003[107]			✓	✓	✓	✓	✓		✓	✓	✓
Mock et al., 1994[99]			✓	✓	✓	✓					✓
Mock et al., 1997[94] Mock et al., 1998[98]	✓	✓	✓	✓	✓	✓	✓		✓		
Mock et al., 2001[95] Pickett et al., 2002[96]	✓	✓			✓	✓					✓
Na 2000[105]		✓	✓	✓	✓	✓					✓
Nieman et al., 1995[103]			✓	✓	✓	✓	✓				✓
Segal et al., 2001[87]			✓	✓	✓	✓				✓	✓
Segal et al., 2003[91]			✓	✓	✓	✓			✓	✓	✓
Segar et al., 1998[84]			✓	✓	✓	✓	✓		✓	✓	✓
Wall, 2000[213]			✓	✓	✓	✓	✓		✓		✓
Winningham et al., 1989[108]			✓	✓	✓	✓	✓		✓		✓
Winningham et al., 1988[89]			✓	✓	✓	✓	✓		✓	✓	✓

Quality Measures

Description

1. Was the study sample well described as to race/ethnicity, sociodemographics, cancer diagnosis and treatment, as well as age?
2. Was the intervention well described (what, how, who, where)?

Measurement

3. Were the outcome and other independent (or predictor) variables valid?
4. Were the outcome and other independent (or predictor) variables reliable (consistent and reproducible)?

Analysis

Did the authors conduct appropriate statistical testing by:

5. conducting statistical testing (when appropriate)?
6. reporting which statistical tests were used?
7. controlling for repeated measures in samples that were followed over time?
8. controlling for differential exposure to the intervention?

Results

9. Did at least 80 percent of enrolled participants complete the study?
10. Did the authors assess if the units of analysis were comparable prior to exposure to the intervention?
11. Did the authors institute study procedures to limit bias appropriately (e.g., randomization, restriction, matching, stratification or statistical adjustment)?

Table 21. Percent of studies meeting individual quality criteria

Quality Measures	Percent Studies Meeting Criterion
Description	
Was the study sample well described as to race/ethnicity, sociodemographics, cancer diagnosis and treatment, as well as age?	8%
Was the intervention well described (what, how, who, where)?	29%
Measurement	
Were the outcome and other independent (or predictor) variables valid?	83%
Were the outcome and other independent (or predictor) variables reliable (consistent and reproducible)?	83%
Analysis	
Did the authors conduct appropriate statistical testing by conducting statistical testing (when appropriate)?	96%
Did the authors conduct appropriate statistical testing by reporting which statistical tests were used?	96%
Did the authors conduct appropriate statistical testing by controlling for repeated measures in samples that were followed over time?	54%
Results	
Did the authors conduct appropriate statistical testing by controlling for differential exposure to the intervention?	0%
Did at least 80 percent of enrolled participants complete the study?	46%
Did the authors assess if the units of analysis were comparable prior to exposure to the intervention?	50%
Did the authors institute study procedures to limit bias appropriately (e.g., randomization, restriction, matching, stratification or statistical adjustment)?	88%

Table 22. Summary of results from the 14 studies excluded due to no concurrent comparison group

Outcome Category	Number of Studies Reference #s of Studies	Summary of Results
Physical fitness		
Cardiorespiratory fitness	10 Sharkey et al., 1993[214] Schwartz, 2000[217] Decker et al., 1989[219] Dimeo et al., 1996[220] Young-McCaughan et al., 2003[221] Schwartz et al., 2001[218] Schwartz, 1999[215] Durak & Lilly, 1998[222] Kolden et al., 2002[223] Dimeo et al., 1998[224]	9 reported improvements (the one that did not was an intervention during bone marrow transplant in acute leukemia patients)
Strength	2 Durak & Lilly, 1998[222] Kolden et al., 2002[223]	Both studies reported improvements
Flexibility	0	
Fatigue	5 Schwartz, 2000[217] Porock et al., 2000[225] Schwartz, 2000[216] Schwartz et al., 2001[218] Schwartz, 1999[215]	Consistent report of improvements
Quality of life	6 Durak & Lilly, 1998[222] Peters et al., 1994[226] Porock et al., 2000[225] Young-McCaughan et al., 2003[221] Schwartz, 1999[215]	Consistent report of improvements
Confusion	0	
Sleep	1 Young-McCaughan et al., 2003[221]	No improvement noted
Self-esteem	0	
Psychosocial outcomes	0	
Physiological outcomes		
Resting blood pressure	1 McTiernan et al., 1998[5]	No improvement noted
Sex hormones	1 McTiernan et al., 1998[5]	No improvement noted
Body size (goal to reduce weight and/or fat)	3 Schwartz, 2000[216] McTiernan et al., 1998[5] Kolden et al., 2002[223]	2 reported decreases, 1 reported no increases
Pain	1 Durak & Lilly, 1998[222]	Improvement reported
Vigor	2 Schwartz, 1999[215] Kolden et al., 2002[223]	One study reported improvement, one reported decline
Symptoms/Side effects	3 Peters et al., 1994[226] Porock et al., 2000[225] Schwartz, 2000[216]	2 reported improvements
Immune parameters	1 Peters et al., 1994[226]	Improvement noted in some but not all parameters

Table 22. Summary of results from the 14 studies excluded due to no concurrent comparison group (continued)

Outcome Category	Number of Studies Reference #s of Studies	Summary of Results
Mental/emotional/psychological well-being		
Depression	3 Porock et al., 2000[225] Decker et al., 1989[219] Kolden et al., 2002[223]	1 of 3 studies reported improvement
Anxiety	2 Porock et al., 2000[225] Kolden et al., 2002[223]	No studies reported improvements

Figure 1 Logic model

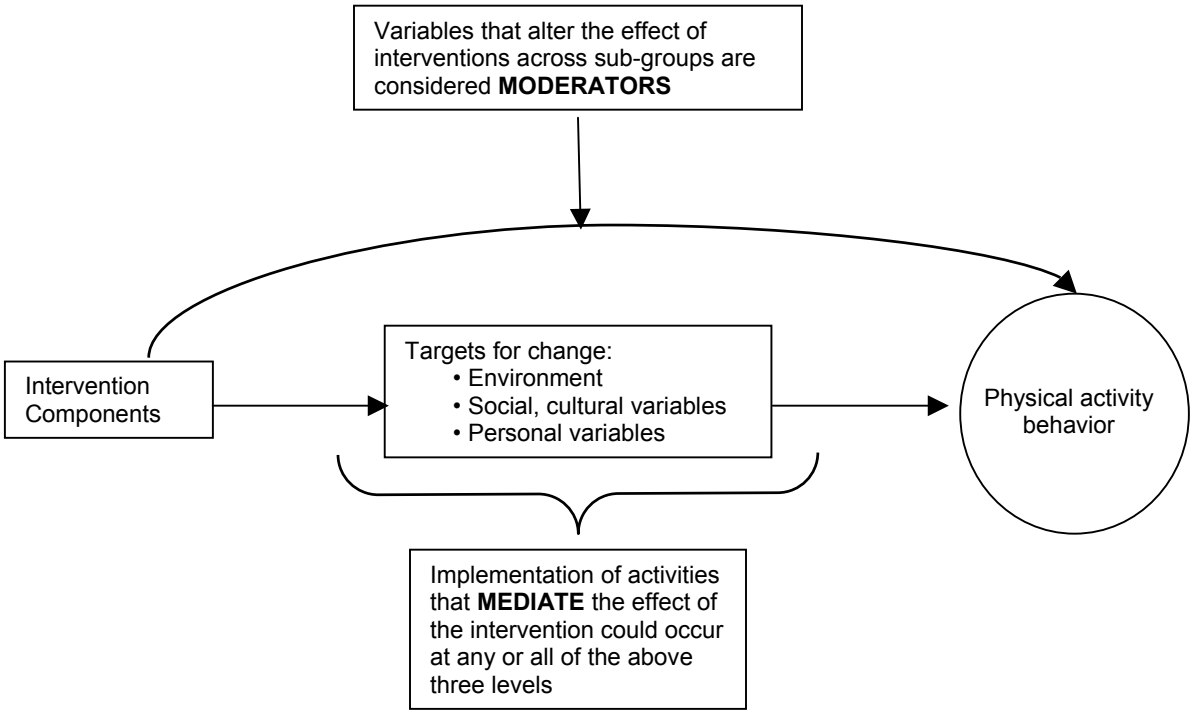
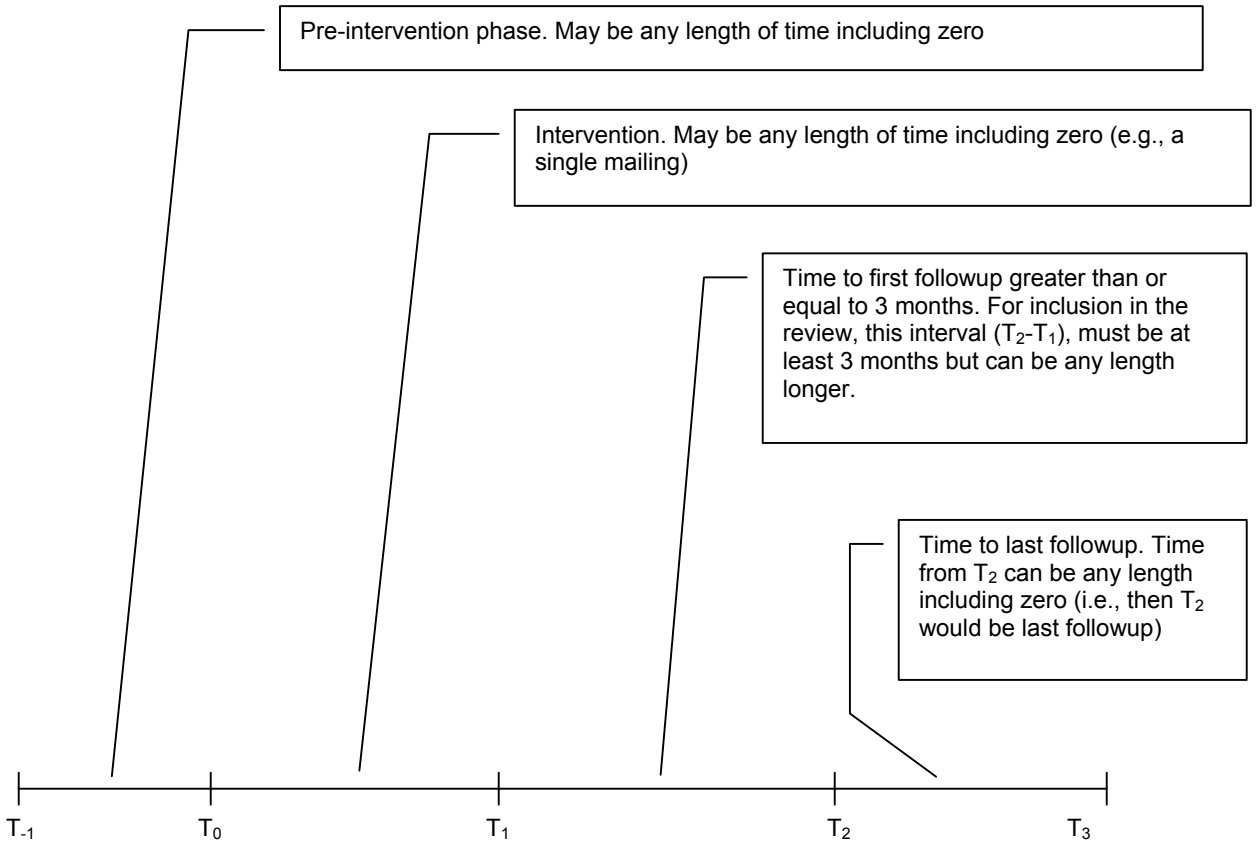


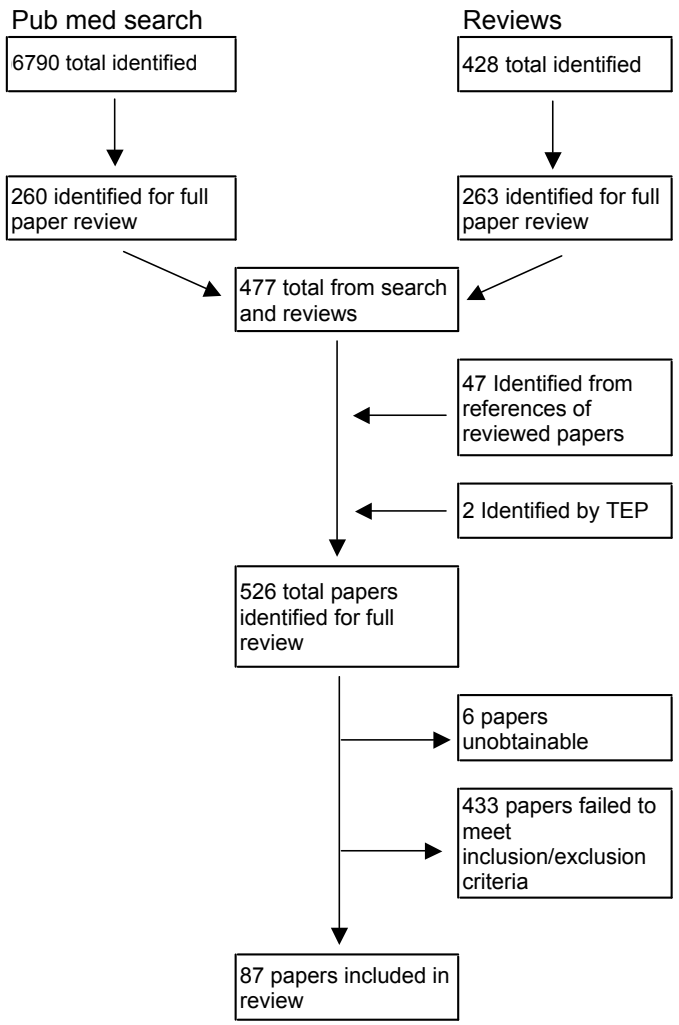
Figure 2. Definition of time points in reviewed studies



T_1-T_0: The length of time of the intervention. For the purpose of the review, the intervention is over when specific contact (except for outcomes measurement) with the subjects ends. This may or may not have been the definition of the end of the intervention by the study authors.

T_2-T_1 and T_3-T_1: These are the followup intervals. This is referred to as time to followup in the review. This may or may not have been how the individual study authors defined the time to followup.

Figure 3. Identification and disposition of references for general population



Reason for exclusion	Number	Percent
Non english language	1	0.2%
Abstract only	2	0.5%
No behavioral intervention or policy change	40	9.2%
No physical activity or fitness outcome	46	10.6%
No concurrent control group	44	10.2%
Fewer than 75 subjects total	75	17.3%
Less than 3 months between end of intervention and follow-up	219	50.6%
Targeted subjects with acute disease	2	0.5%
Targeted subjects with vascular disease	2	0.5%
Targeted subjects with osteoarthritis	2	0.5%

Figure 4. Time between end of intervention and last followup

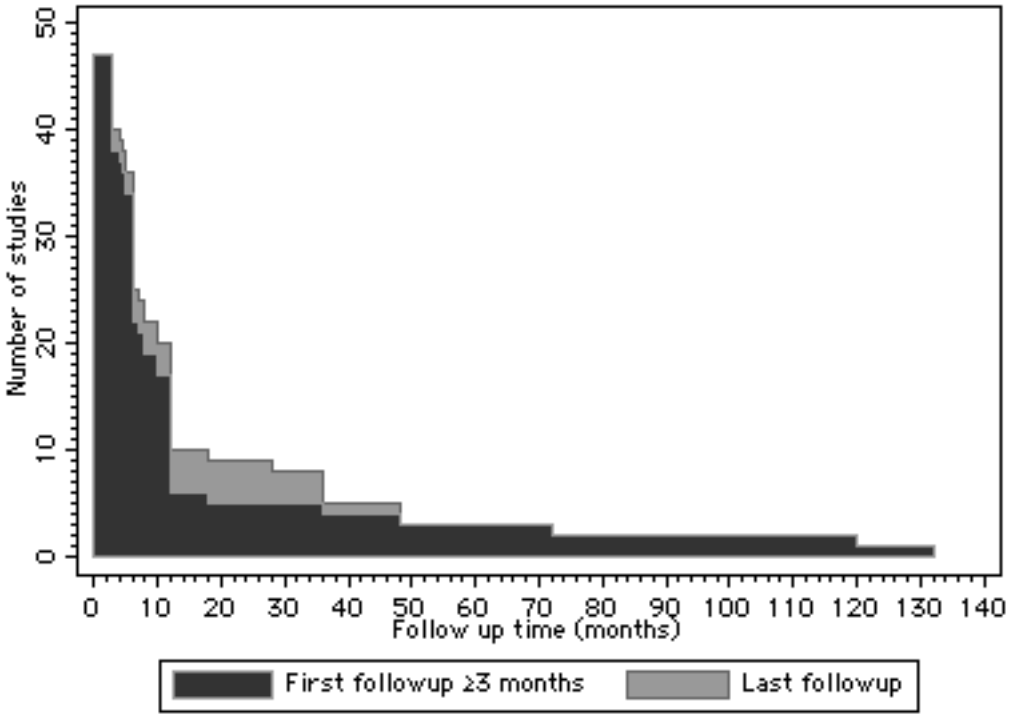


Figure 5. Effect size at last followup within each level of analysis

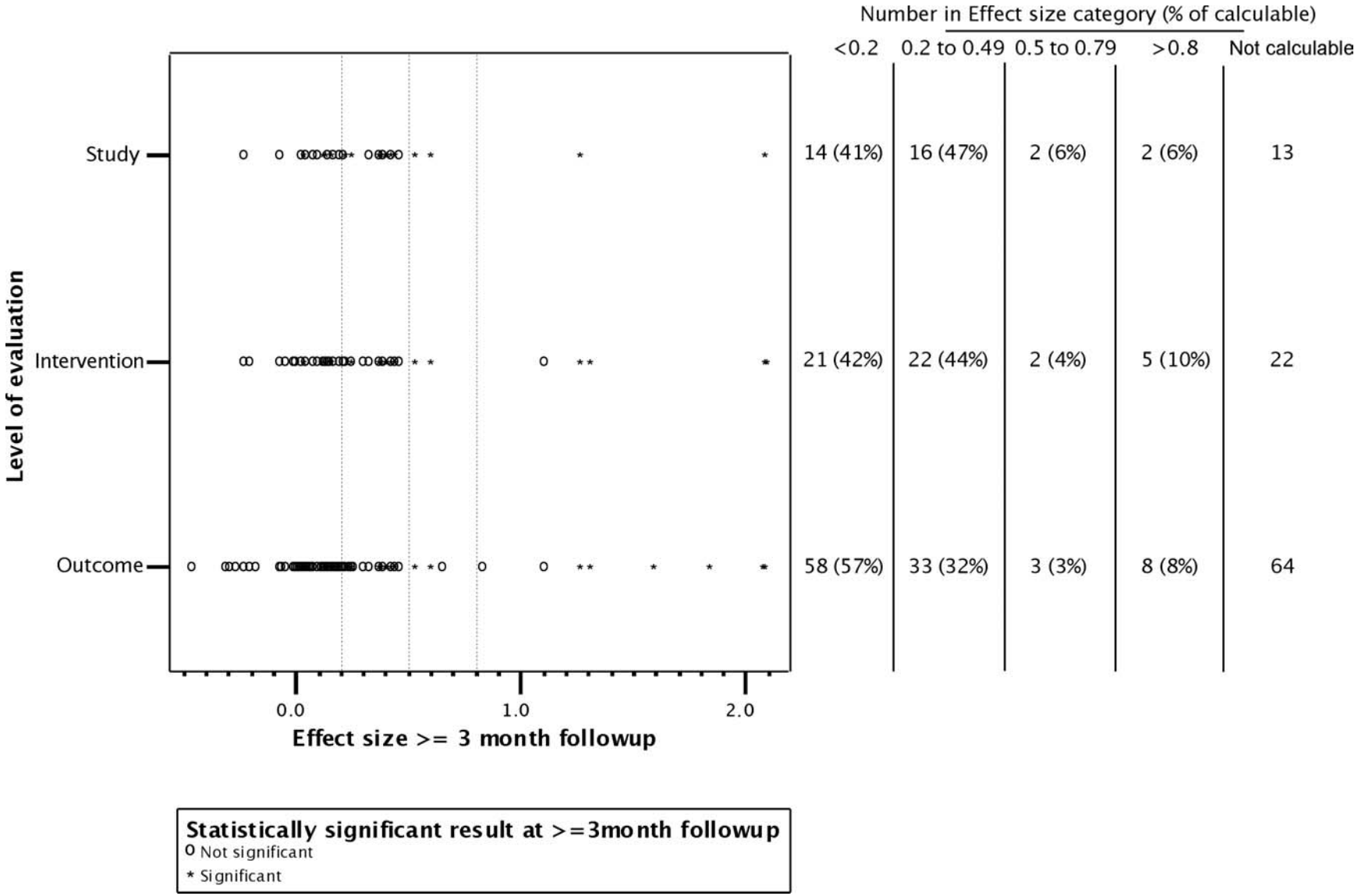


Figure 6. Effect size by measure type for all outcomes

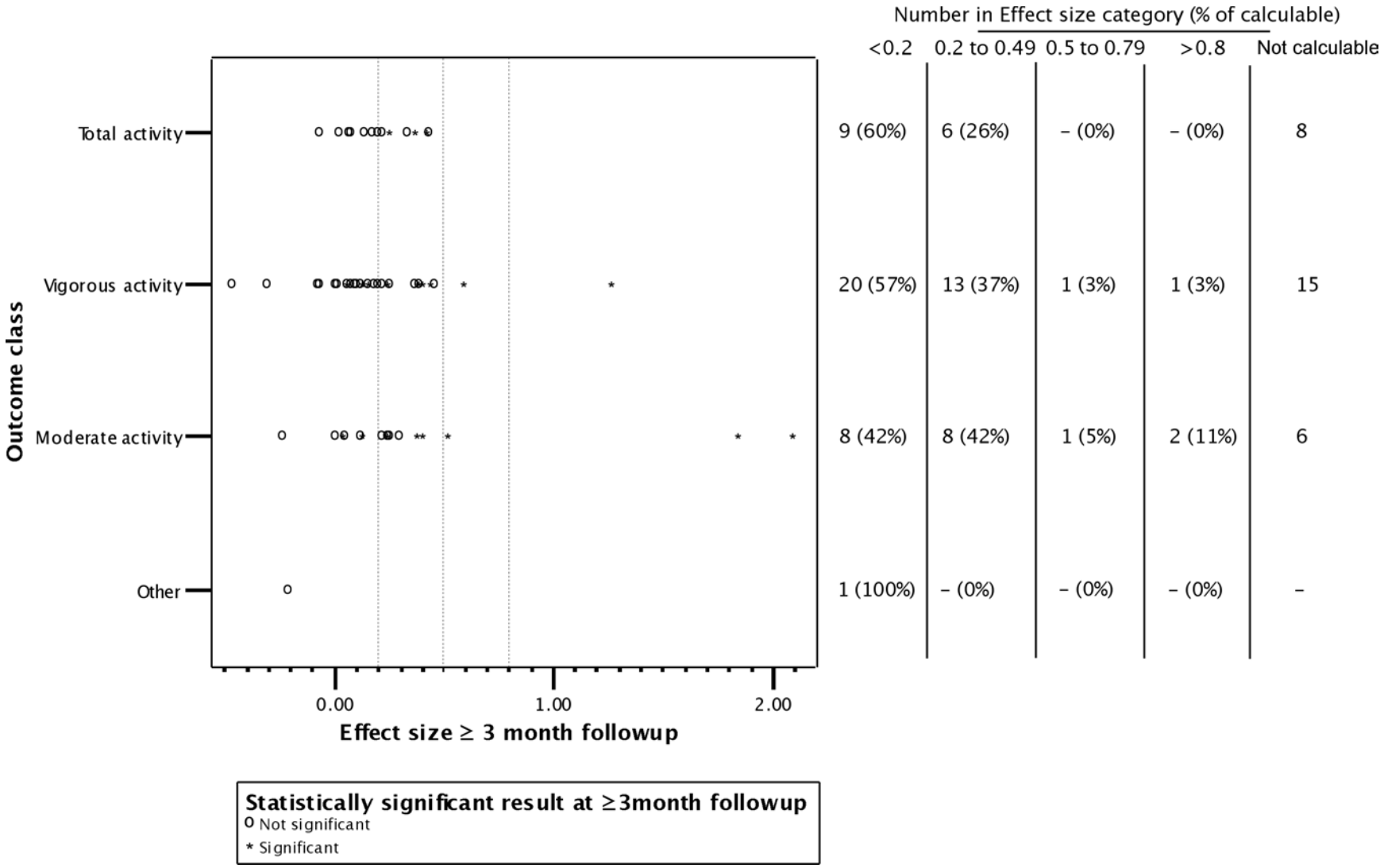
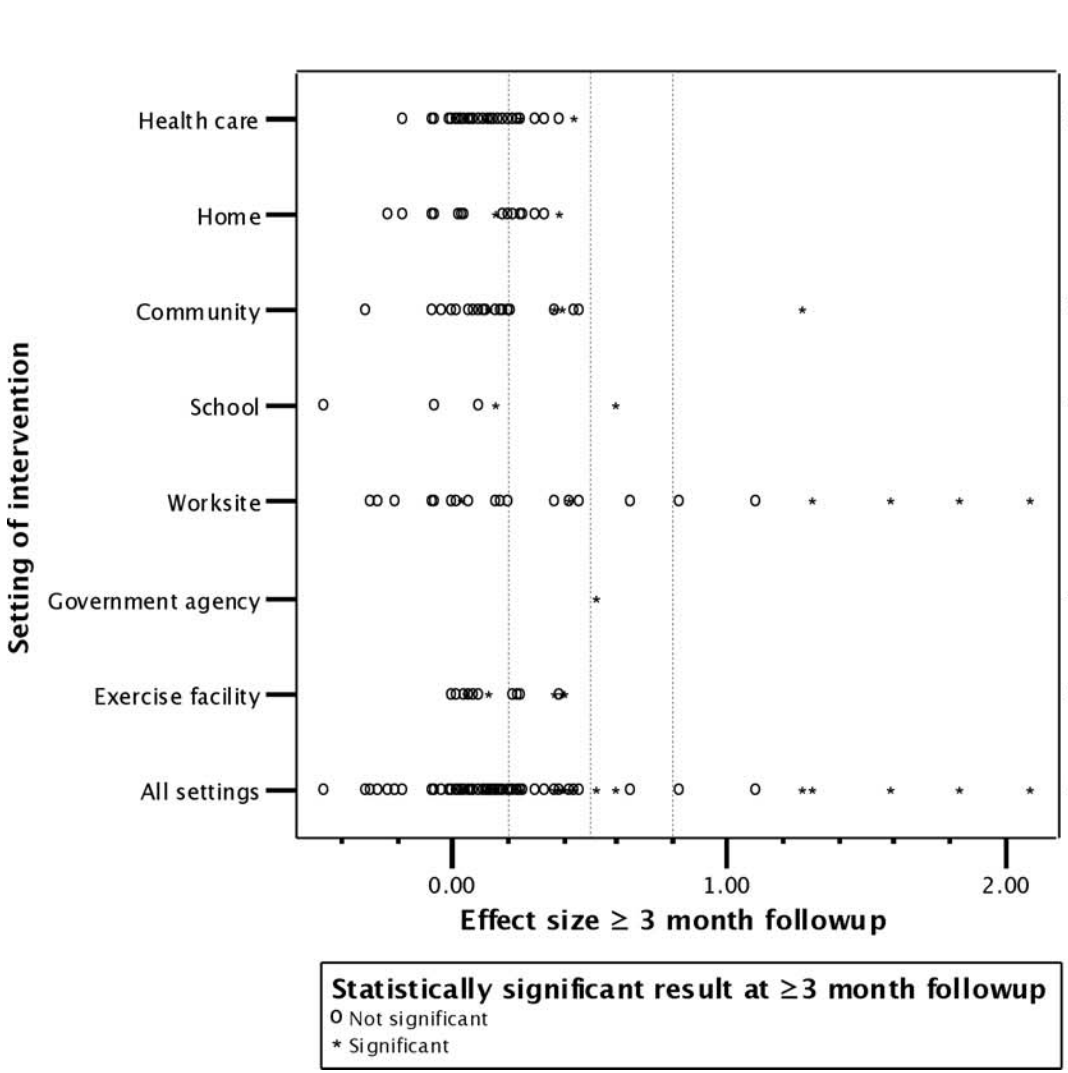


Figure 7. Effect size by intervention setting for all outcomes



Setting of intervention	Number in Effect size category (% of calculable) <0.2	0.2 to 0.49	0.5 to 0.79	>0.8	Not calculable
Health care	26 (59%)	18 (41%)	– (0%)	– (0%)	10
Home	11 (61%)	7 (39%)	– (0%)	– (0%)	4
Community	20 (67%)	9 (30%)	– (0%)	1 (3%)	8
School	4 (80%)	– (0%)	1 (20%)	– (0%)	34
Worksite	13 (52%)	4 (16%)	1 (4%)	7 (28%)	11
Government agency	– (0%)	– (0%)	1 (100%)	– (0%)	2
Exercise facility	8 (47%)	9 (53%)	– (0%)	– (0%)	0
All settings	58 (57%)	33 (32%)	3 (3%)	8 (8%)	64†

†Effect size not calculable for one outcome in religious institution and one outcome in child care center.

Figure 8. Effect size by intervention setting for all interventions

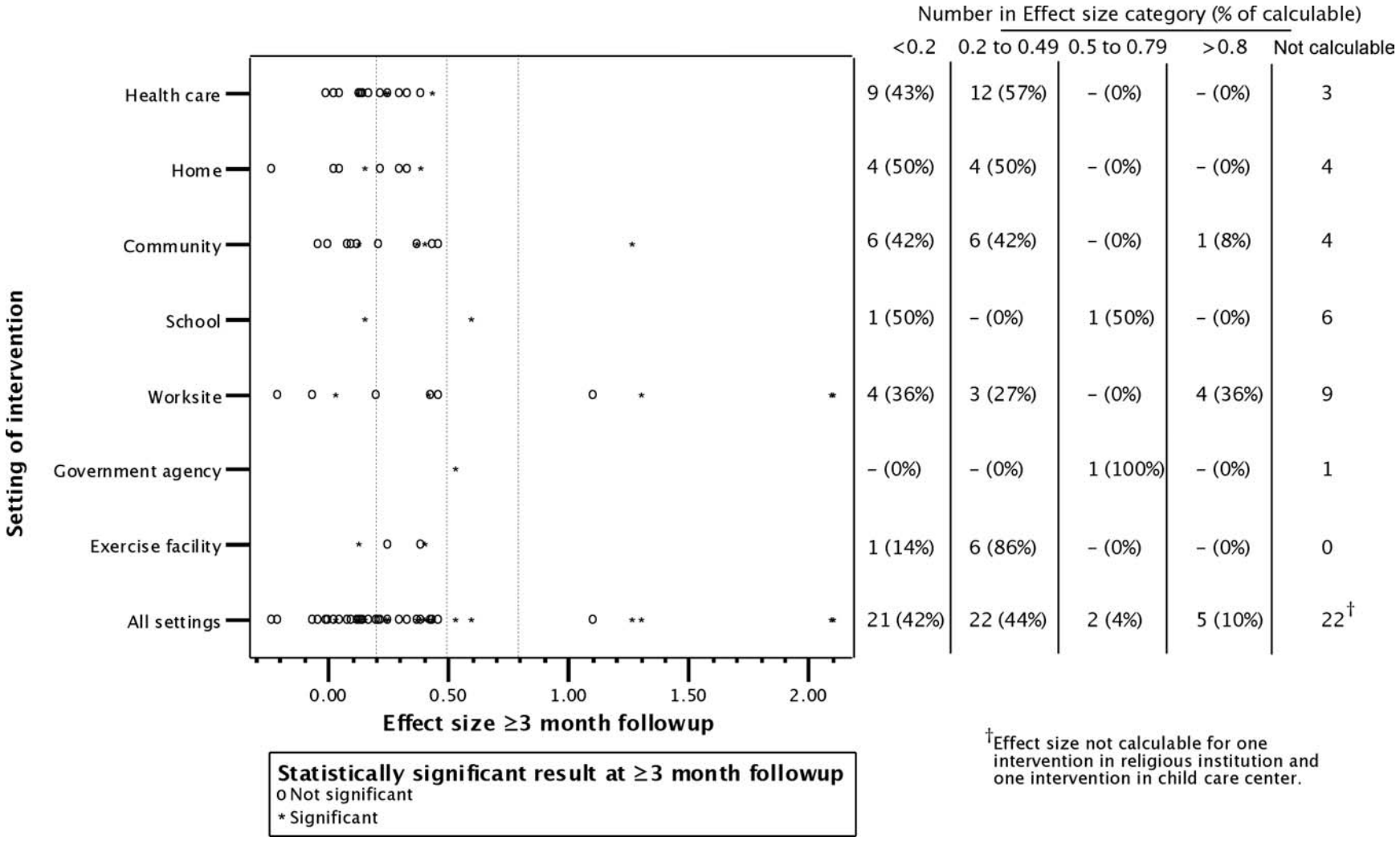
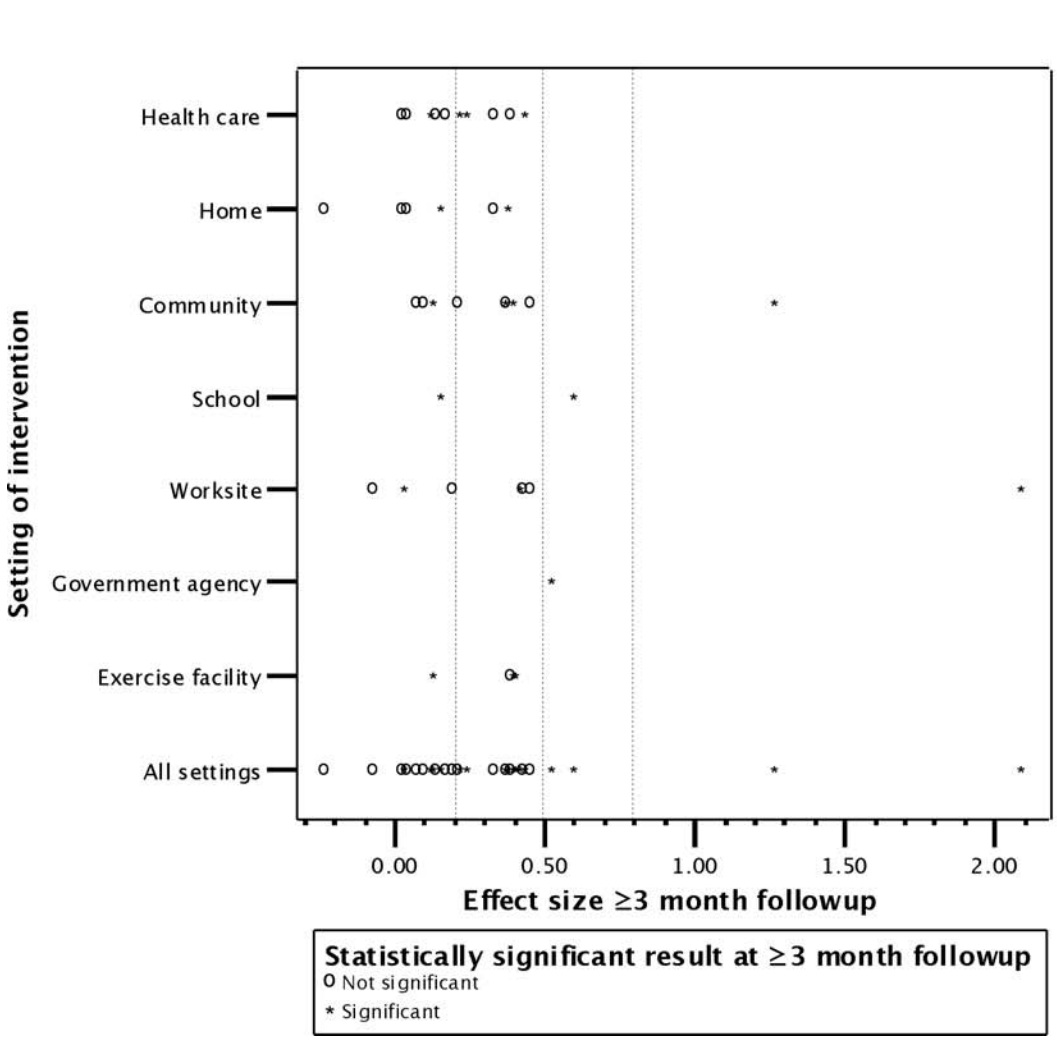


Figure 9. Effect size by intervention setting for all studies



	Number in Effect size category (% of calculable)				
	<0.2	0.2 to 0.49	0.5 to 0.79	>0.8	Not calculable
Health care	6 (46%)	7 (54%)	– (0%)	– (0%)	1
Home	4 (67%)	2 (33%)	– (0%)	– (0%)	1
Community	3 (33%)	5 (56%)	– (0%)	1 (11%)	3
School	1 (50%)	– (0%)	1 (50%)	– (0%)	5
Worksite	3 (43%)	3 (43%)	– (0%)	1 (14%)	6
Government agency	– (0%)	– (0%)	1 (100%)	– (0%)	1
Exercise facility	1 (25%)	3 (75%)	– (0%)	– (0%)	0
All settings	14 (41%)	16 (47%)	2 (6%)	2 (6%)	13†

†Effect size not calculable for one intervention in religious institution and one intervention in child care center.

Figure 10. Effect size by intensity level for all studies

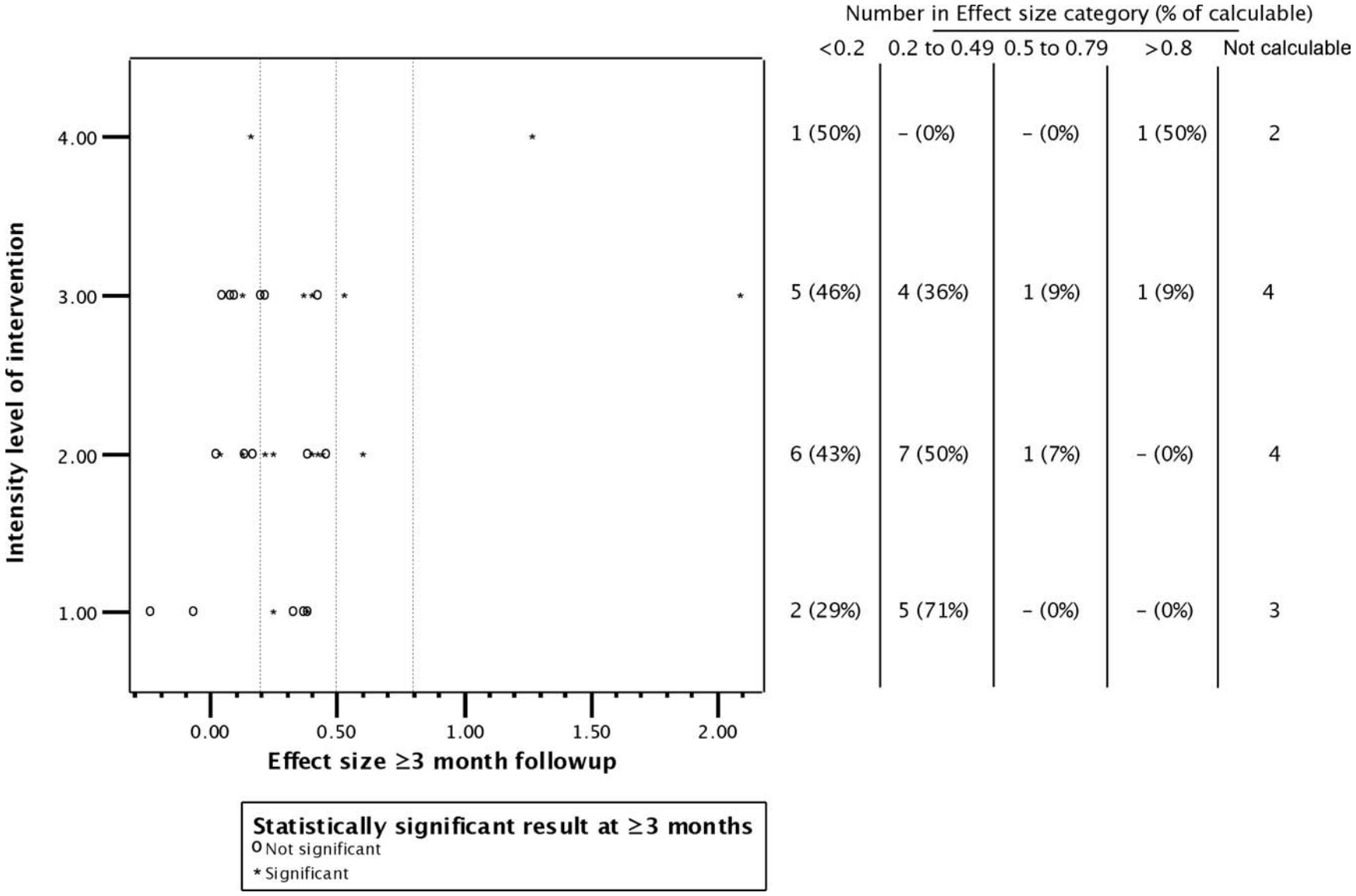


Figure 11. Effect size for studies at last followup by whether study addressed accessibility to exercise opportunities

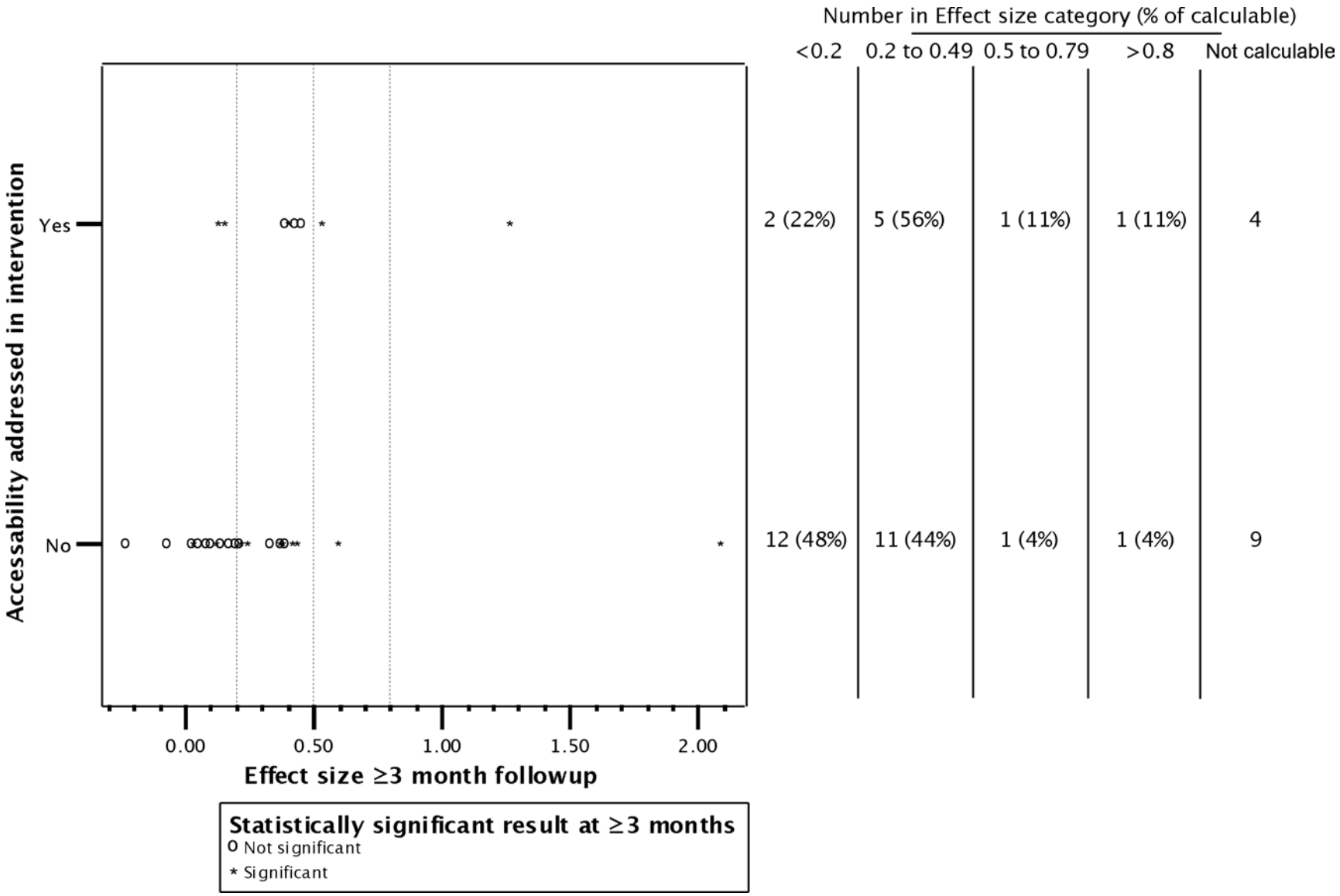


Figure 12. Effect size for studies at last followup by whether study included smoking cessation or diet

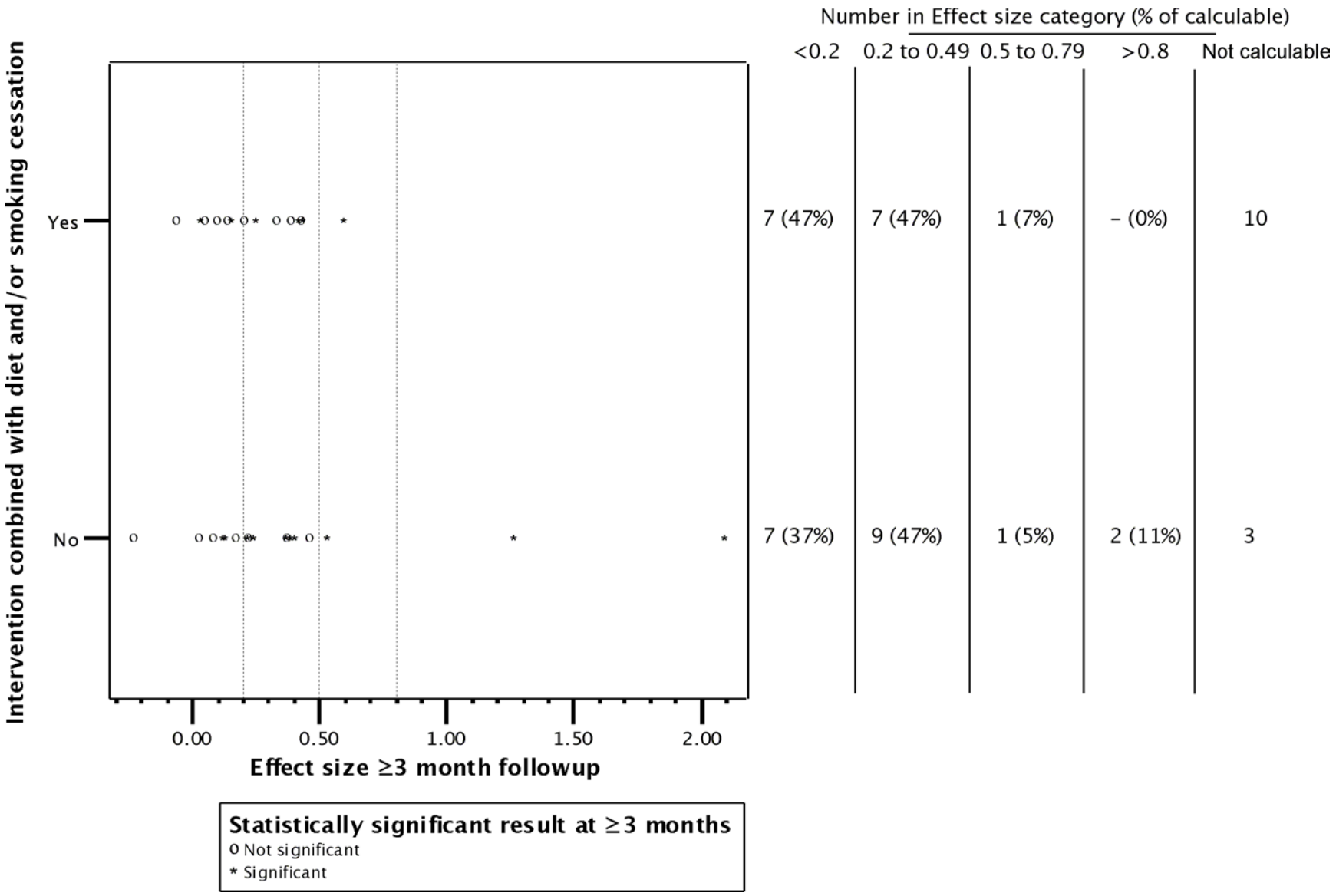


Figure 13. Effect size by whether theory is used for all students, outcomes, and interventions

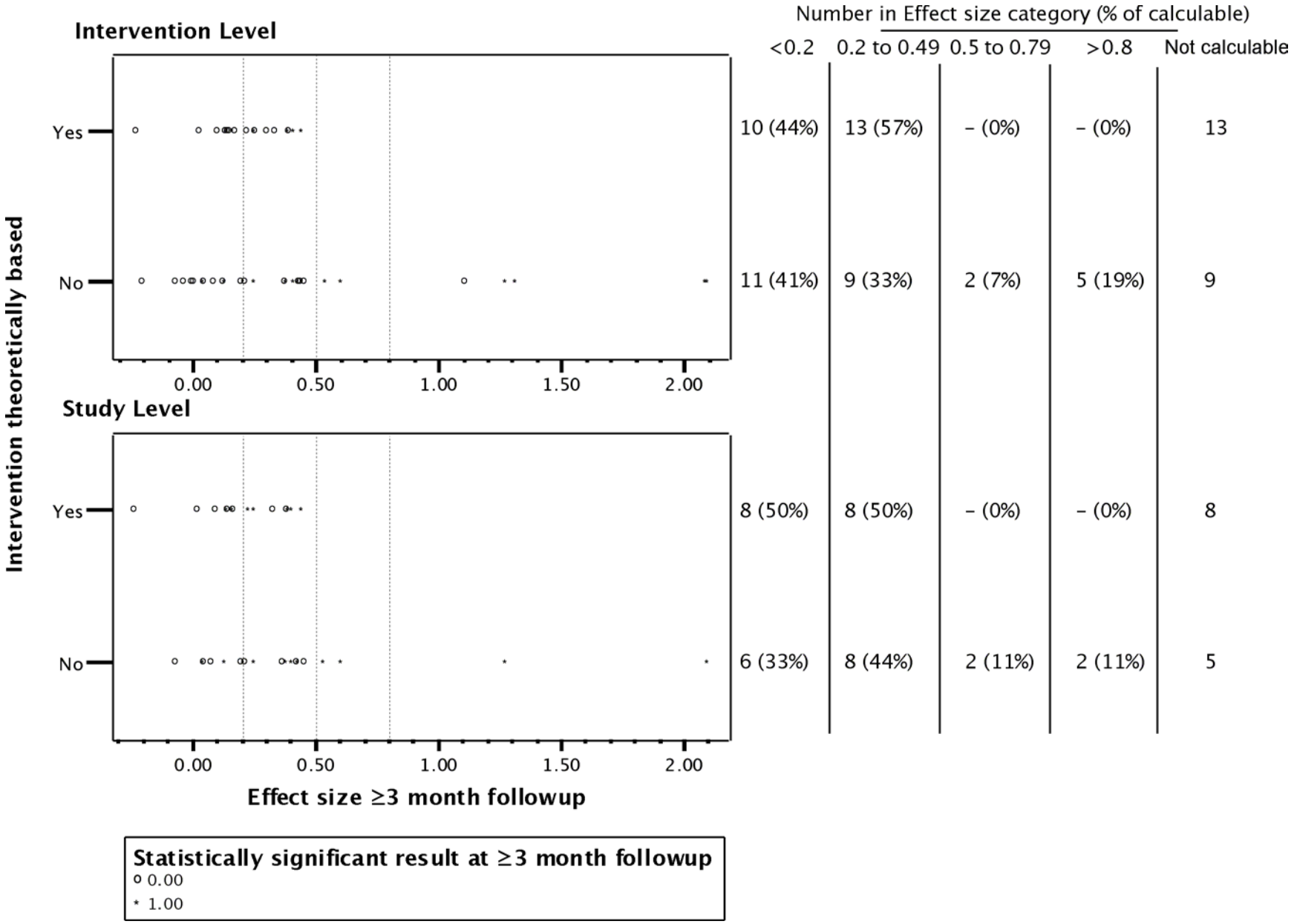


Figure 14. Effect size by time to first followup

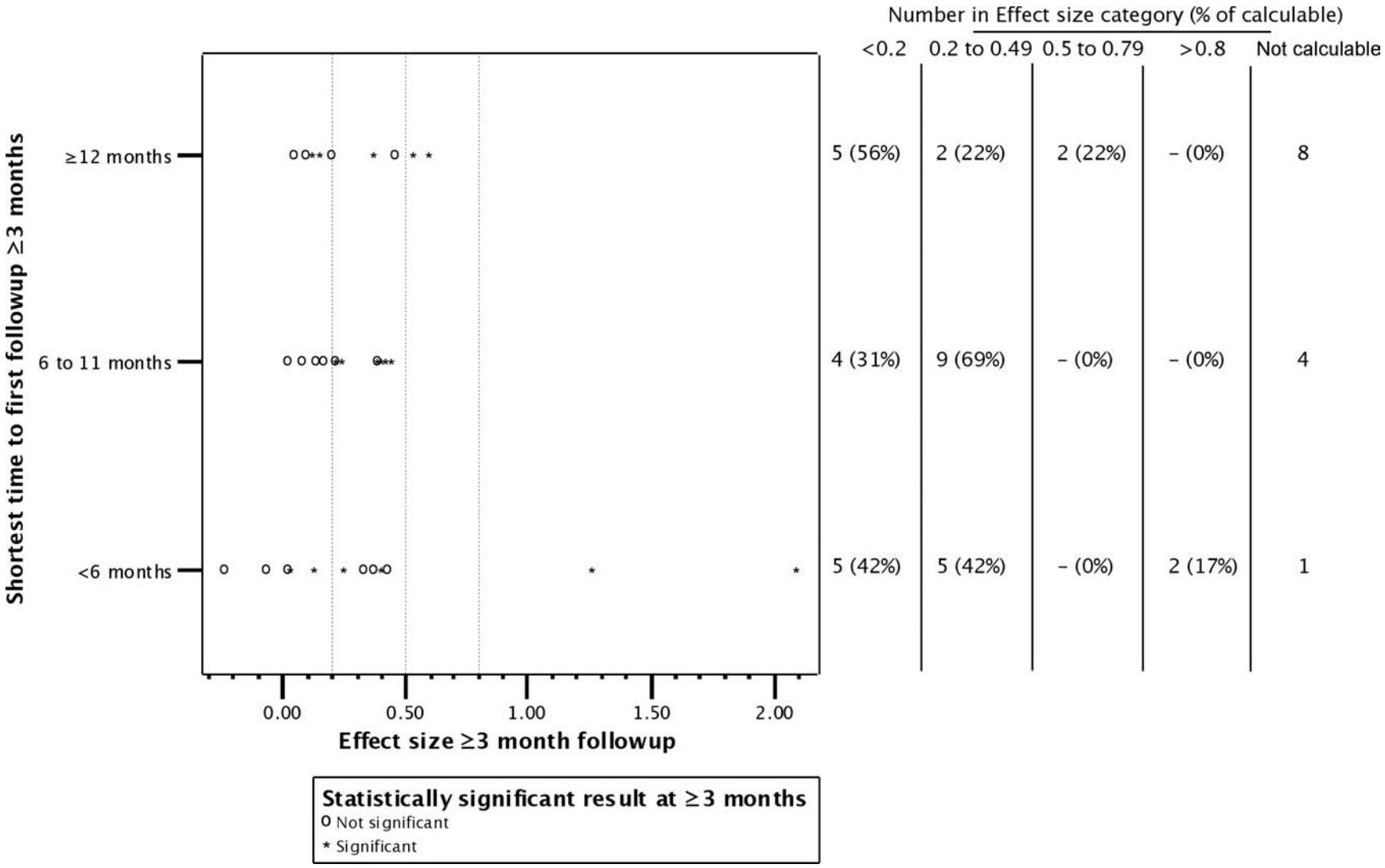


Figure 15. Effect size by time to followup for studies with more than one followup time

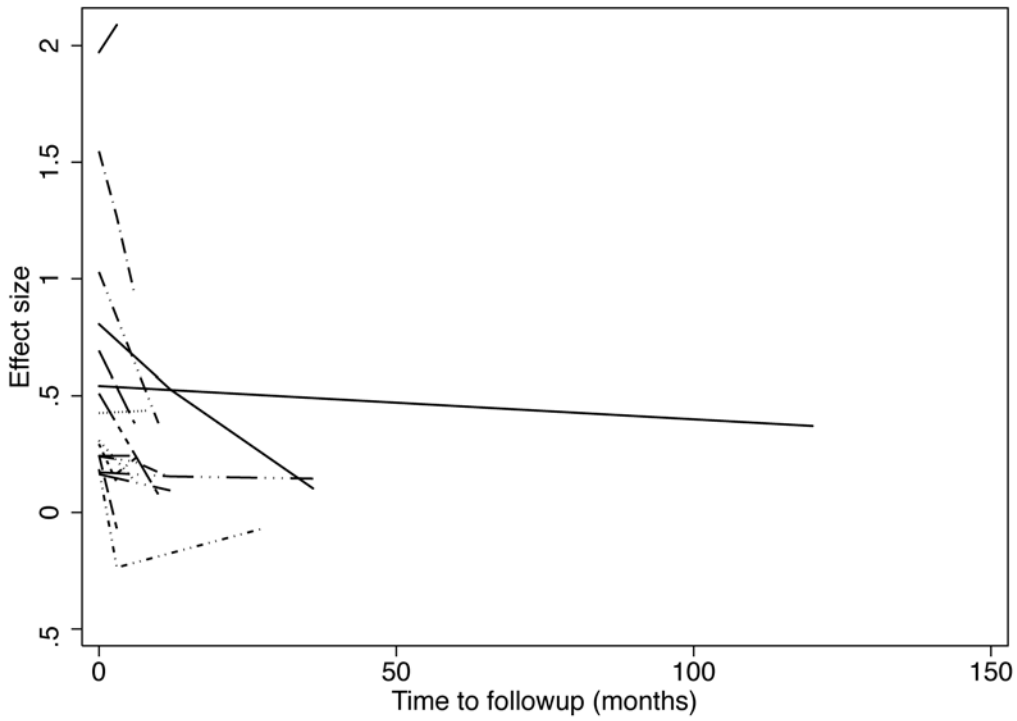


Figure 16. Effect size by number of subjects analyzed for all studies

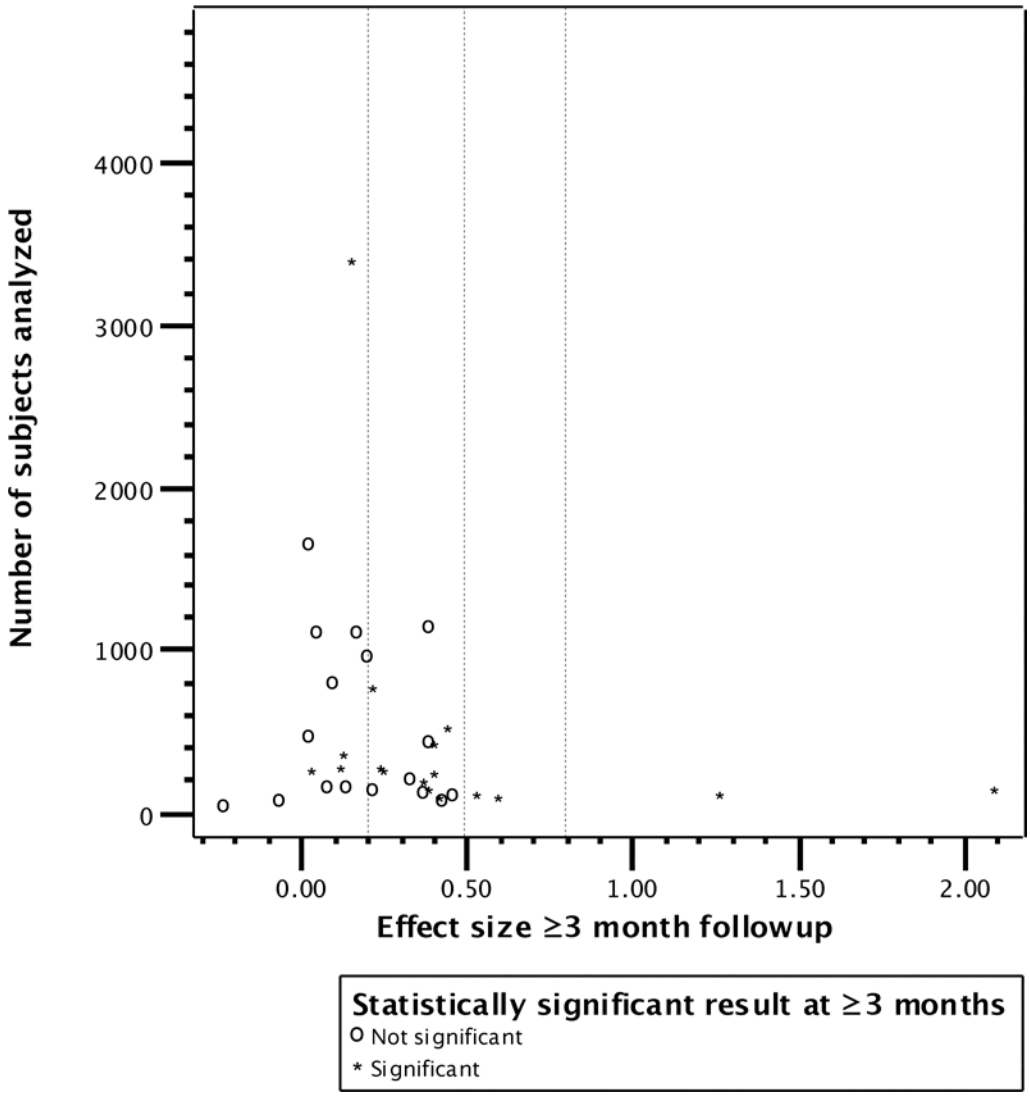


Figure 17. Effect size by source of measure

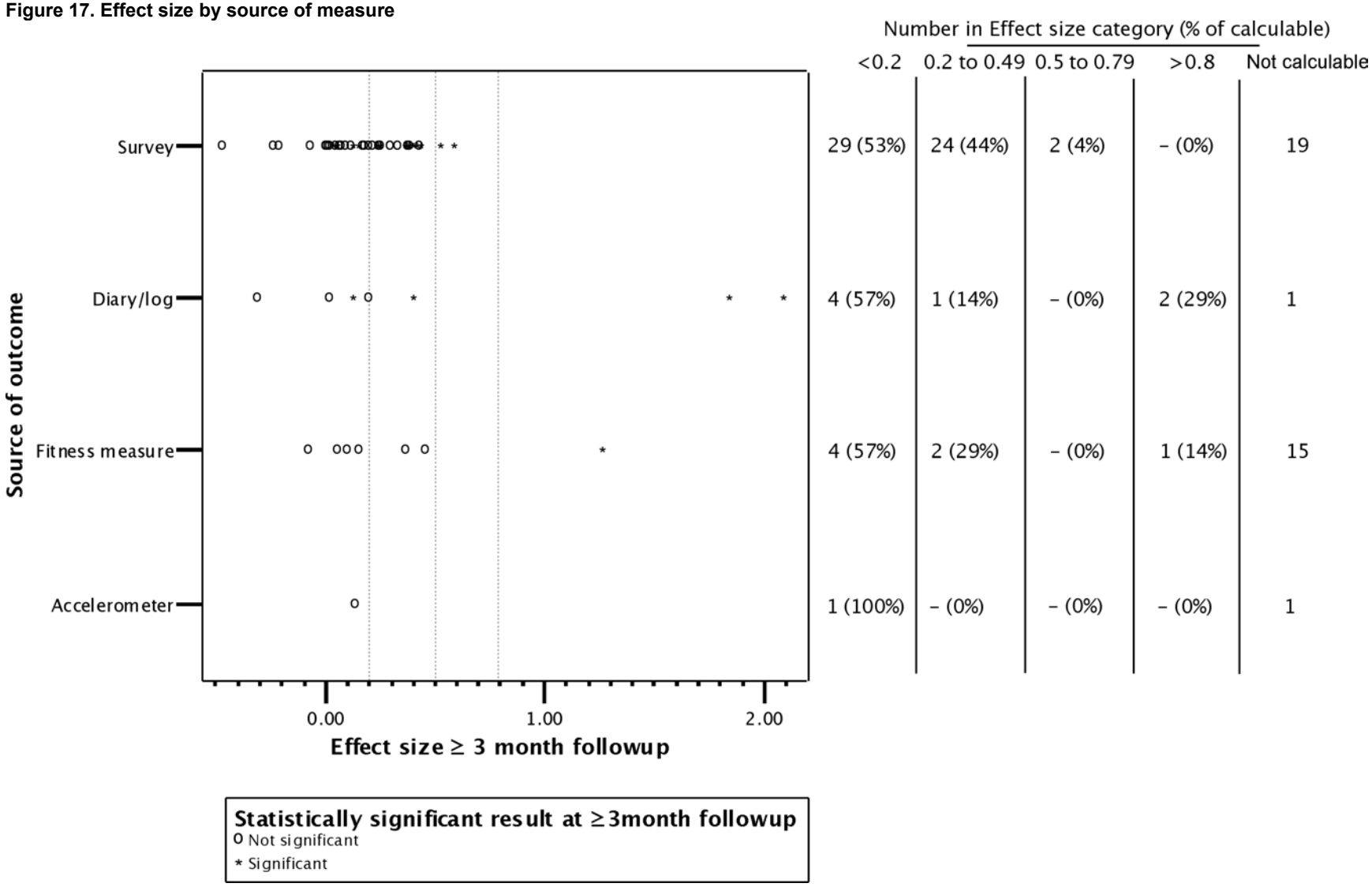


Figure 18. Effect size by number of quality criteria met

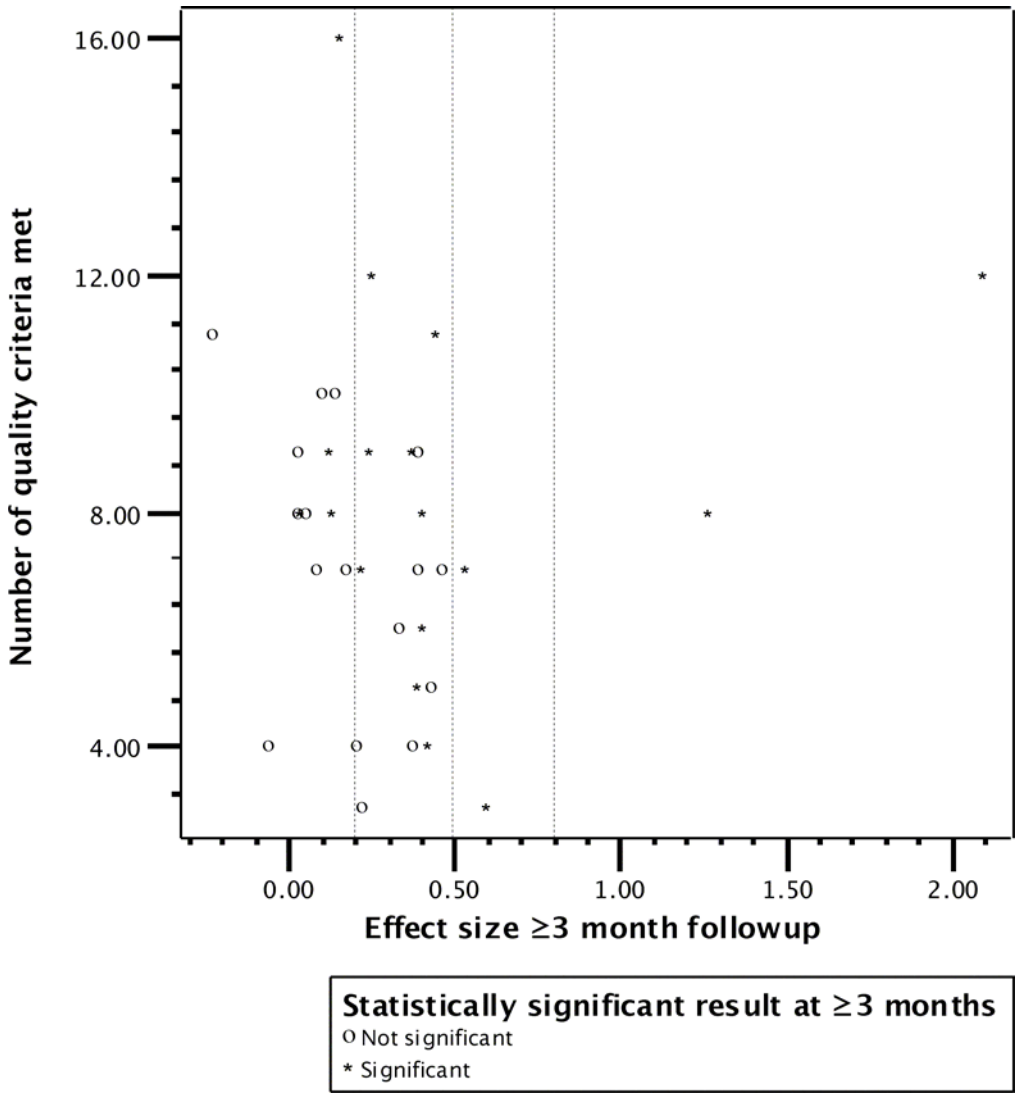


Figure 19. Effect size by percent of enrolled subjects analyzed at followup

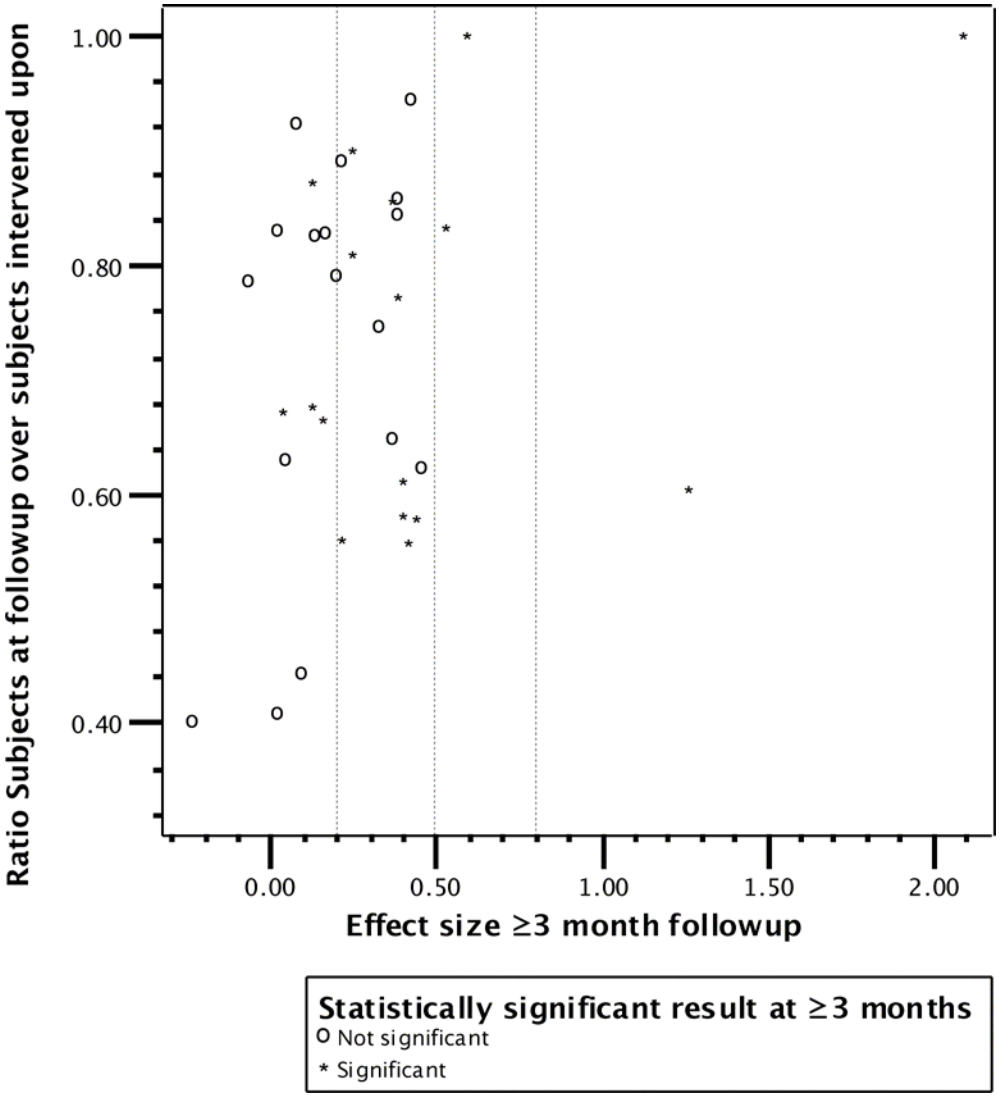


Figure 20. Effect size at last followup for studies randomized by individual subject by rating of study on Chalmers scale

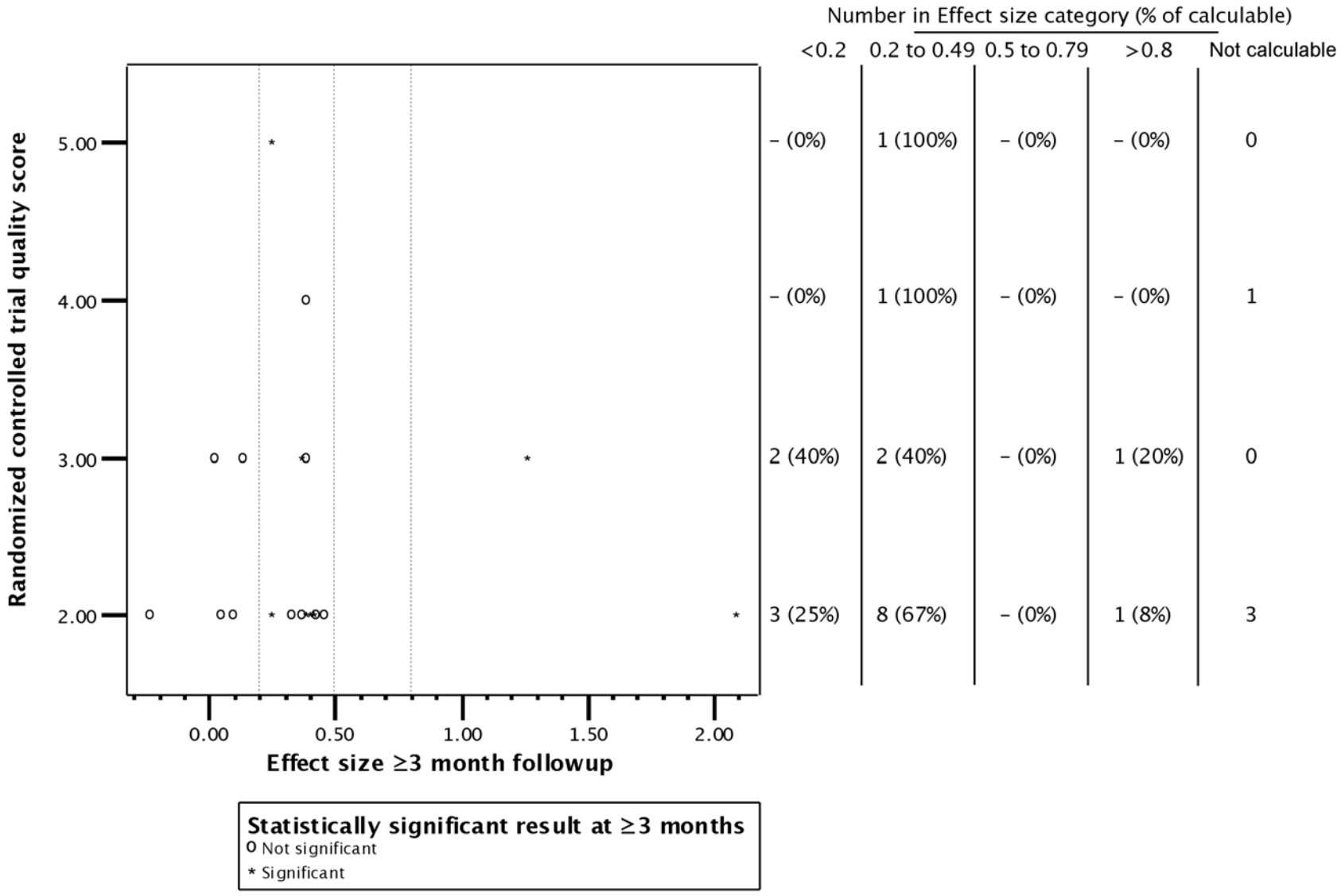
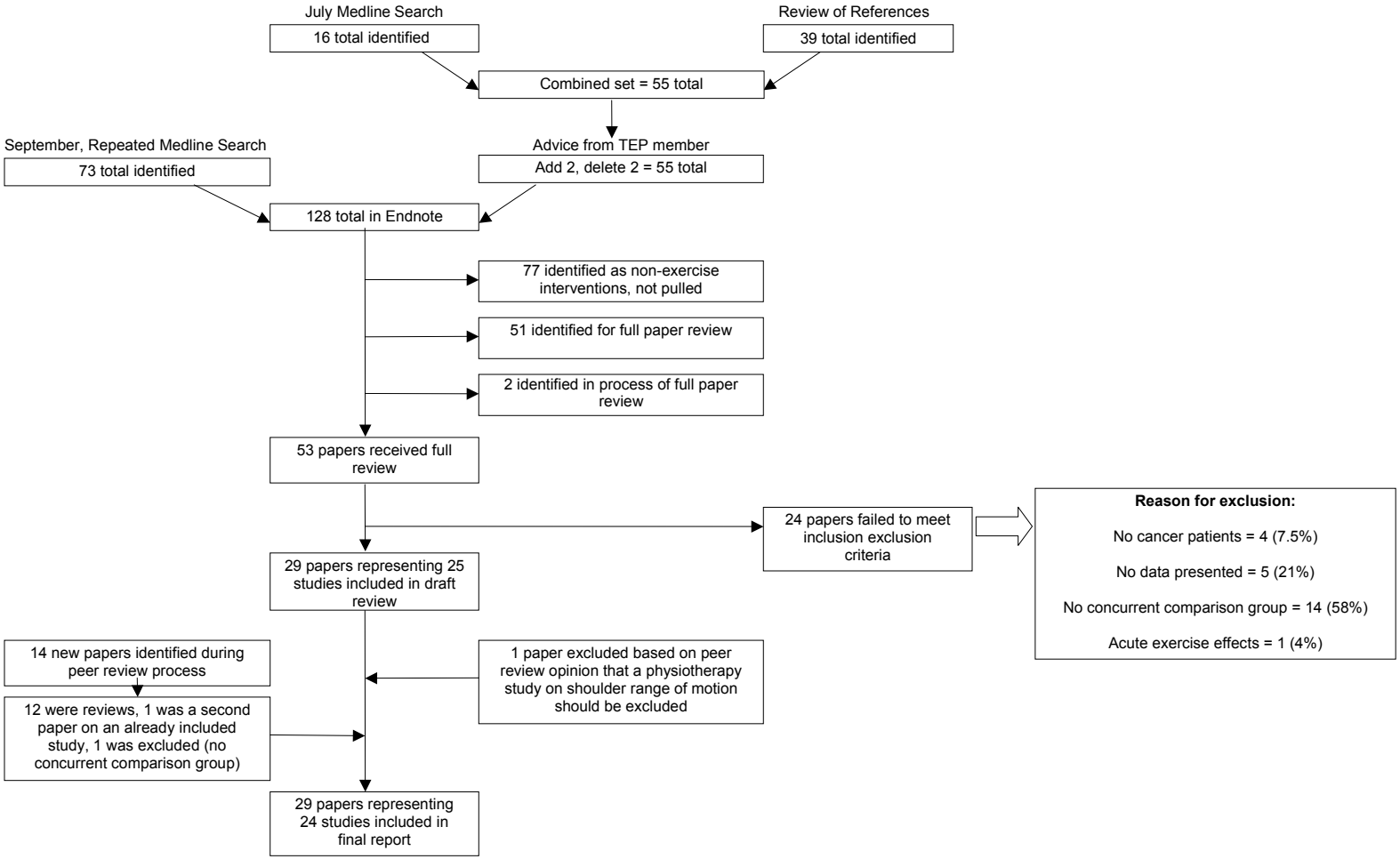


Figure 21. Identification and disposition of references for cancer studies



Evidence Report

Contract No. 290-02-0009, Task Order #3
Prepared by Minnesota Evidence-based Practice Center, Minneapolis, Minnesota

Effectiveness of Behavioral Interventions to Modify Physical Activity Behaviors in General Populations and Cancer Patients and Survivors

Appendixes

Appendix A
Technical Expert Panel Members

Technical Expert Panel Members and Areas of Expertise

TEP Member	Area of Expertise
Russ Pate University of Southern California	Schools, Adolescents
Rod Dishman University of Georgia	Worksite, Adults
Deborah Rohm Young University of Maryland	Churches, Adolescents
Andrea Dunn The Cooper Institute	Community, Adults
Greg Heath Centers for Disease Control	Community
Karen B. Eden Oregon Health and Science University	Health care, environment or public policy
Kerry Courneya University of Alberta	Cancer patients and survivors
Brian Saelens Children's Hospital Medical Center, Cincinnati, Ohio	Environment or Public policy
Bess Marcus Brown University	Adults
National Coalition for Promoting Physical Activity – Kathy Spangler, President	Consumers
National Cancer Institute Representatives Louise Masse Rick Troiano	

Appendix B
Exact Search Strings

Specific Search Strategy

Number	Search Term	Number of References
1	Search exercise[mh]	25,076
2	Search physical activity	64,325
3	Search #1 OR #2	83,789
4	Search randomized controlled trial[pt]	168,406
5	Search randomized controlled trials[mh]	25,643
6	Search controlled clinical trial[pt]	62,062
7	Search intervention studies[mh]	2,295
8	Search clinical trial[pt]	345,151
9	Search #4 OR #5 OR #6 OR #7 OR #8	367,880
10	Search #3 AND #9	6,790

Search Strategy Used on 12/20/02

Number	Search Term	Number of References
1	Exercise [mh]	24,623
2	Physical activity	63,673
3	Search #1 OR #2	82,795
4	Cancer	1,456,200
5	Search #3 AND #4	1,647
6	Randomized controlled trial [pt]	166,627
7	Randomized controlled trials [mh]	24,988
8	Search #6 OR #7	187,507
9	Search #5 AND #8	47
10	Controlled clinical trial [pt]	61,833
11	Search #5 AND #10	10
12	Intervention studies [mh]	2,272
13	Search #5 AND #12	8
14	Clinical trial [pt]	341,915
15	Search #5 AND #14	54
16	Search #9 OR #11 OR #15	70

Search Approach Used for Cancer Part of Review—Completed on 9/17/03—Resulting in 81 Papers

Number	Search Term
1	Exercise[mh]
2	Motor activity[mh]
3	Physical activity[tw]
4	Search #1 OR #2 or #3
5	Randomized controlled trial[pt]
6	Randomized controlled trials[mh]
7	Controlled clinical trial[pt]
8	Intervention studies[mh]
9	Clinical trial[pt]
10	Search #5 OR #6 OR #7 OR #8 OR #9
11	Cancer[mh]
12	Search #4 AND #10 AND #11

Appendix C
Abstraction Forms

General Population (pages 167-194)
Cancer Population (pages 195-216)

Data abstraction form for general population

Data Abstraction Form

Tracking Information: **original edited based on other info:** ○ Yes ○ No

Abstractor: _____

Study Name (if has one): ..... **>1 study in papers:** _____

Citation: Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Funding Source: ☐ Government ☐ Private ☐ Non-funded ☐ Unknown

Study Type: ○ Journal article ○ Technical report ○ Other...

Next Page

Data abstraction form for general population (continued)

Verification/Selection of Study Eligibility

Stop if any of the following is "No"

Reported on a behavioral intervention or policy change	○ Yes	○ No	○ Unclear	**Qualify (1=no)** 0
Reported any physical activity /physical fitness	○ Yes	○ No	○ Unclear	
Concurrent comparison group with reported results	○ Yes	○ No	○ Unclear	
Have ≥ 75 subjects in total	○ Yes	○ No	○ Unclear	
Reported at least 3 month post intervention f/u data	○ Yes	○ No	○ Unclear	

Stop if any of the following is "Yes"

Targets subjects with acute disease	○ Yes	○ No	○ Unclear
Targets subjects with CHD, PVD, CVD	○ Yes	○ No	○ Unclear
Targets subjects with cystic fibrosis	○ Yes	○ No	○ Unclear
Targets subjects with osteoarthritis	○ Yes	○ No	○ Unclear
Targets subjects with severe COPD	○ Yes	○ No	○ Unclear
Targets nursing home residents or prisoners	○ Yes	○ No	○ Unclear
Study of a cardiac rehabilitation program	○ Yes	○ No	○ Unclear
Study of rehabilitation/physiotherapy intervention	○ Yes	○ No	○ Unclear

Do not stop for following but bring information to meeting for discussion:

Is there any other disease in this sample?	○ Yes	○ No	○ Unclear
Are there any other risk factors in this sample?	○ Yes	○ No	○ Unclear

If Yes, describe:

If Yes, describe:

BACK NEXT

Data abstraction form for general population (continued)

Classification Information

A. Study Design:

○ Randomized
○ Non-randomized
○ Other…

} ○ Individual ○ Group

B. Study Sample:

Eligibility Criteria:

.....
.....
.....
.....
.....
.....
.....
.....

Setting for recruitment (check all that apply):

☐ Unknown
☐ School
☐ Community
☐ Worksite
☐ Primary care or health care
☐ Home
☐ Public health agency → ○ Federal ○ State ○ Local → Specify: .....
☐ Other governmental agency → ○ Federal ○ State ○ Local → Specify: .....
☐ Other…

BACK NEXT

Intervention Information

C. Interventions:

Number of intervention groups: _____

Number of comparison groups: _____

Intervention part of a larger study?:

○ Yes → **If Yes, Describe:**
○ No

.....
.....
.....
.....
.....
.....

Intervention description:

If more than one comparison group, enter comparison groups as "intervention" groups starting with #1. For all of the groups, select below each button whether the group is an intervention or comparison group.

Comparison group	Intervention Group #1	Intervention group #2	Intervention Group #3	Intervention Group #4	Intervention Group #5	Intervention Group #6

You should enter intervention information for all groups before proceeding. You should have entered information on

groups. You should see a working name for each intervention above the buttons.

C. Sampling of the population:

To create the comparison and intervention groups, were groups sampled (e.g., clinics or schools) or individuals?

Groups | Individuals

BACK

If there was only one comparison group, the following three pages were completed.

Intervention description: Comparison group (page 1)

Working name (less than 8 characters): .....

Intervention setting:

- ☐ Unknown
- ☐ School
- ☐ Community
- ☐ Worksite
- ☐ Primary care or health care
- ☐ Home
- ☐ Public health agency → ○ Federal ○ State ○ Local → Specify: .....
- ☐ Other governmental agency → ○ Federal ○ State ○ Local → Specify: .....
- ☐ Other...

For this group, was there a physical activity intervention, non-physical activity intervention or neither?

○ Physical activity intervention ○ Non-physical activity intervention ○ No specific intervention

Intervention components:

- ☐ Provision of information
- ☐ Environmental intervention
- ☐ Public health or medical care intervention
- ☐ Combined with diet
- ☐ Combined with smoking cessation
- ☐ Not Specified

PA Mode/Type:

- ☐ Walking
- ☐ Jogging
- ☐ Exercise class
- ☐ Stair climbing
- ☐ Biking
- ☐ Garden or yardwork
- ☐ Lifestyle Exercise
- ☐ Aerobic activity undefined or multiple modes
- ☐ Resistance exercise
- ☐ Stretching and relaxation techniques
- ☐ Not specified
- ☐ Other...

PA Intensity:

○ Light ○ Moderate ○ Vigorous ○ Not specified ○ Not clear

PA Frequency:

sessions per week _____ ○ Not specified ○ Not clear

Frequency of contact:

frequency (include units) _____ ○ Not specified ○ Not clear

Who is contact with? _____

PA duration: (short vs long bouts)

_____ ☐ ○ Not specified ○ Not clear

BACK NEXT

Data abstraction form for general population (continued)

Intervention description: Comparison group (page 2)

PA location:

☐ Home ☐ Community ☐ Worksite ☐ Not specified ☐ Other…
☐ Exercise facility ☐ School ☐ Assisted Living Facility ☐ Not clear

Intervention Tailoring:

☐ None
☐ Stage of life or age
☐ Stage of readiness for change and other psychological variables
☐ Gender
☐ Culture
☐ Exercise preferences or goals
☐ Risk factor status
☐ Other…

Intervention Mode:

☐ Mail ☐ Internet or email ☐ Computerized feedback system ☐ Other…
☐ Telephone ☐ In person ☐ Not specified

Intervention delivery:

☐ Individual ☐ Group ☐ Not specified

Behavioral intervention approaches:

☐ None
☐ Problem solving
☐ Self monitoring
☐ Goal setting
☐ Relapse prevention
☐ Incentives and contracts
☐ Written Feedback or verbal encouragement
☐ Provision of equipment
☐ Self efficacy enhancement
☐ Social support
☐ Skill building
☐ Benefits and barriers
☐ Education on normal response to exercise
☐ Education on why one should exercise
☐ Not clear
☐ Other…

Monetary cost of participation fees, gear and equipment:

○ None ○ Low ○ Medium or High ○ Not specified ○ Not clear

Regimen structure versus flexibility:

○ High structure ○ Middleground ○ High flexibility ○ Not applicable ○ Not clear

Physical/environmental barriers addressed:

☐ None ☐ Distance ☐ Safety ☐ Transportation ☐ Accessibility ☐ Not clear

BACK NEXT

Intervention description: Comparison group (page 3)

Description of the intervention:

What:

.....

.....

How:

.....

.....

Who:

.....

.....

Where:

.....

.....

Other:

.....

.....

Total length of the intervention: .....

Maximum length of follow-up for this intervention: .....

Was there a theory presented as 'underlying the intervention'?:

○ Yes → Describe:
○ No

- ☐ Social Learning Theory ..... (Bandura 1977)
- ☐ Social Cognitive Theory ..... (Bandura 1986)
- ☐ Transtheoretical Model or Stages of Change ..... (Prochaska)
- ☐ Decision Making Theory ..... (Janis and Mann)
- ☐ Social Ecology Theory ..... (Stokel)
- ☐ Problem Behavior Model ..... (Jessor and Jessor)
- ☐ Motivational Interviewing .....
- ☐ Health Belief Model .....
- ☐ Other .....

.....

BACK NEXT

If there was more than one comparison group, they were identified as intervention groups starting with #1 up to #6. For each intervention, they completed the next three pages.

Intervention description: Intervention group 1 (page 1)

Working name (less than 8 characters): .....

Intervention setting:

- ☐ Unknown
- ☐ School
- ☐ Community
- ☐ Worksite
- ☐ Primary care or health care
- ☐ Home
- ☐ Public health agency → ○ Federal ○ State ○ Local → Specify:.....
- ☐ Other governmental agency → ○ Federal ○ State ○ Local → Specify:.....
- ☐ Other...

For this group, was there a physical activity intervention, non-physical activity intervention or neither?

○ Physical activity intervention ○ Non-physical activity intervention ○ No specific intervention

Intervention components:

- ☐ Provision of information
- ☐ Environmental intervention
- ☐ Public health or medical care intervention
- ☐ Combined with diet
- ☐ Combined with smoking cessation
- ☐ Not Specified

PA Mode/Type:

- ☐ Walking
- ☐ Jogging
- ☐ Exercise class
- ☐ Stair climbing
- ☐ Biking
- ☐ Garden or yardwork
- ☐ Lifestyle Exercise
- ☐ Aerobic activity undefined or multiple modes
- ☐ Resistance exercise
- ☐ Stretching and relaxation techniques
- ☐ Not specified
- ☐ Other...

PA Intensity:

○ Light ○ Moderate ○ Vigorous ○ Not specified ○ Not clear

PA Frequency:

sessions per week _____ ○ Not specified ○ Not clear

Frequency of contact:

frequency (include units) _____ ○ Not specified ○ Not clear

Who is contact with? _____

PA duration: (short vs long bouts)

_____ ☐ ○ Not specified ○ Not clear

BACK NEXT

Intervention description: Intervention group 1 (page 2)

PA location:

☐ Home ☐ Community ☐ Worksite ☐ Not specified ☐ Other…
☐ Exercise facility ☐ School ☐ Assisted Living Facility ☐ Not clear

Intervention Tailoring:

☐ None
☐ Stage of life or age
☐ Stage of readiness for change and other psychological variables
☐ Gender
☐ Culture
☐ Exercise preferences or goals
☐ Risk factor status
☐ Other…

Intervention Mode:

☐ Mail ☐ Internet or email ☐ Computerized feedback system ☐ Other…
☐ Telephone ☐ In person ☐ Not specified

Intervention delivery:

☐ Individual ☐ Group ☐ Not specified

Behavioral intervention approaches:

☐ None
☐ Problem solving
☐ Self monitoring
☐ Goal setting
☐ Relapse prevention
☐ Incentives and contracts
☐ Written Feedback or verbal encouragement
☐ Provision of equipment
☐ Self efficacy enhancement
☐ Social support
☐ Skill building
☐ Benefits and barriers
☐ Education on normal response to exercise
☐ Education on why one should exercise
☐ Not clear
☐ Other…

Monetary cost of participation fees, gear and equipment:

○ None ○ Low ○ Medium or High ○ Not specified ○ Not clear

Regimen structure versus flexibility:

○ High structure ○ Middleground ○ High flexibility ○ Not applicable ○ Not clear

Physical/environmental barriers addressed:

☐ None ☐ Distance ☐ Safety ☐ Transportation ☐ Accessibility ☐ Not clear

BACK NEXT

Intervention description: Intervention group 1 (page 3)

Description of the intervention:

What:

.....

.....

How:

.....

.....

Who:

.....

.....

Where:

.....

.....

Other:

.....

.....

Total length of the intervention: .....

Maximum length of follow-up for this intervention: .....

Was there a theory presented as 'underlying the intervention'?:

○ Yes → Describe:
○ No

- ☐ Social Learning Theory ..... (Bandura 1977)
- ☐ Social Cognitive Theory ..... (Bandura 1986)
- ☐ Transtheoretical Model or Stages of Change ..... (Prochaska)
- ☐ Decision Making Theory ..... (Janis and Mann)
- ☐ Social Ecology Theory ..... (Stokel)
- ☐ Problem Behavior Model ..... (Jessor and Jessor)
- ☐ Motivational Interviewing .....
- ☐ Health Belief Model .....
- ☐ Other.....

BACK NEXT

Population and Sample Number (Groups sampled)

Type of Group: _____

Total number of groups within population of groups: ..... ○ Not noted

How sampled:							
Number Groups Enrolled:	.....	.....	.....	.....	.....	.....	.....
How sampled:							
Number Individuals Enrolled:	.....	.....	.....	.....	.....	.....	.....

Is the response rate from the sampling frame indicated in the paper?

○ Yes → Describe: .....
○ No .....

BACK NEXT

Population and Sample Number (Individuals sampled)

"N" for sampling frame: ..... ○ Not noted

How sampled:							
Number Individuals Observed:	.....	.....	.....	.....	.....	.....	.....

Is the response rate from the sampling frame indicated in the paper?

○ Yes → Describe: .....
○ No .....

BACK NEXT

Data abstraction form for general population (continued)

Sample Demographics

								Sig.
Age:								
Mean								
Standard deviation:								
Median								
Age Range:	--	--	--	--	--	--	--	
Other:								
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Gender:								
% male								
% female								
% unknown								
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Race:								
% White								
% Black								
% Asian								
% American Indian								
%Pacific								
% Other								
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Ethnicity:								
% Hispanic or Latino								
% **NOT** Hispanic/Latino								
% Other								
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Socioeconomic status:								

○ TO **Check here if only total population numbers reported so column represents total sample**

Paper ID, page & table:

BACK NEXT

Data abstraction form for general population (continued)

Other factor definitions

Factor 1:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 2:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 3:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 4:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 5:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 6:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 7:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 8:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 9:
Short Factor name:
Measure:
Units:
Results reported as:

Factor 10:
Short Factor name:
Measure:
Units:
Results reported as:

Define Factor **If the desired measure does not appear in the pull-down menu, click here to define additional factors**

BACK NEXT

Define Factor

To enter additional factors, first click below to bring up "factor". Then enter additional factors in list. Try not to create more than one name for the same factor.

factor **Click Here**

BACK

Data abstraction form for general population (continued)

Other Sample Characteristics

								Sig.

○ T.O. **Check here if only total population numbers reported so column represents total sample**

Paper ID, page & table:

BACK NEXT

Data abstraction form for general population (continued)

Outcome Measure Descriptions

Evaluation study characteristics:

Location: _____ **If not USA, describe:** .....

Setting:

- ☐ Hospital
- ☐ Clinic or health care provider office
- ☐ Nursing home
- ☐ Child day care center
- ☐ Drug treatment center
- ☐ Mental health setting
- ☐ Community based organization
- ☐ School
- ☐ Workplace
- ☐ Religious institution
- ☐ Home
- ☐ Prison
- ☐ Street
- ☐ Shelter
- ☐ Community wide
- ☐ Not reported
- ☐ Does not apply
- ☐ Other…

Describe outcome measures used in study:

Describe: .....

Outcome Measures:

Click on each button and enter the information on that outcome measure. If one outcome is noted as the primary outcome, it should be Outcome 1.

Outcome 1 | Outcome 2 | Outcome 3 | Outcome 4 | Outcome 5

Outcome 6 | Outcome 7 | Outcome 8 | Outcome 9 | Outcome 10

Outcome 11 | Outcome 12 | Outcome 13 | Outcome14 | Outcome 15

BACK NEXT

There could be more than one outcome measure identified. The following page would be completed for each outcome identified.

Data abstraction form for general population (continued)

Outcome 1 Definition

Short outcome name: .....

Outcome name: [ ]

Outcome measure: [ ]

How was outcome measured:

☐ Resource utilization	☐ Attendance record review	☐ Other .....
☐ Observation	☐ Physical activity log	
☐ Interview	☐ Accelerometer	
☐ Self administed questionnaire	☐ Pedometer	
☐ Fitness test	☐ Not reported	

Units: .....

Describe how was outcome measured:

.....

.....

.....

To enter additional outcome names, first click below to bring up "outcome". Then enter additional outcomes in list. Try not to create more than one name for the same outcome.

[ ] **Click Here**

[ ]

To enter additional outcome measures for an outcome, first click below to bring up the outcome name. Then enter additional outcome measures in the list. Try not to create more than one name for the same outcome.

[ ]

BACK

Data abstraction form for general population (continued)

Exposure to Intervention

Assessment of exposure to the intervention:

- ☐ Resource utilization → Describe:
- ☐ Observation → Describe:
- ☐ Self report → Describe:
- ☐ Fitness test → Describe:
- ☐ Attendance sheets → Describe:
- ☐ Staff completed process evaluation forms → Describe:
- ☐ % of completed interaction contacts → Describe:
- ☐ Not reported/did not assess → Describe:
- ☐ Other…

BACK NEXT

Results and Mediators

Was there a univariate or bivariate model used with no adjustments employed?

○ Yes → Paper ID(s), Page numbers, Table numbers
○ No .....
.....
.....

Was there a multivariate model used?

○ Yes → Paper ID(s), Page numbers, Table numbers
○ No .....
.....

Were results examined for sub-groups?

○ Yes → Paper ID(s), Page numbers, Table numbers
○ No .....
.....

Mediators

Were there any hypothesized mediators for changes in PA behavior?

○ Yes → Describe: .....
○ No .....
.....

Was exposure to mediators assessed?

○ Yes → Describe: .....
○ No .....
.....

Was there any statistical analysis to assess whether change in mediator was associated with the change in physical activity?

○ Yes → Paper ID(s), Page numbers, Table numbers
○ No .....

BACK NEXT

Data abstraction form for general population (continued)

Other information

What other key issues were addressed in the paper?

- ☐ Costs
- ☐ Potential harms
- ☐ Other benefits
- ☐ Implementation
- ☐ Barriers to implementation
- ☐ Community acceptance or involvement
- ☐ formation of use of existing coalitions to develop, implement or evaluate interventions
- ☐ Ethical constraints
- ☐ Not discussed
- ☐ Other…

Other important information:

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Relevant references:

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BACK NEXT

Data abstraction form for general population (continued)

Study quality: Descriptions and Samplings

Descriptions:

Was the study sample well described?

O Yes O No

Was the intervention well described (what, how, who, where)?

O Yes O No

Explain:

.....
.....
.....
.....
.....

Samplings:

Did the authors specify the sampling frame or universe of selection for the study sample?

O Yes O No O NA O NR

Was the sample that served as the unit of analysis the entire eligible sample or a probability sample at the point of reference?

O Yes O No O NA O NR

Are there other selection bias issues not otherwise addressed?

O Yes O No O NA O NR

Explain:

.....
.....
.....
.....
.....

BACK NEXT

Study quality: Measurement

Measurement:

Did the authors attempt to measure exposure to the intervention?

○ Yes ○ No ○ NA ○ NR

Was the exposure variable valid?

○ Yes ○ No ○ NA ○ NR

Was the exposure variable reliable (consistent and reproducible)?

○ Yes ○ No ○ NA ○ NR

Were the outcome and other independent (or predictor) variables valid?

○ Yes ○ No ○ NA ○ NR

Were the outcome and other independent (or predictor) variables reliable (consistent and reproducible)?

○ Yes ○ No ○ NA ○ NR

Explain:

.....

.....

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.....

BACK NEXT

Study quality: Analysis

Data analysis:

Did the authors conduct appropriate statistical testing by:

conducting statistical testing (when appropriate)?

○ Yes ○ No ○ NA ○ NR

reporting which statistical tests were used?

○ Yes ○ No ○ NA ○ NR

controlling for repeated measures in samples that were followed over time?

○ Yes ○ No ○ NA ○ NR

controlling for differential exposure to the intervention?

○ Yes ○ No ○ NA ○ NR

using a model designed to handle multi-level data when they included group-level and individual covariates in the model?

○ Yes ○ No ○ NA ○ NR

Explain:

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BACK NEXT

Study quality: Interpretation

Interpretation of Results:

Did at least 80% of enrolled participants complete the study?

○ Yes ○ No ○ NA ○ NR

Did the authors assess if the units of analysis were comparable prior to exposure to the intervention?

○ Yes ○ No ○ NA ○ NR

Did the authors institute study procedures to limit bias appropriately (e.g. randomization, restriction, matching, stratification or statistical adjustment)?

○ Yes ○ No ○ NA ○ NR

Bias and confounders: Taken de novs from the paper, you may check both yes and no. If you check yes, be sure to describe all potential biases or unmeasured/contextual confounders NOT identified by the authors. For all responses indicate the likely direction of effect on the result if possible:

☐ Yes ☐ No

Authors: .....

.....

Reviewers: .....

.....

Other:

Other important limitations not specified elsewhere (specify):

.....

.....

.....

.....

.....

BACK | To first screen

Data abstraction form for cancer population

Data Abstraction Form

Tracking Information: **original edited based on other info:** ○ Yes ○ No

Abstractor: _____

Study Name (if has one): ..... **>1 study in papers:** ☐

Citation: Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Paper ID: _____ First Author _____

Journal: _____ Publication year _____

Funding Source: ☐ Government ☐ Private ☐ Non-funded ☐ Unknown

Study Type: ○ Journal article ○ Technical report ○ Other...

Next Page

Data abstraction form for cancer population (continued)

Verification/Selection of Study Eligibility

Stop if any of the following is "No"

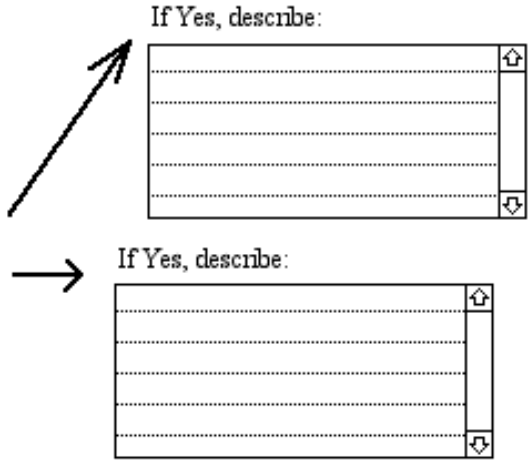
Reported on a behavioral intervention or policy change	○ Yes	○ No	○ Unclear
Intervened on physical activity /physical fitness	○ Yes	○ No	○ Unclear
Concurrent comparison group with reported results	○ Yes	○ No	○ Unclear
Targets subjects with a diagnosis of cancer	○ Yes	○ No	○ Unclear
Targets adults	○ Yes	○ No	○ Unclear

Other info, record but do not stop:

Cancer type:	☐ Breast	☐ Colon	☐ Other…
Survivors:	○ Yes	○ No	○ Unclear
Subjects currently on treatment	○ Yes	○ No	○ Unclear

Do not stop for following but bring information to meeting for discussion:

Is there any other disease in this sample?	○ Yes	○ No	○ Unclear
Are there any other risk factors in this sample?	○ Yes	○ No	○ Unclear



BACK NEXT

Data abstraction form for cancer population (continued)

Classification Information

A. Study Design:

○ Randomized
○ Non-randomized
○ Other…

} ○ Individual ○ Group

B. Study Sample:

Eligibility Criteria:

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Setting for recruitment (check all that apply):

☐ Unknown
☐ School
☐ Community
☐ Worksite
☐ Primary care or health care
☐ Home
☐ Public health agency → ○ Federal ○ State ○ Local → Specify: .....
☐ Other governmental agency → ○ Federal ○ State ○ Local → Specify: .....
☐ Other…

BACK NEXT

Intervention Information

C. Interventions:

Number of intervention groups: _____

Number of comparison groups: _____

Intervention part of a larger study?:

○ Yes → **If Yes, Describe:**
○ No

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.....

Intervention description:

If more than one comparison group, enter comparison groups as "intervention" groups starting with #1. For all of the groups, select below each button whether the group is an intervention or comparison group.

Comparison group	Intervention Group #1	Intervention group #2	Intervention Group #3	Intervention Group #4	Intervention Group #5	Intervention Group #6

You should enter intervention information for all groups before proceeding. You should have entered information on

groups. You should see a working name for each intervention above the buttons.

C. Sampling of the population:

To create the comparison and intervention groups, were groups sampled (e.g., clinics or schools) or individuals?

Groups | Individuals

BACK

If there was only one comparison group, the following three pages were completed.

Intervention description: Comparison group (page 1)

Working name (less than 8 characters): .....

Intervention setting:

- ☐ Unknown
- ☐ School
- ☐ Community
- ☐ Worksite
- ☐ Primary care or health care
- ☐ Home
- ☐ Public health agency → ○ Federal ○ State ○ Local → Specify: .....
- ☐ Other governmental agency → ○ Federal ○ State ○ Local → Specify: .....
- ☐ Other…

For this group, was there a physical activity intervention, non-physical activity intervention or neither?

○ Physical activity intervention ○ Non-physical activity intervention ○ No specific intervention

Were there other intervention elements? if so describe:

○ Yes ○ No ○ Unclear

.....

PA Mode/Type:

- ☐ Aerobic activity undefined or multiple modes
- ☐ Not specified
- ☐ Other…

PA Intensity:

.....

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PA Frequency:

sessions per week _____ ○ Not specified ○ Not clear

PA duration: (short vs long bouts)

_____ ○ Not specified ○ Not clear

BACK NEXT

Intervention description: Comparison group (page 2)

PA location:

☐ Home ☐ Community ☐ Worksite ☐ Not specified ☐ Other…
☐ Exercise facility ☐ School ☐ Assisted Living Facility ☐ Not clear

Intervention Mode:

☐ Mail ☐ Internet or email ☐ Not specified
☐ Telephone ☐ In person ☐ Other…

Intervention delivery:

☐ Individual ☐ Group ☐ Not specified

BACK NEXT

Intervention description: Comparison group (page 3)

Description of the intervention:

What:

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How:

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Who:

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Where:

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Other:

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Total length of the intervention: .....

Maximum length of follow-up for this intervention: .....

Was there a theory presented as 'underlying the intervention'?:

○ Yes → Describe:
○ No

- ☐ Social Learning Theory ..... (Bandura 1977)
- ☐ Social Cognitive Theory ..... (Bandura 1986)
- ☐ Transtheoretical Model or Stages of Change ..... (Prochaska)
- ☐ Decision Making Theory ..... (Janis and Mann)
- ☐ Social Ecology Theory ..... (Stokel)
- ☐ Problem Behavior Model ..... (Jessor and Jessor)
- ☐ Motivational Interviewing .....
- ☐ Health Belief Model .....
- ☐ Other.....

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BACK NEXT

If there was more than one comparison group, they were identified as intervention groups starting with #1 up to #6. For each interventionm they completed the next three pages.

Intervention description: Intervention group 1 (page 1)

Working name (less than 8 characters): .....

Intervention setting:

- ☐ Unknown
- ☐ School
- ☐ Community
- ☐ Worksite
- ☐ Primary care or health care
- ☐ Home
- ☐ Public health agency → ○ Federal ○ State ○ Local → Specify: .....
- ☐ Other governmental agency → ○ Federal ○ State ○ Local → Specify: .....
- ☐ Other…

For this group, was there a physical activity intervention, non-physical activity intervention or neither?

○ Physical activity intervention ○ Non-physical activity intervention ○ No specific intervention

Were there other intervention elements? if so describe:

○ Yes ○ No ○ Unclear .....

PA Mode/Type:

- ☐ Aerobic activity undefined or multiple modes
- ☐ Not specified
- ☐ Other…

PA Intensity:

.....

PA Frequency:

sessions per week _____ ○ Not specified ○ Not clear

PA duration: (short vs long bouts)

_____ ☐ ○ Not specified ○ Not clear

BACK NEXT

Intervention description: Intervention group 1 (page 2)

PA location:

☐ Home ☐ Community ☐ Worksite ☐ Not specified ☐ Other...
☐ Exercise facility ☐ School ☐ Assisted Living Facility ☐ Not clear

Intervention Mode:

☐ Mail ☐ Internet or email ☐ Not specified
☐ Telephone ☐ In person ☐ Other...

Intervention delivery:

☐ Individual ☐ Group ☐ Not specified

BACK NEXT

Intervention description: Intervention group 1 (page 3)

Description of the intervention:

What:

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How:

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Who:

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Where:

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Other:

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Total length of the intervention: .....

Maximum length of follow-up for this intervention: .....

Was there a theory presented as 'underlying the intervention'?:

○ Yes → Describe:
○ No

- ☐ Social Learning Theory ..... (Bandura 1977)
- ☐ Social Cognitive Theory ..... (Bandura 1986)
- ☐ Transtheoretical Model or Stages of Change ..... (Prochaska)
- ☐ Decision Making Theory ..... (Janis and Mann)
- ☐ Social Ecology Theory ..... (Stokel)
- ☐ Problem Behavior Model ..... (Jessor and Jessor)
- ☐ Motivational Interviewing .....
- ☐ Health Belief Model .....
- ☐ Other .....

BACK NEXT

Population and Sample Number (Groups sampled)

Type of Group: _____

Total number of groups within population of groups: ..... ○ Not noted

How sampled:							
Number Groups Enrolled:	.....	.....	.....	.....	.....	.....	.....
How sampled:							
Number Individuals Enrolled:	.....	.....	.....	.....	.....	.....	.....

Is the response rate from the sampling frame indicated in the paper?

○ Yes → Describe: .....
○ No .....

BACK NEXT

Population and Sample Number (Individuals sampled)

"N" for sampling frame: ..... ○ Not noted

How sampled:							
Number Individuals Observed:	.....	.....	.....	.....	.....	.....	.....

Is the response rate from the sampling frame indicated in the paper?

○ Yes → Describe: .....
○ No .....

BACK NEXT

Data abstraction form for cancer population (continued)

Sample Demographics

								Sig.
Age:								
Mean	.....	.....	.....	.....	.....	.....	.....	
Standard deviation:	.....	.....	.....	.....	.....	.....	.....	
Median	.....	.....	.....	.....	.....	.....	.....	
Age Range:	..... --	..... --	..... --	..... --	..... --	..... --	..... --	
Other:	.....	.....	.....	.....	.....	.....	.....	
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Gender:								
% male	.....	.....	.....	.....	.....	.....	.....	
% female	.....	.....	.....	.....	.....	.....	.....	
% unknown	.....	.....	.....	.....	.....	.....	.....	
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Race:								
% White	.....	.....	.....	.....	.....	.....	.....	
% Black	.....	.....	.....	.....	.....	.....	.....	
% Asian	.....	.....	.....	.....	.....	.....	.....	
% American Indian	.....	.....	.....	.....	.....	.....	.....	
%Pacific	.....	.....	.....	.....	.....	.....	.....	
% Other	.....	.....	.....	.....	.....	.....	.....	
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Ethnicity:								
% Hispanic or Latino	.....	.....	.....	.....	.....	.....	.....	
% **NOT** Hispanic/Latino	.....	.....	.....	.....	.....	.....	.....	
% Other	.....	.....	.....	.....	.....	.....	.....	
Not reported:	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	○ NR	
Socioeconomic status:								

○ TO **Check here if only total population numbers reported so column represents total sample**

Paper ID, page & table:

BACK NEXT

Data abstraction form for cancer population (continued)

Other Sample Characteristics

								Sig.

○ TQ **Check here if only total population numbers reported so column represents total sample**

Paper ID, page & table:

Data abstraction form for cancer population (continued)

Exposure to Intervention

Assessment of exposure to the intervention:

- ☐ Resource utilization → Describe:
- ☐ Observation → Describe:
- ☐ Self report → Describe:
- ☐ Fitness test → Describe:
- ☐ Attendance sheets → Describe:
- ☐ Staff completed process evaluation forms → Describe:
- ☐ % of completed interaction contacts → Describe:
- ☐ Not reported/did not assess → Describe:
- ☐ Other…

BACK NEXT

Other information

What other key issues were addressed in the paper?

- ☐ Costs
- ☐ Potential harms
- ☐ Other benefits
- ☐ Implementation
- ☐ Barriers to implementation
- ☐ Community acceptance or involvement
- ☐ formation of use of existing coalitions to develop, implement or evaluate interventions
- ☐ Ethical constraints
- ☐ Not discussed
- ☐ Other…

Other important information:

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Relevant references:

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BACK NEXT

Study quality: Descriptions and Samplings

Descriptions:

Was the study sample well described?

O Yes O No

Was the intervention well described (what, how, who, where)?

O Yes O No

Explain:

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.....

Samplings:

Did the authors specify the sampling frame or universe of selection for the study sample?

O Yes O No O NA O NR

Was the sample that served as the unit of analysis the entire eligible sample or a probability sample at the point of reference?

O Yes O No O NA O NR

Are there other selection bias issues not otherwise addressed?

O Yes O No O NA O NR

Explain:

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BACK NEXT

Study quality: Measurement

Measurement:

Did the authors attempt to measure exposure to the intervention?

○ Yes ○ No ○ NA ○ NR

Was the exposure variable valid?

○ Yes ○ No ○ NA ○ NR

Was the exposure variable reliable (consistent and reproducible)?

○ Yes ○ No ○ NA ○ NR

Were the outcome and other independent (or predictor) variables valid?

○ Yes ○ No ○ NA ○ NR

Were the outcome and other independent (or predictor) variables reliable (consistent and reproducible)?

○ Yes ○ No ○ NA ○ NR

Explain:

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BACK NEXT

Study quality: Analysis

Data analysis:

Did the authors conduct appropriate statistical testing by:

conducting statistical testing (when appropriate)?

O Yes O No O NA O NR

reporting which statistical tests were used?

O Yes O No O NA O NR

controlling for repeated measures in samples that were followed over time?

O Yes O No O NA O NR

controlling for differential exposure to the intervention?

O Yes O No O NA O NR

using a model designed to handle multi-level data when they included group-level and individual covariates in the model?

O Yes O No O NA O NR

Explain:

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BACK NEXT

Study quality: Interpretation

Interpretation of Results:

Did at least 80% of enrolled participants complete the study?

○ Yes ○ No ○ NA ○ NR

Did the authors assess if the units of analysis were comparable prior to exposure to the intervention?

○ Yes ○ No ○ NA ○ NR

Did the authors institute study procedures to limit bias appropriately (e.g. randomization, restriction, matching, stratification or statistical adjustment)?

○ Yes ○ No ○ NA ○ NR

Bias and confounders: Taken de novs from the paper, you may check both yes and no. If you check yes, be sure to describe all potential biases or unmeasured/contextual confounders NOT identified by the authors. For all responses indicate the likely direction of effect on the result if possible:

☐ Yes ☐ No

Authors: .....

.....

Reviewers: .....

.....

Other:

Other important limitations not specified elsewhere (specify):

.....

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BACK | To first screen

Appendix D

Characteristics of Physical Activity Interventions in the Studies of the General Population

Appendix D. Characteristics of physical activity interventions in the studies of the general population
(Studies are sorted by intervention setting)

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Hillsdon et al., 2002[97]	1	Primary/health care Home/telephone In person Telephone Health promotion specialist Unknown telephone caller	1 30-minute session in person 6 3-minute motivational interviewing phone consultations over 34 weeks	Stage of change None	Not specified Not specified Not specified Not specified	Written feedback/verbal encouragement Benefits and barriers Assessment of motivation and confidence Exploring concerns about taking up regular PA Helping with decision making None	Motivational Interviewing
	2	Primary/health care Home/telephone In person Telephone Health promotion specialist Unknown telephone caller	1 30-minute session in person 6 3-minute phone consultations over 34 weeks to give direct advice	None None	Not specified Moderate Intensity 5 days/week 30 minutes Aerobic activity	Education on why one should exercise None	Health Belief Model
Bull et al., 1998[113] Bull et al., 1999[57]	1	Primary/health care In person Mail Family physician Pamphlet	1 3-minute physician advice session 1 mailed standardized pamphlet	None None	Not specified Moderate Intensity 5 days/week 30 minutes Not specified	Education on why one should exercise Education on normal response to exercise Benefits and barriers Written feedback/verbal encouragement Self efficacy enhancement Problem solving Education on how to exercise Injury concerns were discussed None	Transtheoretical Model Social Cognitive Theory

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Primary/health care In person Mail Family physician Pamphlet	1 3-minute physician advice session 1 mailed tailored pamphlet	Stage of change Other psycho-logical variables None	Not specified Moderate intensity 5 days/week 30 minutes Not specified	Education on normal response to exercise Education on why one should exercise Benefits and barriers Self efficacy enhancement Education on how to exercise Written feedback/verbal encouragement Problem solving None	Transtheoretical Model Social Cognitive Theory
Steptoe et al., 2000[75] Steptoe et al., 1999[58] Steptoe et al. 2001[131] Hilton et al., 1999[130]	Control	Primary/health care In person Nurse	1 contact: 'usual care' in a primary care clinic	None Diet Smoking cessation	Not specified Moderate to vigorous 12 sessions per month Not specified	Benefits and barriers Written feedback/verbal encouragement Suggestions about different activities Education on why one should exercise None	None
	1	Primary care/health care In person Nurse	3-6 contacts: 1 'usual care' visit with a nurse in a primary care clinic 2-3 20-minute counseling sessions 1-2 phone consultations to encourage behavior change	Stage of change Diet Smoking cessation	Not specified Moderate intensity 12 sessions per month Not specified	Skill building Incentives and contracts Self monitoring Goal setting Relapse prevention Benefits and barriers Education on why one should exercise None	Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Kreuter & Strecher, 1996[155]	1	Primary/health care Computerized feedback system Mail Physician Mailing	1 physician office visit 1 mailing	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Written feedback/verbal encouragement Education on why one should exercise None	None
	2	Primary/health care Computerized feedback system Mail Physician Mailing	1 physician office visit 1 mailing	Risk factor status Stage of change Other psycho-logical variables Diet Smoking cessation	Not specified Not specified Not specified Not specified	Written feedback/verbal encouragement Benefits and barriers Relapse prevention Education on why one should exercise None	Health Belief Model Transtheoretical Model
Halbert et al., 1999[132] Halbert et al., 2000[59]	Control	Primary/health care Not specified Possibly physician advice Exercise specialist	20-minute diet counseling session with exercise specialist May have received exercise advice from physician	None Diet	Not specified Not specified Not specified Not specified	None None	None
	1	Primary/health care In person Possibly physician advice Exercise specialist	3 visits with the exercise specialist (baseline, 3 months, 6 months) May have received exercise advice from physician	Individualized based on progress, enthusiasm, health None	Not specified Moderate Intensity 3+ days/week 20+ minutes Aerobic	Benefits and barriers Self efficacy enhancement Goal setting Self monitoring Education on why one should exercise None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Harland et al., 1999[135]	Control	Primary/health care In person Not specified	1 contact: Test results packet with information on health habits, leaflets on local exercise opportunities, and brief advice targeted by test results	Results of baseline fitness testing Diet Smoking cessation	Not specified Not specified Not specified Not specified	Written feedback/verbal encouragement Benefits and barriers Education on why one should exercise Information on local exercise opportunities None	None
	1	Primary/health care or exercise facility (participant choice) In person Health visitor	2 contacts: Test results packet with information on health habits, leaflets on local exercise opportunities, and brief advice targeted by test results plus 1 40-minute motivational interview within 2 weeks	Results of baseline fitness testing Stage of change Diet Smoking cessation	Not specified Not specified Not specified Not specified	Benefits and barriers Education on why one should exercise Written feedback/verbal encouragement None	Motivational Interviewing Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Primary/health care or exercise facility (participant choice) In person Health visitor	2 contacts: Test results packet with information on health habits, leaflets on local exercise opportunities, and brief advice targeted by test results plus 1 40-minute motivational interview within 2 weeks plus 30 vouchers entitling free access to exercise facility	Results of baseline fitness testing Stage of change Diet Smoking cessation	Not specified Not specified Not specified Not specified	Benefits and barriers Incentives and contracts Written feedback/verbal encouragement Education on why one should exercise Accessibility	Motivational Interviewing Transtheoretical Model
	3	Primary/health care or exercise facility (participant choice) In person Mail Health visitor	6 contacts in 3 months: Test results packet with information on health habits, leaflets on local exercise opportunities, and brief advice targeted by test results plus 5 40-minute motivational interview over 12 weeks	Results of baseline fitness testing Stage of change Diet Smoking cessation	Not specified Not specified Not specified Not specified	Benefits and barriers Written feedback/verbal encouragement Education on why one should exercise None	Motivational Interviewing Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	4	Primary/health care or exercise facility (participant choice) In person Mail Health visitor	6 contacts in 3 months: Test results packet with information on health habits, leaflets on local exercise opportunities, and brief advice targeted by test results plus 5 40-minute motivational interview over 12 weeks PLUS 30 vouchers entitling free access to exercise facility	Results of baseline fitness testing Stage of change Diet Smoking cessation	Not specified Not specified Not specified Not specified	Incentives and contracts Benefits and barriers Written feedback/verbal encouragement Education on why one should exercise Accessibility	Motivational Interviewing Transtheoretical Model
Kerse et al., 1999[60]	1	Primary/health care In person Not specified	Not specified (Intervention to doctors was 5 sessions over 2-3 months. Intervention to patients (from doctors) not described)	None None	Not specified Not specified Not specified Not specified	Not specified None	None
Eckstrom et al., 1999[136]	1	Primary/health care In person Physician advice	Not specified	Stage of change None	Not specified Not specified Not specified Not specified	Not specified None	Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Graham-Clarke & Oldenburg, 1994[117] A Fresh Start	1	Primary/health care In person General practitioner	1 video 1 health risk assessment	Stage of change Risk factor status Diet Smoking cessation	Not Specified Not specified Not specified Not specified	Education on why one should exercise Benefits and barriers Self monitoring Goal setting Skill building Education on normal response to exercise Education on how to exercise Relapse prevention None	Transtheoretical Model
	2	Primary/health care In person General practitioner	1 Health Risk Assessment 1 video 1 set of self-help booklets	Stage of change Risk factor status Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on why one should exercise Benefits and barriers Self monitoring Goal setting Skill building Education on normal response to exercise Education on how to exercise Relapse prevention None	Transtheoretical Model
Green et al., 2002[61]	Control	Primary/health care Mailing Physician signed letter	1 mailing	Risk factor status Diet Smoking cessation	Not specified Not specified Not specified Not specified	None None	None
	1	Primary/health care Phone call Mail Telephone Physician Behavioral health specialist	5 contacts in 3 months: 2 mailings 3 motivational counseling phone calls (20-30 minutes each)	Risk factor status Diet Smoking cessation	Not specified Moderate intensity Frequency not reported 30 minutes Not specified	Benefits and barriers Goal setting Problem solving Social support None	Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Keyserling et al., 2002[150] Keyserling et al., 2000[232]	Control	Primary/health care Mail American Diabetes Association pamphlets	1 mailing	None Diet	Not specified Not specified Not specified Not specified	None None	None
	1	Primary/health care In person Counselor	4 individual clinic based counseling sessions in 6 months	Individualized counseling Disability status (chair exercises for non-ambulatory participants) Diet	Not specified Moderate intensity 7 days/week 30 minutes Aerobic and non-aerobic activity	Benefits and barriers Goal setting Self-monitoring Education on why one should exercise Written feedback/verbal encouragement Problem solving None	Behavior Change Theory
(Note: this group is NOT included in the analysis because they had no 3 month followup)	2	Primary health care Community In person Telephone Counselors Community Diabetes Educators	19 contacts over 12 months: 4 individual clinic based counseling sessions in 6 months 3 group sessions over 12 months 12 monthly calls from community diabetes educator	Individualized counseling Disability status (chair exercises for non-ambulatory participants) Diet	Not specified Moderate intensity 7 days/week 30 minutes Aerobic and non-aerobic activity	Social Support Benefits and barriers Goal setting Self-monitoring Education on why one should exercise Written feedback/verbal encouragement Problem solving None	Behavior Change Theory
Smith et al., 2000[164]	1	Primary/health care In person General practitioner	1 physician's visit with physical activity advice	None None	Not specified Not specified Not specified Not specified	None None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Primary/health care In person Mail General practitioner Booklet	2 contacts in 6-10 weeks: 1 physician's visit with physical activity advice 1 stage matched brochure mailed home 2 weeks later	Stage of change None	Not specified Not specified Not specified Not specified	None None	Transtheoretical Model
Knutsen & Knutsen, 1989[151] Knutsen & Knutsen, 1991[152] Thelle et al., 1976[154]	1	Primary/health care Home In person Mail Unknown letter writer Home-visit physicians Newsletters	2 years: 1 letter 2 home visits (1 from a physician, 1 from a dietician) 2 phone calls 8 newsletters Offer of repeated lipid testing at 2 years	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on why one should exercise Education on available community opportunities for physical activity None	None
Luepker et al., 1994[49] Jacobs et al., 1986[142] Mittelmark et al., 1986[144] Carlaw et al., 1984[141]	1	Community Worksite School Telephone In person Mass media Not specified	5 years: Community wide interventions with multiple individual programs	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Written feedback/verbal encouragement Skill building Education on why one should exercise Modeling Social support Incentives and contracts Social marketing None	Social Learning Theory Diffusion of innovation theory
Miller et al., 2002[78]	1	Community Mail Mail	1 mailing	None None	Not specified Not specified Not specified Not specified	Benefits and barriers Education on why one should exercise None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Community Preschools/childcare center In person Mail Mail Other moms	1 discussion session to explore barriers to physical activity participation in moms with young children 1 mailing 1 phone call after group discussion Postings on bulletin boards at childcare centers as to physical activity opportunities Other intervention activities less well defined	None None	Not specified Not specified Not specified Not specified	Benefits and barriers Social support / networking Provision of equipment Social advocacy Capacity building Lobbying exercise providers to provide childcare or convenient class times Formation of walking groups Education on why one should exercise Accessibility	None
Caserta & Gillett, 1998[115] Gillet et al., 1996[63] Gillet & Caserta, 1996[79]	1	Community In person Experienced geriatric nurse practitioner	64 classes in 16 weeks	None None	Not specified Vigorous intensity 3 days/week 30 minutes Aerobic and non-aerobic activity	Social support Education on normal response to exercise Education on why one should exercise Self monitoring Written feedback/verbal encouragement Accessibility	None
	2	Community In Person Experienced geriatric nurse practitioner	16 classes in 16 weeks	None None	Home Vigorous intensity 3-5 days/week 30 minutes Aerobic activity	Self monitoring Education on normal response to exercise Written feedback/verbal encouragement Education on why one should exercise None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Elder et al., 1995[148] Mayer et al., 1994[233]	1	Community In person/phone Counselors were students in public health/health sciences. Classroom facilitators were project coordinator, students, & retired health professionals.	11+ contacts in 24 months: Health risk assessment feedback counseling 1 set written materials 2 followup phone calls at 5 month intervals 8 health education classes	Individualized by exercise preferences or goals Risk factor status Diet Home safety Motor vehicle safety	Not specified Moderate 30 minutes 3x weekly Aerobic	Goal setting Written feedback/verbal encouragement Skill building Education on why one should exercise Problem solving Self-monitoring Self-evaluation Self-reinforcement None	Social Learning Theory Kanfer's model of Self-Control & Self-Change Model
Godin et al., 1987[116]	1	Community In person Not specified	2 contacts: 1 lab visit for fitness test 1 lab visit to hear results of test	None None	Not specified Not specified Not specified Not specified	None None	None
	2	Community In person Not specified	2 contacts: 1 lab visit for fitness test and health age appraisal 1 lab visit to hear results	Individualized None	Not specified Not specified Not specified Not specified	None None	None
	3	Community In person Not specified	2 contacts: 1 lab visit for health age appraisal 1 lab visit to hear results	Individualized None	Not specified Not specified Not specified Not specified	None None	None
Owen et al., 1987[161]	Control	Community In person Certified fitness instructors	24 classes over 12 weeks	Schedule/time preference None	Exercise facility Moderate intensity 2 days/week 60 minutes Aerobic	None None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	1	Community In person Certified fitness instructors	24 classes over 12 weeks 1 meeting with certified fitness instructor 2 homework assignments	Schedule/time preference None	Exercise facility Home Moderate intensity 2 days/week 60 minutes Aerobic	Benefits and barriers Education on why one should exercise Goal setting Problem solving Education on normal response to exercise Self-management Self monitoring Planning a personal schedule of programmed exercise Resuming exercise safely after time off Planning future exercise patterns Gradual fading of instructor guidance Education on how to exercise None	None
Owen et al., 1987[77]	Control 1	Community Not applicable Not applicable	No intervention: control group was made up of those who were offered an intervention but then refused intervention	Not applicable Not applicable	Not applicable Not applicable Not applicable Not applicable	Not applicable Not applicable	Not applicable
(This second external comparison group is not included in the results or evidence table)	Control 2	Community In person Qualified fitness instructor	24 fitness classes in 12 weeks (2 days/ week)	None None	Community Not specified 2 days/week Aerobic and non-aerobic activity	"Program contained elements derived from behavioral theories and emphasized training in self-management methods" [77] None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Community Mail Not specified	2 mailings in 12 weeks	None None	Not specified Not specified Not specified Aerobic and non-aerobic activity	Planning strategies Setting up environmental cues to exercise Self-reinforcement Self-talk strategies Education on normal response to exercise Education on why one should exercise Benefits and barriers Relapse prevention Incentives and contracts Self monitoring Problem solving None	None
	3	Community Mail Not specified	7 mailings in 12 weeks (The only difference between groups 2 and 3 was spreading out the mailings differently)	None None	Not specified Not specified Not specified Aerobic and non-aerobic activity	Planning strategies Setting up environmental cues to exercise Self-reinforcement Self-talk strategies Education on normal response to exercise Education on why one should exercise Benefits and barriers Relapse prevention Incentives and contracts Self monitoring Problem solving None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Pereira et al., 1998[64] Kriska et al., 1986[162]	1	Community Mail Telephone In person Exercise leader Unknown caller Peers Unknown home visitor	16+ contacts in 2 years: 16 group walking sessions in 1st 8 weeks followed by 'frequent' social gatherings, phone calls, letters, and occasional home visits over the remainder of the 2 year intervention	Preference of walking alone or in a group None	Community Moderate intensity 7 miles walked per week Aerobic activity	Social support Goal setting Incentives and contracts Problem solving Written feedback/verbal encouragement None	None
Eaton et al., 1999[50] Carleton et al., 1995[166] Carleton et al., 1987[165] McGraw et al., 1989[169] Marcus et al., 1992[167] Levin et al., 1998[168] Pawtucket Heart Health Program	1	Community Worksite School Religious institutions In person Mail Volunteer peers Local media Health educators and counselors Community recreation programs	7 years: Community wide intervention with 3 specific physical activity interventions: Exercity, Get Fit, and Imagine Action	Reading level Stage of change Diet Smoking cessation	Community, schools, worksites, churches Moderate intensity 3-5 days/week 15-60 minutes Aerobic activity	Social support Skill building Education on why one should exercise Maintenance strategies Self monitoring Goal setting Self-reinforcement Written feedback/verbal encouragement Benefits and barriers Relapse prevention Problem solving Incentives and contracts Self efficacy enhancement Accessibility	Social Learning Theory Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Belisle et al., 1987[74]	Control	Community/sports center In person Exercise leader	20 contacts in 10 weeks	None None	Exercise facility Not specified Not specified 3 days/week 45-50 minutes Aerobic and non-aerobic activity	Skill building Injuries Importance of regular program attendance Education on normal response to exercise Education on why one should exercise Accessibility	None
	1	Community/sports center In person Exercise leader	20 contacts in 10 weeks: Health education content is the only difference between the 2 groups	None None	Exercise facility Not specified Not specified 3 days/week 45-50 minutes Aerobic and non-aerobic activity	Relapse prevention Problem solving Self monitoring Education on why one should exercise Energy expenditure of various activities Keeping record/habit maintenance Critical situations Awareness of abstinence violation effect Education on normal response to exercise Self management Skill building Accessibility	Relapse Prevention Model
Belisle et al., 1987[74]	Control	Community/sports center In person Exercise leader	11-14 contacts in 10 weeks	None None	Exercise facility Not specified Not specified 3 days/week 45-50 minutes Aerobic and non-aerobic activity	Skill building Injuries Importance of regular program attendance Education on normal response to exercise Education on why one should exercise Accessibility	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	1	Community/sports center In person Exercise leader	11-14 contacts in 10 weeks	None None	Exercise facility Not specified Not specified 3 days/week 45-50 minutes Aerobic and non-aerobic activity	Relapse prevention Problem solving Self monitoring Education on why one should exercise Energy expenditure of various activities Keeping record/habit maintenance Critical situations Awareness of abstinence violation effect Education on normal response to exercise Self management Skill building Accessibility	Relapse Prevention Model
Kreuter et al., 2000[133] Bull et al. 1999 [134]	1	Primary care/home Mail Mail	1 mailing (general, not personalized)	None Diet Smoking cessation	Not specified Not specified Not specified Aerobic activity	Education on why one should exercise Ways to begin and maintain physical activity Benefits and barriers Following a 3 month physical activity plan None	Transtheoretical Model
	2	Primary care/home Mail Mail	1 mailing general advice, personalized by having name of patient printed on top of first page	Generic material but personalized using the patient's name Diet Smoking cessation	Not specified Not specified Not specified Aerobic activity	Education on why one should exercise Ways to begin and maintain physical activity Benefits and barriers Following a 3 month physical activity plan None	Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	3	Primary care/home Mail Mail	1 mailing Personalized and individualized advice according to answers to physical activity survey	Stage of change Exercise preferences and goals Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on why one should exercise Ways to begin and maintain physical activity Benefits and barriers Following a 3 month physical activity plan Caloric expenditure of preferred activity Specific physical activity goal set by patient Types of physical activity patient preferred None	Transtheoretical Model
Marcus et al., 1998[73] Bock et al., 2001[114]	Control	Home Mail AHA self-help manuals	4 mailings in 6 months: General self-help	None None	Not specified Not specified Not specified Not specified	Education on why it is important to exercise Skill building Goal setting Education on how to exercise safely Relapse prevention How to use rewards None	None
	1	Home Mail Computerized feedback system Individualized self-help materials	4 mailings in 6 months: Tailored stage matched self-help	Stage of change None	Not specified Moderate intensity 5 days/week 30 minutes Aerobic activity	Education on why it is important to exercise Modeling Written feedback/verbal encouragement Incentives and contracts Self efficacy enhancement Benefits and barriers Social support None	Transtheoretical Model

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Blalock et al., 2000[76]	Control	Home Mail Brochure	1 mailing	None Diet	Not specified Not specified Not specified Not specified	Education on why one should exercise None	None
	1	Home Mail Brochure	2 mailings	None Diet	Not specified Not specified Not specified Not specified	Education on why one should exercise (information only)	None
	2	Home Mail Brochure	2 mailings	None Diet	Not specified Not specified Not specified Not specified	Action plan behavioral focus Education on why one should exercise Goal setting Benefits and barriers None	Precautions adoption process model
	3	Home Mail Brochure	2 mailings	None Diet	Not specified Not specified Not specified Not specified	Information PLUS action plan with behavioral focus Education on why one should exercise Goal setting Benefits and barriers None	Precaution adoption process model
Chen et al., 1998[145]	Control	Home Mail Telephone Not specified	1 mailing 1 5 minute phone call	None None	Not specified Moderate intensity Not specified Aerobic activity	Incentives and contracts Education on why one should exercise Benefits and barriers Education on how to exercise None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	1	Home Mail Telephone Trained telephone counselors	6 20-30 minute phone calls 6 mailings over 5 weeks	Individual tailoring None	Not specified Moderate intensity 3-5 days/week 30-60 minutes Aerobic activity	Self-efficacy Education on how to exercise Goal setting Social support Skill building Benefits and barriers Relapse prevention Incentives and contracts Education on why one should exercise Problem solving Written feedback/verbal encouragement None	Social Cognitive Theory
Burke et al., 1998[65]	Control	School Not specified Not specified	2 10 week school terms	None None	School Not specified 3-5 days/week not specified Not specified	None None	None
	1	School In person Teachers	2 10 week school terms 'WASPAN' program only	Fitness levels Diet	School Not specified 3-5 days/week 15-25 minutes/ session Not specified	There were 6 classroom lessons to 'establish a rationale' for the physical activity program. It is likely that the content was behavioral, but the specifics are not provided. None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	School In person Teachers Parents	2 10 week school terms 'WASPAN' program PLUS enrichment, which involved parents for monitoring and encouragement	Fitness levels Exercise preferences Diet	School Home Not specified 3-5 days/week 15-25 minutes Not specified	Goal setting Written feedback/verbal encouragement There were 6 classroom lessons to 'establish a rationale' for the physical activity program. It is likely that the content was behavioral, but the specifics are not provided. None	None
Dale et al., 1998[146] Dale & Corbin, 2000[66]	Control	School In person Teachers	1 school year (Traditional PE)	None None	School Not specified Not specified Not specified	None None	None
	1	School In person Teachers	5 contacts a week for 1 school year: Concept based PE: 1 weekly classroom health education session, 1 weekly session in gymnasium, 3 weekly sessions of sports activities	None None	School Moderate Intensity 5 days/week duration not reported Aerobic activity	Skill building Education on why one should exercise Education on normal response to exercise Self monitoring Goal setting Written feedback/verbal encouragement None	None
Howard et al., 1996[56]	1	School In person Not specified	5 40-minute health education sessions over 5 weeks	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on normal response to exercise Education on why one should exercise None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Lovibond et al., 1986[156]	Control	Worksite In person Mail Therapist	17 contacts in 6 months: 4 individual counseling sessions (did NOT include CHD risk projections or behavioral components. These sessions focused on health education) 12 group sessions 1 mailing	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on normal response to exercise Education on why one should exercise Written feedback/verbal encouragement Goal setting Social support Modeling Social reinforcement Problem solving None	Social Learning Theory
	1	Worksite In person Mail Therapist	17 contacts in 6 months: 4 individual counseling sessions (more personalized than control group, including CHD risk projections. But no behavioral components.) 12 group sessions 1 mailing	Risk factor status Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on normal response to exercise Education on why one should exercise Social reinforcement Written feedback/verbal encouragement Stimulus control Goal setting Self monitoring None	Social Learning Theory

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Worksite In person Mail Therapist	17 contacts in 6 months: 4 individual counseling sessions (personalized, including CHD risk projections. Behaviorally based.) 12 group sessions 1 mailing	Risk factor status Individual needs Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on normal response to exercise Education on why one should exercise Social reinforcement Written feedback/verbal encouragement Contingency management Stimulus control Goal setting Self monitoring None	Social Learning Theory

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Edmundson et al., 1996[118] Luepker et al., 1996[53] Nader et al., 1999[52] Perry et al., 1997[119] Simons-Morton et al., 1997[120] Stone et al., 1996[121] Nader et al., 1996[122] McKenzie et al., 2001[123] McKenzie et al., 1996[124] McKenzie et al., 1994[125] Hearn, 1992[126] McKenzie et al., 1995[127] Elder et al. 1994 [149]	Control	School In person Physical education teachers	3 PE classes per week for 2.5 -3 school years	None None	School Not specified 3 days/week 30 minutes Not specified	Not specified Not specified	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	1	School Home In person Sent home through student Classroom teachers Physical education teachers	3 PE classes per week for 2.5 -3 school years Home program for ½ of intervention schools Plus, changes in health education and school lunch program	Language Diet Smoking cessation	School Home Moderate intensity 3+ days/week 30 minutes Aerobic activity	Self efficacy enhancement Provision of equipment Education on normal response to exercise Education on why one should exercise Skill building Incentives and contracts Social support Written feedback/verbal encouragement Self monitoring Modeling/rehearsing Social norm setting Accessibility	Social Cognitive Theory Social Learning Theory
Nader et al., 1989[129] Nader et al., 1986[128]	1	School Telephone Mail In person Family-oriented newsletter with mail-in contest Trained graduate students	18 contacts in 1 year: 12 weekly sessions then 4 monthly sessions then 2 bi-monthly sessions	Language Diet	School Vigorous intensity 1 day/week 25 minutes Aerobic activity	Self monitoring Goal setting Behavioral rehearsal modeling Self-regulation skills Incentives and contracts Written feedback/verbal encouragement Social support Problem solving Benefits and barriers Self efficacy Education on normal response to exercise Education on why one should exercise Education on how to exercise Accessibility	Social Learning Theory

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Stevens et al., 1998[62]	Control	Community Mail Mail	1 mailing	None None	Not specified Not specified Not specified Not specified	Education on why one should exercise None	None
	1	Exercise facility In person Mail Exercise development officer	3 contacts in 10 weeks: 1 mailing 2 in person consultations with exercise development officer	Personalized exercise prescription None	Not specified Not specified Not specified Not specified	Self monitoring Education on why one should exercise Education on normal response to exercise Access to fitness facility	None
Bauer et al., 1985[51] Rose, 1970[137] Rose et al., 1980[138]	1	Worksite Not specified Not specified Nurses	5 or 6 years: Worksite wide interventions with multiple individual programs and more personalized intervention for men at higher risk for coronary heart disease	None Diet Smoking cessation	Not specified Moderate intensity 7 days/week 20 minutes Aerobic activity	Not specified Not specified	None
Gomel et al., 1993[139] Gomel et al., 1997[140]	Control	Worksite In person Unknown contact	1 30 minute health risk assessment no counseling on results	None None	Not specified Not specified Not specified Not specified	None None	None
	1	Worksite In person Unknown contact	1 50 minute health risk assessment with counseling on results	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	None None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Worksite In person Unknown contact	1-7 contacts in 10 weeks: 1 50-minute health risk assessment with counseling on results Up to 6 group health education classes	Stage of change Risk factor status Diet Smoking cessation	Not specified Not specified Not specified Not specified	Benefits and barriers Self monitoring Goal setting Relapse prevention Problem solving Written feedback/verbal encouragement None	Transtheoretical Model
	3	Worksite In person Unknown contact	1-7 contacts in 10 weeks: 1 50-minute health risk assessment with counseling on results Up to 6 group health education classes Incentives	Stage of change Risk factor status Diet Smoking cessation	Not specified Not specified Not specified Not specified	Incentives and contracts Self monitoring Goal setting Relapse prevention Benefits and barriers Problem solving Written feedback/verbal encouragement None	Transtheoretical Model
Gemson & Sloan, 1995[68]	Control	Worksite In person Physician	1 physicians visit	None None	Not specified Not specified Not specified Not specified	None None	None
	1	Worksite Mail In person Computerized feedback system Physician	1 mailing 1 physicians visit	Risk factor status Diet Smoking cessation	Not specified Not specified Not specified Not specified	None None	None
Lombard et al., 1995[69]	Control	Worksite In person Research assistant Researcher	1 contact in 3 months	None None	Worksite Moderate intensity 3 days/week 20 minutes Aerobic activity	Social support Self-monitoring None	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	1	Worksite In person Telephone Research assistant Researcher	37 contacts in 3 months: Frequent prompting support – 'touching base' by phone	None None	Worksite Moderate intensity 3 days/week 20 minutes Aerobic activity	Social support Self monitoring None	None
	2	Worksite In person Telephone Research assistant Researcher	37 contacts in 3 months: Frequent prompting support – 'verbal encouragement and feedback' by phone	None None	Worksite Moderate intensity 3 days/week 20 minutes Aerobic activity	Social support Goal setting Written feedback/verbal encouragement Self monitoring None	None
	3	Worksite In person Telephone Research assistant Researcher	13 contacts in 3 months: Less frequent prompting support – 'touching base' by phone	None None	Worksite Moderate intensity 3 days/week 20 minutes Aerobic activity	Social support Self monitoring None	None
	4	Worksite In person Telephone Research assistant Researcher	13 contacts in 3 months: Frequent prompting support – 'verbal encouragement and feedback' by phone	None None	Worksite Moderate intensity 3 days/week 20 minutes Aerobic activity	Social support Goal setting Written feedback/verbal encouragement Self monitoring None	None
MacKeen et al., 1985[157] Remington et al., 1978[158] Taylor et al., 1973[159]	1	Worksite Community In person Unknown supervisor	1.5 years	None None	Not specified Vigorous intensity 3+ days/week 60 minutes Aerobic and non aerobic activity	None Accessibility	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Mutrie et al., 2002[70]	1	Worksite Mail Packet	1 contact to encourage walking to commute to work	None None	Community Worksite Not specified Not specified Aerobic activity	Self efficacy enhancement Decisional balance Consciousness raising Practical information to implement intervention Provision of equipment Safety	Transtheoretical Model
O'Loughlin et al., 1996[67]	1	Worksite In person Not specified	1 contact in 3 months	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Education on why one should exercise Written feedback/verbal encouragement Goal setting None	None
Ostwald 1989[160]	Control	Worksite In person Mail Not specified	One all-day seminar Monthly newsletter for 3 months One physical exam	None Diet	Not specified Not specified Not specified Not specified	Education on why one should exercise Written feedback/verbal encouragement None	None
	1	Worksite In person Mail Not specified	One all-day seminar Monthly newsletter for 3 months One physical exam Treadmill test More extensive interpretation of tests than for control group	None Diet	Exercise facility Not specified Not specified Not specified	Education on why one should exercise Written feedback/verbal encouragement Accessibility	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
	2	Worksite In person Mail Exercise physiologist	1 all-day seminar Monthly newsletter for 3 months 1 physical exam Treadmill test More extensive interpretation of tests than for control group 3 months supervised exercise	Individualized exercise prescription Diet	Exercise facility Not specified Three times per week Aerobic	Education on why one should exercise Written feedback or verbal encouragement Provision of equipment Education on normal response to exercise Skill building Education on how to exercise Accessibility	None
Sherman et al., 1989[163]	1	Worksite Not specified Not specified	30 days	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	None	None
Perklo-Makela, 1999[72]	1	Public health agency In person Physiotherapist Occupational health nurse Occupational physician Psychologist Agricultural advisor	10-20 contacts over 2.5 months	None None	Municipal health center Not specified 1-2 days/week duration not reported Aerobic and non-aerobic activity	None Accessibility (class provided)	None

Author/Year	Groups	Intervention Setting Intervention Mode Intervention Delivery	Intervention Length	Intervention Tailoring Additional Intervention Elements	PA Location PA Intensity PA Frequency/Duration PA Mode	Behavioral Components Environmental Components	Theory
Linenger et al., 1991[71]	1	Government agency Local environmental changes Not specified	Environmental changes made early in the year between baseline and followup measures. Changes maintained to end of evaluation and beyond. Length of intervention unknown.	None Diet Smoking cessation	Exercise facility/Naval Air Base Not specified Not specified Aerobic activity	Social support Benefits and barriers Stressed the expectancy of improved performance and improved appearance for future transfer and promotion Incentives and contracts Written feedback/verbal encouragement Accessibility Distance (new facilities built, activity groups formed, hours of facilities extended, point of decision prompts)	None
Edye et al., 1989[147]	Control	Worksite Not specified Not specified	2-4 medical screening visits (depending on risk level) over 3 years Physician advice to be physically active at each visit	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	None None	None
	1	Worksite In person Physician Nurse	2-4 medical screening visits (depending on risk level) over 3 years Physician advice to be physically active at each visit 3 counseling visits with a nurse over 3 month period	None Diet Smoking cessation	Not specified Not specified Not specified Not specified	Verbal encouragement Education on why one should exercise None	None

If no details are listed for the control intervention, that study had no physical activity intervention for the control group

Appendix E
Evidence Tables

Evidence Table 1: General Population (pages 251-272)
Evidence Table 2: Cancer Survivors (pages 273-284)

Evidence Table 1. General population
(Studies are sorted alphabetically by first author)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Bauer, et al., 1985[51] UK Heart Disease Prevention Project	Tested worksite based education program and, for a subset, personal counseling versus no intervention Randomized Group Worksite 953	1) Employed at English and Welsh factories that participated in the study. 2) Male worker. 3) Aged 40 to 59 years. 4) All jobs except for 2 steel work plants where only office staff participated.	1) Somewhat active or greater versus sedentary 2) Moderately active or greater versus sedentary Leisure exercise was assessed on a 4-point scale. Results were reported only for a subset of 5 intervention and 5 control worksites at 4-7 years after intervention.			4 to 7 years 1) Somewhat active or greater versus sedentary 0.196 2) Moderately active or greater versus sedentary 0.030
Belisle et al., 1987[74]	Tested relapse prevention approach in sport center exercise program Randomized Group Sport center 350	Volunteers registering in beginners level exercise groups	1) Adherence to PA, measured by mean # of sessions attended (jogging, aerobic dance, pre-ski)	0 months 1) **0.294**		3 months 1) **0.129**
Belisle et al., 1987[74]	Tested relapse prevention approach in sport center exercise program Randomized Group Sport center 243	Volunteers registering in beginners level exercise groups	1) Adherence to PA, measured by mean # of sessions attended (jogging, aerobic dance, pre-ski)			3 months 1) **0.398**

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Blalock et al., 2000[76]	Tested mailed general osteoporosis information packets, action plans or both					
	Randomized Individual Community 408	1) Women 2) Aged 35-43 years 3) Live in 3 North Carolina counties 4) Have a telephone number listed in a local directory 5) Premenopausal 6) Not have osteoporosis, be pregnant or breast-feeding, or have been advised against increasing their level of exercise or calcium intake by their physician	1) Percent meeting "action" stage of exercise, measured as weight-bearing PA ≥ 3 times/week or currently trying to increase exercise level.			12 months 1) NN
Bull et al., 1999[57] Bull et al. 1998 [113]	Tested brief advice from a family physician and a standard brochure or brief physician advice plus a stage matched tailored brochure versus no advice.					
	Non-Randomized Individual Health care 763	1) Adult patients at the 10 participating family practices that attended the practice over a 3 week time period of recruitment. 2) Being sedentary (reported no vigorous exercise, moderate exercise, or walking in the previous 2 weeks). 3) Exercise was not contraindicated and it was appropriate in context of the consultation to discuss exercise with the patient. Excluded if there was no time in the consultation to discuss PA or he/she was already active.	1) Percent of subjects "now active" (1 episode of PA in last 2 weeks). 2) Total number of exercise sessions in previous 2 weeks 3) Total amount of time exercising in previous 2 weeks	1 month 1) 1: 0.171 2: 0.240 1&2 combined: **0.216** 2) **IS** **3) IN**	6 months 1) 1: 0.218 2: 0.148 1&2 combined: **0.197** 2) IN **3) IN**	12 months 1) 1: 0.077 2: 0.150 1&2 combined: 0.124 2) NN 3) DN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Burke, et al., 1998[65]	Tested effect of physical activity and nutrition program in school for 11 year olds and an "enrichment" program for high risk children versus no intervention at all.					
	Randomized Group School 720	989 children from 18 schools were invited to take part. It is unclear whether *all* children in all 18 schools were invited to participate.	1) Change in shuttle run (# of laps) from baseline for high risk (HR) and low risk (LR) boys and girls 2) Change in 1.5km run (# of laps) from baseline for high risk (HR) and low risk (LR) boys and girls 3) Change in leisure time PA, measure in minutes/week. Based on 7-day PA diary	0 months 1) 1:IN **IS IS IS** 2:**IS IS IS** 2) 1:DN DN DN IN 2:IN DN IN DN 3) 1:NN 2:NN		6 months 1)1:**IS** DS **IS IS** 2:IS IN **IS IS** 2) 1:DN DN DN DN 2:IS NN NN NN 3) 1:NN 2:NN
Caserta & Gillett, 1998[115] Gillett et al. 1996[63] Gillett et al. 1996[79]	Tested health education group or supervised exercise group in women in their 60s					
	Randomized Individual Community 110	**INCLUSION:** 1) Obese older women 2) Community dwelling 3) Sedentary 4) Aged 60-70 yrs The study included non-smokers, who reported only light exercise for the previous six months. **EXCLUSION:** Women whose chronic health or mobility problems precluded vigorous walking. The following were also excluded: women with known cardiovascular, pulmonary, neurological or kidney diseases, uncontrolled hypertension, and debilitating musculoskeletal disorders.	1) Differences in aerobic exercise frequency, days/week, based on 7-day Physical Activity Readiness Questionnaire (PARQ). Aerobic defined as PA at 60-80% maximum heart rate. 2) Aerobic exercise duration (minutes/session), based on 7-day PARQ. Aerobic defined as PA at 60-80% max. heart rate 3) Predicted VO2 maximum using submaximal exercise cycle ergometry	0 months 1) 1 vs 2: **0.414** 2) 1 vs 2: -0.132 3) 1: **1.547** 2: 0.015	3 months 1) 1 vs 2: -0.310 2) 1 vs 2: 0.199 3) 1: **1.266** 2: 0.437	6 months 1) 1 vs 2: -0.611 2) 1 vs 2: 0.090 3) 1: **0.932** 2: 0.135

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Chen et al., 1998[145]	Tested mailed behavior change materials and six telephone based counseling sessions in ethnic minority women versus control					
	Randomized Individual Community 50	1) Women 2) Not currently exercising more than once a week or walking more than 90 minutes per week 3) Able to speak, comprehend, and read English 4) Free of any heart disease or other exclusionary conditions as determined by the PARQ 5) Have a 6th grade education or higher	1) Self-reported minutes walked per week in the last two weeks (derived by multiplying response to times walked by minutes walked per time)	0 months 1) 0.185	3 months 1) -0.236	28 months 1) -0.066
Dale et al., 1998[146] Dale & Corbin 2000 [66]	Tested conceptual physical education program for ninth-grade students versus traditional physical education					
	Non-randomized Group School 334	Graduating classes of 1995 and 1996 at the Project Teens intervention school. (Different followup lengths for each graduating class)	1) Differences in percent of students participating in moderate activity (e.g. walking, bicycling) at least 5 days/week, and at least 30 minutes/day. 2) Differences in percent of students participating in vigorous activity at least 3 days/week and at least 20 minutes/day. 3) Differences in percent of students participating in muscle fitness activities at least 3 days/week.		12 months (Class of 1996) 1) IN DN 2) IN IN 3) IN IN 24 months (Class of 1995) 1) IN IN 2) IN IN 3) IN **IS**	48 months 1) DN IN IN DN 2) DN NN **IS** IN 3) IN IN DN IN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Eaton et al., 1999[50] Carleton et al., 1995[166] Carleton et al., 1987[165] McGraw et al., 1989[169] Marcus et al., 1992[167] Levin et al., 1998[168] Pawtucket Heart Health Program	Tested multiple community wide efforts including school programs, organizational activation and community activation over about 7 years					
	Non-randomized Group Community Worksite 2075	**COMMUNITY:** 2 Communities between 40,000 to 100,000 people. **INDIVIDUAL:** All citizens ages 18-64 that were part of the social community, thus residents of the community, and persons who were working in or visiting the city.	1) Percent sedentary (self report of zero days per week of sweat related physical activity)	1) IN		18 months 1) IN
Eckstrom, et al., 1999[136]	Tested effect of teaching physical activity counseling to internal medicine residents on physical activity of their patients, versus no intervention to internal medicine residents					
	Randomized Group Health care 465	1) Patients who were already scheduled for an appointment during the 3-month physician intervention period were in the pool. Surveys were sent to every third patient on this list, to ensure that more than 10 patients of each physician would be included in the sample.	1) Total activity: "Do you do some regular exercise/" (range, 0-12 based on frequency and duration)			6 months 1) 0.021

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Edmundson et al., 1996[118] Luepker et al., 1996[53] Nader et al., 1999[52] Perry et al., 1997[119] Simons-Morton et al., 1997[120] Stone et al., 1996[121] Nader et al., 1996[122] McKenzie et al., 2001[123] McKenzie et al., 1996[124] McKenzie et al., 1994[125] Hearn, 1992[126] McKenzie et al., 1995[127] Elder et al. 1994 [149] CATCH	Tested school food service modifications, enhanced physical education and classroom health curricula on third through fifth grades Randomized Group School 3396	**GROUPS:** 1) Public elementary schools 2) Distance from one of the four study centers 3) Ethnically diverse 4) Food service potential for intervention 5) Commitment to offering at least a 90 minutes a week physical education class and participating in a 3-year study 6) Willing to cooperate with random assignment to treatment or control status **INDIVIDUALS:** Parental consent to participate and have blood sample result at baseline.	1) Self-reported daily minutes of vigorous physical activity using Self-administered Physical Activity Checklist (SAPAC) (1 day recall of 22 physical activities) 2) Self-reported daily minutes of total physical activity using SAPAC (1 day recall of 22 physical activities)	0 months 1) **0.172** 2) **-0.099**	12 months 1) **0.155** 2) **-0.070**	36 months 1) **0.145** 2) -0.070
Edye et al., 1989[147]	Tested individual counseling by occupational health professionals and 3 counseling sessions with a nurse versus periodic health screening only Randomized Individual Worksite 1937	Work for 1 of 2 Australian government organizations and fit within specific ranges for one of the following risk factors: diastolic blood pressure, cholesterol, smoking, alcohol, obesity, or lack of fitness.	1) Net change in proportion who are not fit (lack of fitness = HR > 120 beats/minute after 2 minutes stepping up and down 20cm step x 30 per minute).			36 months 1) IN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Elder et al., 1995[148]	Tested health risk assessment (HRA) with no feedback versus HRA with feedback, counseling, written materials, 2 phone calls, and 8 health education classes					
San Diego Medicare Prevention Health Project	Randomized Individual Health care 798	Medicare beneficiaries enrolled in a risk-sharing HMO	1) Self-reported frequency, duration, and intensity of exercise per week 2) Self-reported stretching minutes per week	0 months 1) 0.164 2) 0.047		24 months 1) 0.094 2) 0.091
Gemson & Sloan, 1995[68]	Tested effect of a computerized health risk appraisal with counseling					
	Randomized Individual Worksite 90	Merrill Lynch New York City office employees who were at least 30 years old and had been working for the company at least one year, uninterrupted.	1) Change in self-reported PA (number of times/ week)			6 months 1) **0.420**
Godin et al., 1987[116]	Tested effect of providing information on physical fitness, health age or both					
	Randomized Individual Community 130	Adults aged 20 to 60 years old	1) Frequency of participation "in one or more physical activities, lasting 20 to 30 minutes per workout session, in your free time during the last 3 months" [SCALE 1-6: (1) never, (2) less than once a month, (3) about once a month, (4) about two or three times a month, (5) about one or two times a week, and (6) three or more times per week]			3 months 1) 1: 0.369 2: 0.000 3: 0.123

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Gomel et al., 1993[139] Gomel et al. 1997 [140]	Tested worksite based health risk assessment with no risk counseling (control) versus health risk assessment with counseling on results or health risk assessment with counseling on results plus 6 health education sessions, or health risk assessment with counseling on results plus health education plus incentives.					
	Randomized Group Worksite 364	**INCLUSION:** Employees of 28 stations of ambulance service with more than 12 employees in the state of New South Wales, Australia. **EXCLUSION:** The exclusion criteria were an anticipated absence from work of more than 4 weeks during the 3 months following recruitment, imminent transfer to another station not included in the study, and serious health problems that would have precluded involvement in the health risk assessment.	1) Aerobic capacity (O2 consumption), measured in ml x kg-1 x min-1. (Measures at 3, 6, 9, and 12 months which represent different amounts of followup for the 3 intervention groups)	0 months 1) 1:Not available 2:Not available 3:NN	3 months 1) 1:Not available 2:NN 3:Not available 6 months 1) 1:NN 2:Not available	6 months 1) 1:NN 2:Not available 3:IN 12 months 1) 1:IN 2:IN 3:Not available
Graham-Clarke & Oldenburg, 1994[117] A Fresh Start	Tested lifestyle counseling using videos or videos and self help materials in primary care					
	Randomized Group Health care 382	**INCLUSION** 1) Both sexes 2) Aged 18-69 years 3) Were assessed to have one or more modifiable cardiovascular disease risk factors **EXCLUSION:** Suffering from a chronic debilitating disease, were not available for 12 months of followup, or could not speak or write English	1) Energy expenditure (METs)/fortnight. Measured as kilocalories l x kg-1 x hr-1.			12 months 1) NN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Green et al., 2002[61]	Tested mailed tailored health improvement profile (HIP) report from physician with up to 2 pamphlets and free resource line versus same plus 1 additional mailing and 3 motivational counseling phone calls					
	Randomized Individual Health care 256	**INCLUSION:** Patients from a large suburban primary care clinic were recruited. Inactive men and women patients aged 20-64 years (Inactive = exercised <15 min per day, even if they exercise daily.) Interested in increasing exercise in the next 6 months **EXCLUSION:** Patients who were already identified as having heart disease or diabetes were not eligible for this study and received a separate intervention. Forty-five additional patients were excluded because they had either disenrolled or moved after completing the questionnaire. Patients were also excluded if they had conditions that would make it unsafe to increase exercise.	1) Change in PA, measured by self-report on the 11 item Patient-centered Assessment and Counseling for Exercise (PACE) survey.			3 months 1) **0.245**

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Halbert et al., 2000[59] Halbert et al. 1999 [132] The Exercise for Older Adults Project	Tested advice given by an exercise specialist three times over six months in general practitioner's office to sedentary patients over age 60 Randomized Individual Health care 269	**INCLUSION:** 1) Community dwelling men and women aged 60 or older. 2) Participants had to be healthy 3) All subjects had to be sedentary contemplators at study entry. 4) Willing to be randomized **EXCLUSION:** 1) Patients unable to increase their current level of exercise 2) Patients walked or did forms of brisk exercise 3 or more times per week for 20 minutes or more per time 3) History of stroke or myocardial infarction or history of admission for transient ischemic episode or angina in the previous six months, malignancy or other life threatening disease, inability to cooperate with the requirements of the study, having a condition in which physical activity was contraindicated, or if they were taking any beta-blocker medications. 4) Plans to move away during study period	1) Self-reported walking, measured by frequency (sessions/week) 2) Self-reported walking, measured by minutes (minutes/session) 3) Self-reported vigorous exercise [*not defined*] (sessions/week) 4) Self-reported vigorous exercise frequency (minutes/session) 5) Energy expenditure (EE) based on accelerometer, measured as total per day, per day as percent of total EE, during activity per day, or during activity per kg body weight. Adjusted for study group, age, sex, years of education, and household income.	0 months 1) **0.243** 2) NN 3) **0.243** 4) **0.243**		6 months 1) **0.243** 2) NN 3) **0.243** 4) **0.243** 5) NN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Harland et al., 1999[135] The Newcastle Exercise Project	Tested brief or intensive motivational interviewing with or without financial incentive in primary care patients versus control					
	Randomized Individual Health care 442	**INCLUSION:** Patients aged 40 to 64 years old. **EXCLUSION:** Patients unable to complete a sub maximal exercise test were excluded (patients with cardiovascular or respiratory disease causing raised risk), as were patients undertaking regular vigorous exercise at least 3 times a week over the previous 6 months.	1) Increase in self-reported PA score, noted as an increase 1 or more levels from baseline. Assessed by a shortened version of National Fitness Survey: level 0 (no sessions), level 1 = 1-4 sessions, level 2 = 5-11 sessions, level 3 ≥ 12 moderate sessions, level 4 > 12 moderate or vigorous sessions, level 5 (≥ 12 sessions vigorous). Activities categorized as moderate (5-7.5 kcal/min) or vigorous (> 7.5 kcal/min). 2) Increased sessions of vigorous PA 3) Increased sessions of moderate PA	0 months 1) 1: 0.638 2: 0.402 3: 1.029 4: 0.601 2) 1: 0.599 2: 0.317 3: 0.981 4: 0.772 3) 1: 0.631 2: 0.402 3: 0.739 4: 0.584		9 months 1) 1: -0.005 2: 0.042 3: 0.094 4: 0.214 2) 1: 0.247 2: 0.383 3: 0.247 4: 0.383 3) 1: 0.075 2: 0.062 3: 0.011 4: 0.238
Hillsdon, et al., 2002[97]	Tested 30 minutes of brief negotiation (motivational interviewing) or direct advice in middle-aged primary care patients versus no advice at all					
	Randomized Individual Health care 1658	**INCLUSION:** 1) Aged 45-64 years. 2) Registered with two medical centers in Wellingborough, England. 3). Did not undertake regular exercise to improve/maintain their health and/or fitness and had done less than 4 occasions of moderate intensity PA in the last 4 weeks. **EXCLUSION:** They reported a long-standing illness, disability, and/or were permanently sick or disabled and not able to work. Orthopedic, arthritis, and cardiovascular diseases were the most common reasons for medical exclusions.	1) Mean percent change in energy expenditure, Kilocalories/week. Based on self-reported PA, with a logbook of 36 activities and an energy cost assigned to each activity. Adjusted for baseline energy expenditure, age, gender, health status, employment, education, and home earnings.			4.5 months (interventions 1 & 2 combined) 0.021

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Howard et al., 1996[56]	Tested a series of five school-based 40 minute cardiovascular risk education sessions versus no intervention					
	Randomized Group School 98	Children, grades 4 through 6 who attended the participating private parochial school.	1) Frequency of PA ≥ 30 minutes/week, times per week. Measured by 6-item questionnaire. 2) Percent reporting that most of their PA is running. 3) Aerobic fitness score, assessed by the Canadian Aerobic Fitness Test (CAFT, 9 minute stepping exercise). Score ranges from 1 (poor) to 5 (excellent) based on recovery pulse and test duration.			12 months 1) -0.464 2) **0.597** 3) 0.096
Kerse, et al., 1999[60]	Tested effect of educating general practitioners about health behaviors and well-being of elderly versus no general practitioner education					
	Randomized Group Health care 267	1) ≥65 years old 2) English speaking 3) Community dwelling 4) Attended practice in last 18 months 5) Attended the enrolled general practitioner for 3 of the past 5 consultations 6) Randomly selected from among patients that could be chosen	1) Self-reported walking (minutes/day) 2) Self-reported walking (minutes/day as a 5 point scale of quintiles) 3) Self-reported walking (minutes/previous fortnight) 4) Self-reported walking (minutes/previous fortnight as a 3 point scale of tertiles) 5) Self-reported total activity (minutes/ previous fortnight) 6) Self-reported total activity (minutes/day as a 5 point scale of quintiles) 7) Frequency of change in walking (minutes of walking yesterday, range decreased > 20 to increased > 20).			12 months 1) 0.115 2) **0.122** 3) **0.122** 4) **0.122** 5) 0.062 6) 0.071 7) NN
Keyserling et al., 2002[150] Keyserling et al. 2000[232] The New Leaf Program	Testing 1 mailing (control) versus 4 individual clinic based counseling sessions versus 4 individual clinic based counseling sessions plus 3 community based group counseling sessions and monthly phone calls from a community diabetes educator.					
	Randomized Individual Health care 165	1) African-American women aged ≥ 40 years. 2) Type 2 diabetes, defined as diagnosis of diabetes at ≥ 20 years with no history of ketoacidosis.	1) Kilocalories/day attributed to physical activity by accelerometer (Note: the group with the most intensive intervention is not included in these results because of insufficient followup time)	0 months 1) **0.308**		6 months 1) 1:0.136 2:Insufficient followup

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Knutsen & Knutsen, 1991[153] Knutsen & Knutsen 1989[151] Thelle et al. 1976[154] The Tromso Survey: Family Intervention Study	Family based advice on diet, smoking, and exercise given twice at home with two followup phone calls and a quarterly newsletter Randomized Individual Community 1060 men 935 women 1131 children	**INCLUSION:** 1) Men aged 30-55 and their closest family (those living in the same household). 2) Men with high risk for coronary heart disease without known hypertension, myocardial infarction, or symptoms of intermittent claudication or angina pectoris. 3) Female adult living in the same household as the adult males in the Tromso Family Intervention Study 4) Children of high-risk males in the Tromso Family Intervention Study **EXCLUSION:** Persons with known coronary heart disease and/or diabetes mellitus or those with chest or calf pain.	1) Percent self-reported physically active in leisure (*not defined*): mean age-adjusted.			48 months 1) men -0.068 women -0.070 children 0.044
Kreuter & Strecher, 1996[155]	Tested no feedback (control) versus typical or enhanced health risk assessment feedback. Randomized Individual Health care 1131	1) Ages 18-75 2) Patient at any one of 8 Independent community-based group family medical practices	1) Percent participating in aerobic exercise at least 3 times per week (based on response to questionnaire)			6 months 1) 1: -0.009 2: 0.384

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Kreuter et al., 2000[133]	Tested tailored and personalized, personalized and general, or non-personalized general education materials mailed to adult family practice patient versus no materials at all.					
Bull et al. 1999 [134]	Randomized Individual Health care 203	Adult patients age ≥ 18 years.	1) Change in self-reported number of sessions per week subjects participated in > 30 minutes in 8 different categories of PA 2) Change in self-reported number of sessions per week subjects participated in > 30 minutes in 4 categories of moderate intensity leisure PA (sports, strengthening exercises, dancing, aerobic-type exercise) 3) Change in self-reported number of sessions per week subjects participated in > 30 minutes in 4 categories of daily living PA (childcare, work in the home, home repair, yard work)			3 months 1) 1: 0.329 2: 0.215 3: 0.296 2) 1: 0.198 2: 0.179 3: 0.298 3) 1: 0.246 2: -0.181 3: 0.035
Linenger et al., 1991[71]	Tested multiple environmental changes (paths, equipment, facility hours, etc.) on one Naval Air base against 2 control groups: another Naval air base and a Navy Wide sample.					
	Non-randomized Group Other governmental agency 2372	1) Active duty personnel at Naval Air Station North Island (intervention) or 1 of 2 control groups: Active duty personnel at Naval Air Station Moffett or a Navy wide sample. 2) Not leaving the Navy or expecting transfer orders or deployment for at least six months. Only those individuals eligible for Physical Readiness Test during the two-month testing period and those who completed surveys.	1) Change in time (minutes) for 1.5 mile run 2) Change in leisure time Kilocalories expended per week by self report (unclear how assessed)			12 months 1) **IS** 2) NN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Lombard, et al., 1995[69] The Noontime Walkers Program	Tested effect of frequency and structure of telephone prompting in a walking program Randomized Individual School 135	Staff or faculty at a large southeastern university. No positive answers on the Physical Activity Readiness Questionnaire or physician clearance.	1) Number of participants walking (walking = 1 day/week for ≥ 20 minutes). 2) Number of participants meeting American College of Sports Medicine (ACSM) cardiovascular exercise goals (walking ≥ 20 minutes/day x 3 days/week).	0 months 1) 1: 0.814 2: **1.971** 3: 0.916 4: 0 2) 1: 0.814 2: **1.269** 3: 0.576 4: 0		3 months 1) 1: **2.089** 2: **2.089** 3: **1.307** 4: 1.106 2) 1: **1.837** 2: **1.590** 3: 0.650 4: 0.832
Lovibond, et al., 1986[156]	Tested the effect of a basic, extended or maximal behavioral treatment program Randomized Individual Worksite 75	1) Worked for 3 large government departments in Sydney, Australia 2) Attended lunchtime meetings organized by these departments 3) Aged 30 to 60 years 4) Willing to undergo a thorough medical exam 5) Found to have a high overall risk of coronary heart disease (although free of clinical evidence of disease).	1) Mean change in aerobic capacity, measured ml/kg/minute. Based on Cooper 12-minute fitness test.	0 months 1) 1: IN 2: IN 1 and 2 combined: IS		6 months 1) 1: IN 2: IN
Luepker et al., 1994[49] Minnesota Heart Health Project	Tested 5 to 6 year community-wide program of mass media, community organization and direct education Non-randomized Group Community 4762	Those who spoke no English or judged mentally incompetent to participate were ineligible to complete surveys	1) PA, percent active ("Are you regularly active in your leisure time?" - yes/no). Measured for cross-sectional and cohort surveys. Adjusted within strata and standardized across strata (adjusted for age, education, and gender).			12 months 1) IN for both cross-sectional and cohort surveys

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
MacKeen et al., 1985[157] Remington et al., 1978[158] Taylor et al., 1973[159] Cooperative Study on Physical Activity and Cardiovascular Disease	Tested an 18 month supervised exercise program versus no intervention Randomized Individual Worksite Community 104	**INCLUSION:** 1) Employee (faculty/staff) of the Penn State or Member of two residential neighborhoods in Minneapolis or faculty for the Wisconsin universities 2) Male 3) Age 40-59 4) Possess two or more risk factors within intermediate ranges 5) Live within 55-mile radius of the university/worksite **EXCLUSION:** 1) Men with one or no risk factor(s) within these ranges were designated normals and those with one or more risk factor(s) beyond the range of eligibility were designated medical exclusions 2) Persons who were extremely active (vigorous PA) 3) Cardiovascular disease or disabilities	1) Mean jogging/running hours/week for preprogram 1967 and followup 1979. 2) Aerobic activity (hours/week). 3) Heavy Activity Metabolic Index (Kilocalories/day). 4) Total Leisure Activity (Kilocalories/day): Leisure time PA in followup. Data derived from Minnesota Leisure Time PA Interview 5) Percent of subjects not exercising to maximum on treadmill at followup. 6) Maximal Exercise Intensity (METs) at followup 7) Maximal Oxygen Uptake (mL/kg/min) at followup 8) Maximal Oxygen Uptake (L/min) at followup. 9) Maximal Heart Rate at followup			132 months 1) 0.013 2) 0.000 3) 0.000 4) 0.172 5) -0.076 6) 0.368 7) 0.454 8) 0.153 9) 0.055
Marcus, et al., 1998[73]	Tested four mailings (baseline, one, three and six months) of individually tailored materials versus standard materials Randomized Individual Community 150	**INCLUSION:** 1) Healthy sedentary men and women (sedentary was defined as failing to meet CDC/ACSM criteria for minimum moderate PA participation 5days/week for 30 minutes or vigorous PA participation 3 days/week for 20 minutes) **EXCLUSION:** 1) Coronary artery disease, alcoholism or other substance abuse, chronic med and orthopedic problems that would hinder PA 2) Age < 18 3) Current or planned pregnancy	1) Self reported minutes per week of physical activity in last 7 days (calculated from days per week of activity and length of sessions**)** 2) Percent meeting CDC/ACSM criteria	0 months 1) **0.424** 2) **0.692**		6 months 1) 0.250 2) **0.382**

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Miller et al., 2002[78]	Tested print information given to mothers of young children with/without a discussion group on barriers to physical activity in mothers with young children and activities to encourage overcoming those barriers (formation of walking groups, lobbying exercise facilities for childcare or convenient class times) versus no intervention.					
	Randomized Group Community 441	Moms of young children who's children were enrolled in the 6 low SES, 9 medium SES, or 6 high SES child care centers that participated in the study.	1) Percent adequately active PA (≥ 150 minutes of moderate PA per week) with odds ratios measured with 7-day recall from the Active Australia evaluation.	0 months 1) 1: 0.099 2: **0.308**		5 months 1) 1: NN 2: NN
Mutrie, et al., 2002[70] Walk In to Work Out	Tested written interactive materials distributed at work					
	Randomized Individual Worksite 166	Employee of 3-city workplaces (large public sector organizations) who responded to a survey and were identified as contemplating or preparing to become more physically active	1) Time spent walking to work (minutes/week) 2) Time spent cycling to work (minutes/week)			6 months 1) **IS** 2) NN
Nader et al., 1989[129] San Diego Family Health Project	Tested twelve weekly and six approximately monthly family meetings at school versus no intervention					
	Randomized Group School 183	**Inclusions:** Families of 5th and 6th grade students at one of 12 participating elementary schools, where family is defined as any group of 1 or more children and 1 or more adults who cohabit and share family functions such as food preparation and socialization of children. **Exclusions:** Frank hypertension or medical treatment of hypertension or clinical heart disease since the project rationale dictated focusing on the "healthy" family.	1) Energy expenditure, expressed as kilocalories/kg/day, measured by a standardized 7-day recall 2) Aerobic power, assessed by modified Astrand Rhyming protocol			12 months 1) NN in adults and children 2) NN in adults and children

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
O'Loughlin et al., 1996[67] Coeur ensante St-Louis du Parc Project	Tested single health screening at a worksite					
	Non-randomized Group (but analyzed at the individual level) Worksite 260	All teaching, administrative, and support staff who were employed by the selected elementary schools (grade 1-6) in St-Louis du Parc, Canada	1) Self-reported leisure time exercise behavior score (sessions per week x intensity weight per session)			4 months 1) **0.034**
Ostwald, 1989[160]	Tested an all day educational seminar with physical exam, labs, and treadmill with/without three time weekly supervised exercise					
	Randomized Group (but analyzed at individual level) Worksite 85	Treatment company participants were randomized to mild, moderate, or intensive intervention where mild was the control group	1) Percent of employees moderately to very active (based on Lifegain Health Practices Survey) 2) Percent of balanced workouts, including strength, endurance, and flexibility. 3) Treadmill test, mean length of time in minutes.			5 months 1) 1: -0.268 2: 0.423 2) 1: -0.207 2: -0.297 3) IN
Owen, N 1987[161]	Tested standard 2x weekly 12 week exercise class to same class with self-management curriculum					
	Non-randomized Individual Community 147	Adults who sign up and pay $70 to take a fitness course	1) Self reported hours exercised in last week (no further description) 2) Self reported exercise sessions per week (no further description)			6 months 1) 0.091 2) 0.212
Owen, N 1987[77]	Tested single mailing or multi-mailing self-instructional training program versus no mailings (control 1) or a 12 week fitness class (control 2)					
	Non-andomized Individual Community 156	Men over 35 and women over 40. Those with preexisting health problems had to obtain medical clearance prior to starting the program Treatment group participants had to be willing to pay $20 to participate	1) Percent of subjects meeting ACSM (1978) criteria for regular, vigorous exercise. 2) Minutes of vigorous exercise/week. 3) Number of aerobic exercise sessions/week. (Results reported here for comparison to control group 1 only)	0 months 1) 2: 0.510 3: 0.061 2) 2: **IS** 3: NN 3) 2: IN 3: IN		10 months 1) 2: -0.042 3: 0.076 2) 2: IN 3: IN 3) 2: NN 3: IN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Pereira et al., 1998[64] Kriska et al. 1986[162]	Tested 2 year organized walking program (group or individual by individual's choice) versus no intervention					
	Randomized Individual Community 196	1) Women aged between 50-65 2) At least 1 year after cessation of menses 3) Abstention from HRT 4) Freedom from physical handicaps that might preclude walking	1) Weekly Kilocalories expenditure for "total usual walking" (described as number of blocks and minutes/day for exercise + number of blocks and minutes/day for nonexercise) 2) Weekly Kilocalories expenditure for usual walking for exercise 3) Weekly Kilocalories expenditure for sport and recreation 4) Weekly Kilocalories expenditure for past-year exercise 5) Pafferberg sport and recreation index 6) Pafferberg sport and recreation index with walking excluded	5) 0.542		120 months 1) **0.371** 2) **0.371** 3) 0.121 4) 0.113 5) 0.212 6) 0.180
Perklo-Makela, 1999[72]	Tested 2½ months of aerobic training and work issue lectures					
	Randomized Individual Health care 105	Female farmers, 25-45 years of age with moderate musculoskeletal symptoms that had not yet affected their work ability	1) Leisure-time physical activity (*not defined*)/week, reported as percent participating less than once a week, once a week, or ≥ 2 times a week	0 months 1) ≥2 times/wk 0.538 ≥1 time/wk 0.805 **Overall statistically significant**	12 months 1) ≥2 times/wk 0.385 ≥1 time/wk 0.527 **Overall statistically significant**	36 months 1) ≥2 times/wk 0.155 ≥1 time/wk 0.103
Sherman et al., 1989[163]	Tested 30 day worksite-based wellness programs consisting of classes, blood pressure screening, and behavior modification programs versus no intervention					
	Non-randomized Individual Worksite 85	Company employee of the small (n=1), medium (n=1), and large (n=1) companies that participated	1) Percent of participants reporting an increase, decrease, or no change in level of exercise	0 months 1) 0.246		3 months 1) -0.069

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Smith et al., 2000[164] The Active Practice project	Tested prescription for exercise from a general practitioner with/without mailed booklet versus no advice at all					
	Non-randomized Individual Health care 1101	**INCLUSION:** Active and inactive 25-65 year old patients of selected practices **EXCLUSION:** 1) Patients with poor English 2) Not supplying a telephone contact # 3) A contraindication to exercise 4) Not coming to see the doctor themselves 5) Reporting a health problem at followup that prevented 30 minutes of moderate activity 6) Being in poor mental state at followup (e.g., intoxicated)	1) Mean change in PA, mean time in minutes/week preceding survey. [Sum of minutes (≥ 10 minutes) walking and moderate and vigorous PA reported]. 2) Percent of subjects increasing PA > 60 minutes per week compared with baseline 3) Percent of subjects attaining 3344 Kjoules/week of PA. (This outcome was only reported by 'treatment received' not by intention to treat)	6 weeks 1) 1: IN 2: IN 2) 1: 0.132 2: 0.167 3) 1: IN 2: DN		7 months 1) 1: IN 2: IN 2) 1: 0.101 2: 0.251 3) 1: IN 2: IN

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Steptoe et al.,2000[75] Steptoe et al. 1999 [58] Steptoe et al. 2001[131] Hilton et al. 1999[130]	Tested routine counseling versus behaviorally oriented counseling in primary care patients with coronary risk factors Randomized Group Health care 511	**INCLUSION:** 1) Patients with at least 1 of the 3 risk factors: Total cholesterol between 6.5 and 9 mmol/l; regular smoking of more than 1 cigarette a day; BMI of 25-35 combined with low physical activity. 2) Lack of physical activity was defined as fewer than 12 sessions per month of PA at a vigorous level, making the individual breathless, for at least 20 minutes continuously. 3) 18-69 years old, be available for 12 months and have adequate written and spoken English. **EXCLUSION:** 1) Active followup and/or medication for coronary heart disease, history of cardiovascular disease or peripheral vascular disease (including angina, myocardial infarction, cerebrovascular accident, or transient ischemic attacks), chronic illness including diabetes, thyroid disease, musculo-skeletal, neurological, or respiratory disorders likely to interfere with exercising (patients with asthma were included at the general practitioner discretion), 2) A special diet, lipid-lowering drugs, pregnancy or breastfeeding 3) Serious or terminal illness 4) Psychiatric problems likely to interfere with adherence to the study protocol	1) Change in number of PA episodes (past 4 weeks) PA described as brisk walking, dancing and aerobics, heavy gardening and housework, lasting ≥ 20 minutes.	0-4 months 1) **0.426**		8 months 1) **0.437**

Evidence Table 1. General population (continued)

Author Year	Study Design Unit of Assignment Recruitment Setting # Analyzed	Inclusion Criteria	Outcomes Measured	Effect Size at End of Intervention	Effect Size at Closest Followup ≥ 3 Months	Effect Size at Last Reported Followup
Stevens et al.,1998[62]	Tested in person consultation with an exercise development officer and a personalized 10-week program to increase regular physical activity versus mailing on local 'leisure centers'					
	Randomized Individual Health care 415	Patients at one particular health clinic, aged 45-74, who returned questionnaire, were physically inactive and not excluded on a medical basis (e.g. being registered as disabled or having heart disease). Physically inactive was defined as less than either of the current recommendations of 20-30 min. moderate intensity activity sessions or 12-20 min. vigorous intensity activity sessions per month.	1) Mean number of occasions of moderate physical activity in the four weeks before followup 2) Mean number of occasions of vigorous physical activity in the four weeks before followup 3) Mean number of occasions of moderate or vigorous physical activity in the four weeks before followup			8 months 1) **0.306** 2) **0.041** 3) **0.281**

*Number corresponds to outcome number. Months refers to number of months following the end of the intervention. When an effect size could be calculated, it is given. Where the effect size could not be calculated the following code is used to refer to the reported outcomes: IS=statistically significant increase in physical activity, IN=non-statistically significant increase in physical activity, NN=no change in physical activity, DN=non-statistically significant decrease in physical activity, and DS=statistically significant decrease in physical activity. Where there is more than one intervention, the different interventions are noted as #: for example "1:IN 2:IN" represents the results of two interventions. If more than one number or symbol appears for each intervention, the numbers and symbols relate to the results for subgroups. The data is only reported by subgroup when that is the only way the information is presented in the paper.

Evidence Table 2. Cancer survivors
(Studies are sorted alphabetically by first author)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Berglund et al., 1993[92]	Non-RCT Primary care	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 30-60 minutes 3 days/week	8 weeks	Activities in community Activities in the home Anxiety symptoms Body image problems Change of lifestyle Depressive symptoms Global health Pain Participation in patient organization Physical strength problems Physical training Quality of life Satisfaction about information given Sick leave Tiredness Work status

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Low intensity Aerobic activity Strength training Duration not reported 1 day/week	7 weeks	Anxiety Anxious preoccupation Aversions Avoidance Body image problems Cognitive functioning Communication with staff Depression Fatalistic Fighting spirit Hopeless Information problems Mixed symptoms A Mixed symptoms B Mucous membrane disturbances frequency Pain Physical strength problems Physical training Problems with activities at home Problems with activities in community Quality of life Sexual problems frequency Sick leave Surgery effects Tiredness Work status Worry

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Burnham & Wilcox, 2002[86]	RCT Unknown	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	Aerobic capacity ml/kg/min Anger Anxiety Body fat percent Body weight Confusion Depression Fatigue Flexibility Personal energy Quality of life
Courneya, et al., 2002[82] Courneya et al., 2003[83]	RCT Unknown	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psychotherapy	65-75% maximum heart rate Aerobic activity 20-30 minutes 3-5 days/week	10 weeks	Anxiety Attitude Behavioral beliefs Body fat composition Cardiovascular endurance Control beliefs Depression Exercise adherence, continuous Exercise adherence, dichotomous Fatigue Flexibility Intention to exercise Normative beliefs Perceived behavioral control Personality Quality of life Satisfaction with life Subjective norms

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Unknown	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	No	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Body Mass Index Body weight Breast cancer subscale Emotional well-being Fatigue General health Glucose (mmol/liter) Happiness Heart rate (peak) IGF-1:IGFBP-3 molar ratio IGFBP-1 (ng/ml) IGFBP-3 (ng/ml) IGF-I (ng/ml) IGF-II (ng/ml) Insulin (pmol/liter) Insulin Resistance Index Peak power output, Watts Peak VO2 ml/kg/min Physical well-being Power output at the ventilatory equivalent for CO_2 Quality of life Self esteem Social/family wellbeing Sum of skinfolds Trial outcome index score

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Cunningham et al., 1986[85]	RCT Primary care	Acute leukemia	Pre-planned exercise During treatment Coping	Individual (10) Comp 1 (10) Intervention 1 (10) Intervention 2	Not applicable	**Intervention 1:** Intensity not reported Physical therapy exercises 30 minutes 3 days/week **Intervention 2:** Intensity not reported Physical therapy exercises 30 minutes 5 days/week	35 days	Arm fat area Arm muscle area Body weight Calorie intake percent of estimated nutrient needs Changes in excretion of creatinine as a percent of admission measures Protein intake percent of estimated nutrient needs of admission measure Weekly nitrogen balance (G) Weekly temperature
Dimeo et al., 1997[101]	RCT Primary care	Breast Germ cell Sarcoma Lung Adenoscar-cinoma Neuro-blastoma	Pre-planned exercise During treatment Coping	Individual (37) Comp 1 (33) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 30 minutes 7 days/week	Not clear/day of hospital discharge	Blood transfusions (U) Duration of neutropenia (days) Duration of thrombopenia (days) Heart rate percent estimated maximum Heart rate (maximal) Hematocrit Hemoglobin In-hospital days Loss of physical performance during hospitalization Physical max performance (km/h) Platelets transfusions (U) Severity of diarrhea Severity of infection Severity of mucositis Severity of pain Vigor

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Dimeo et al., 1997[102]	Non-RCT Primary care	Breast Non-small cell lung carcinoma Sarcoma Semioma Non-Hodgkin's lymphoma	Pre-planned exercise Post treatment Rehabilitation	Individual (16) Comp 1 (16) Intervention 1	Not applicable	80% maximum heart rate Walking 15-30 minutes 5 days/week	6 weeks	Body Mass Index Cardiac function and dimensions Complications ECG function Fatigue Hemoglobin Physical maximum performance (km/hr)
Dimeo et al., 1999[106]	RCT Primary care	Solid tumors or breast carcinoma Metastatic breast carcinoma Seminoma Sarcoma/ adenocar-cinoma Hodgkin's disease Non-Hodgkin's lymphoma Small cell lung carcinoma	Pre-planned exercise During treatment Coping	Individual (33) Comp 1 (29) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not reported/ hospital discharge	Anger/hostility Anxiety Depression Fatigue Global psychologic distress Hostility Interpersonal sensitivity Obsessive compulsive traits Phobic anxiety Somatization Vigor
Djuric et al., 2002[81]	RCT Community	Breast	Behavioral Post treatment Health promotion	Individual (13) Comp 1 (10) Comp 2 (13) Comp 3 (11) Intervention 1	Diet	Moderate intensity PA mode not reported 30-45 minutes 5-7 days/ week	12 weeks 84 +/- contacts	Attendance at sessions/telephone counseling Body weight change Body weight loss percent achieving 10% Dietary intakes (kcal/d) energy and fat Self-report PA

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Hayes et al., 2003[104]	Non-RCT Primary care	Acute myeloid leukemia Breast Multiple myeloma Non-Hodgkin's lymphoma Lymphoblas-tic lymphoma/ leukemia Rhabdomyo-sarcoma	Pre-planned exercise During treatment Rehabilitation	Individual (6) Comp 1 (6) Intervention 1	Not applicable	**Intervention 1:** 70-90% maximum heart rate Aerobic activity Strength 20-40 minutes 3 days/week **Comparison 1:** Intensity not reported Stretching 20-40 minutes 3 days/week	3 months	CD3+ (helper/suppressor T-cell) CD4+ (helper T-cells) CD8+ (suppressor T-cell) Lymphocytes Ratio CD4+/CD8+ T cell function adjusted for CD3+ Total T-cell function White blood cells
MacVicar et al., 1986[112]	Non-RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (4) Comp 1 (6) Intervention 1 (healthy controls) (6) Intervention 2 (cancer survivors)	Not applicable	**Intervention 1 and 2:** 60-85% maximum heart rate on pre-test aerobic assessment Aerobic activity duration not reported 3 days/week	10 weeks	Anger/hostility Confusion/bewilderment Depression Fatigue Tension/anxiety Total mood disturbance Vigor VO2 maximum

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
MacVicar et al., 1989[88]	RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (16) Comp 1 (11) Intervention 1 (18) Intervention 2	Not applicable	**Intervention 1:** Low intensity Non-aerobic Stretching and flexibility Duration not reported 3 days/week **Intervention 2** 60-80% heart rate reserve Aerobic activity 3 days/week	10 weeks	Heart rate Maximum test time VO2 maximum Workload maximum
McKenzie et al., 2003[107]	RCT Unknown	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (7) Comp 1 (7) Intervention 1	Not applicable	Intensity not reported Aerobic activity Strength/ resistance Stretching 30-60 minutes 3 days/week	8 weeks	Arm volume by circumference Arm volume by water displacement General health quality of life Mental health quality of life Physical functioning quality of life Vitality quality of life

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Not applicable	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Anxiety Body image Depression Difficulty sleeping Exercise level Fatigue Impact of Medical Illness on subject Nausea Physical functioning Physical functioning (daily activities) Psychologic distress Self-esteem/concept Vomiting
Mock, et al., 1997[94] Mock et al., 1998[98]	Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks	Anxiety Body dissatisfaction Depression Difficulty sleeping Exercise level Fatigue Physical functioning
Mock et al., 2001[95] Pickett et al., 2002[96]	RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking Aerobic activity 15-30 minutes 5-6 days/week	6 weeks	Anxiety Depression Exercise participation Exercise tolerance Fatigue Physical activity level Quality of life Total mood disturbance Vigor
Na, 2000[105]	RCT Hospital/ primary care	Stomach	Pre-planned exercise During treatment Rehabilitation	Individual (18) Comp (17) Intervention	Not applicable	Intensity not reported Aerobic activity 60-90 minutes 4-5 days/ week	2 weeks	Natural Killer cell cytotoxic activity (NKCA)

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Nieman et al., 1995[103]	RCT Unknown	Breast	Pre-planned exercise Post treatment Survival	Individual (8) Comp 1 (8) Intervention 1	Not applicable	75% maximum heart rate Walking Strength/ resistance 60 minutes 3 days/week	8 weeks	E: T20: 1 (mononuclear cells to cancer cell ratio NKCA or % lysis) E: T40:1 (mononuclear cells to cancer cell ratio NKCA % lysis) Heart rate Leg extension strength Lymphocytes Neutrophils NK cell cytotoxic activity % lysis NK cells Physical functioning T-cells Total leukocytes
Segal et al., 2001[87]	RCT Primary care	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: Self-directed exercise (42) Intervention 2: Supervised exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Aerobic capacity Physical functioning General health quality of life Quality of life Mental health Role limitations, emotional Role limitations, physical Body weight Bodily pain Vitality quality of life Social functioning

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Segal et al., 2003[91]	RCT Primary care	Prostate	Pre-planned exercise During treatment Coping	Individual (73) Comp 1 (82) Intervention 1	Not applicable	60-70% one repetition maximum Strength/ resistance: 9 exercises, 2 sets each, 8-12 repetitions Duration not reported 3 days/week	12 weeks	Muscular fitness Fatigue Quality of life health-related PSA levels Testosterone Body Mass Index Body weight Skinfolds Waist circumference
Segar et al., 1998[84]	RCT Home	Breast	Pre-planned exercise Post treatment Rehabilitation and health	Individual (10) Comp 1 (10) Intervention 1 (10) Intervention 2: Exercise plus behavior modification	Behavior modification	≥60% maximum heart rate Aerobic activity 30 minutes 4 days/week	10 weeks	Anxiety Depression Exercise adherence (min) Self-esteem
Wall, 2000[213]	RCT	Lung	Pre-planned exercise Pre- treatment Buffering	Individual (51) Comp 1 (53) Intervention 1	Not applicable	Intensity not reported Aerobic activity Strength/ resistance Duration not reported 7 days/week	7-10 days	Hope [Herth Hope Index HHI] Power (personal not PA related)

Evidence Table 2. Cancer survivors (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported
Winningham et al., 1988[89] Winningham et al., 1989[108]	RCT Unknown	Breast	Pre-planned Exercise During treatment Coping	Individual (12) Comp 1 (14) Intervention 1 (16) Intervention 2	Not applicable	**Intervention 1:** Intensity not reported Stretching Duration not reported 3 days/week **Intervention2:** 60-85% maximum heart rate Aerobic activity 20-30 minutes 3 days/week	10 weeks	Percent body fat Body weight Lean body weight Nausea Somatization Subcutaneous body fat distribution Sum of skinfolds

Appendix F

Cancer Outcomes Tables

Table F-1. Physical activity behavior

First Author/Year Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2002[82] Courneya et al., 2003[83] RCT Home	All cancers possible Breast	Behavioral Post treatment Coping & Rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psychotherapy	65-75% estimated maximum heart rate Aerobic activity 20-30 minutes 3-5 days/week	10 weeks	Exercise (minutes) % performing ≥60 minutes of exercise/ week % performing ≥150 minutes of exercise/ week	 p < .001 p < .001
Mock, et al. 1997[94] Mock et al. 1998[98] Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks or 4-6 chemotherapy cycles	Exercise level [0-10 Exercise Rating Scale]	p< .001
Mock et al. 1994[99] RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking Aerobic activity 10-45 minutes 4-5 days/week	4-6 months	Exercise level [scale of 0-4 according to no minimum per day and no days per week walked]	**ES 2.93**
Mock et al. 2001[95] Pickett et al. 2002[96] RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking 15-30 minutes 5-6 days/week	6 weeks to 6 months	Exercise participation [PA self-report diary]	Not reported

Table F-1. Physical activity behavior (continued)

First Author/Year Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Segal et al., 2001[87] RCT Primary care Home	Breast	Behavioral & pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% predicted maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Exercise adherence (minutes) [self report PA logs]	Not reported

Table F-2. Physical fitness: cardiovascular, strength and flexibility

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	Aerobic capacity ml/kg/min [treadmill] Flexibility [sit and reach/ lower body]	**ES 0.668** **ES 0.666**
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Heart rate (peak) Peak power output, Watts [cycle ergometer] Peak VO2 ml/kg/min [cycle ergometer] Power output at the ventilatory equivalent for CO2 [metabolic measure-ment cart]	p<.02 **ES 0.950** **ES 0.599** **ES 0.860**

Table F-2. Physical fitness: cardiovascular, strength and flexibility (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya, et al., 2002[82] Courneya et al., 2003[83]	RCT Home	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psychotherapy	65-75% estimated maximum heart rate Aerobic activity 20-30 minutes 3-5 days/week	10 weeks	Cardiovascular endurance [modified Balke Treadmill Test] Flexibility [sit and reach test]	**ES 0.00** **ES 0.024**
Dimeo et al., 1997[101]	RCT Primary care	Breast Germ cell Sarcoma Lung Adenoscarci-noma Neuroblasto-ma	Pre-planned exercise During treatment Coping	Individual (37) Comp 1 (33) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not clear/day of hospital discharge	Maximum performance (km/hour)	**ES 0.319**
Dimeo et al., 1997[102]	Non-RCT Primary care	Breast Non-small cell lung carcinoma Sarcoma Semioma Non-Hodgkin's lymphoma	Pre-planned exercise Post treatment Rehabilitation	Individual (16) Comp 1 (16) Intervention 1	Not applicable	80% maximum heart rate Walking 15-30 minutes 5 days/week	6 weeks	Physical maximum performance (km/hour) [treadmill test]	**ES 0.535**

Table F-2. Physical fitness: cardiovascular, strength and flexibility (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
MacVicar et al., 1989[88]	RCT Exercise facility	Breast	Pre-planned exercise During treatment Coping	Individual (16) Comp 1 (11) Intervention 1 (18) Intervention 2	Not applicable	**Intervention 1:** Low intensity Non-aerobic Stretching and flexibility Duration not reported 3 days/week **Intervention 2:** 60-80% heart rate reserve Aerobic interval training 3 days/week	10 weeks	Heart rate Maximum test time VO2 maximum L/min (cycle ergometer) Workload maximum (cycle ergometer)	p<.04 p<.01 p<.01 p<.01
MacVicar et al., 1986[112]	Non-RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (4) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	60-85% maximum heart rate on pre-test aerobic assessment Aerobic activity 3 days/week	10 weeks	VO2 maximum L/min (cycle ergometer)	Mean change reported Functional capacity increased in intervention group
Mock, et al., 1997[94] Mock et al., 1998[98]	Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks or 4-6 chemo-therapy cycles	Physical fitness [12 minute walk test]	p<.003
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Physical fitness [12 minute walk test]	**ES 1.242**

Table F-2. Physical fitness: cardiovascular, strength and flexibility (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Mock et al., 2001[95] Pickett et al., 2002[97]	RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking 15-30 minutes 5-6 days/ week	6 weeks to 6 months	Exercise fitness [12-minute walk test]	p<.01
Nieman et al., 1995[103]	RCT Unknown	Breast	Pre-planned exercise Post treatment Survival	Individual (8) Comp 1 (8) Intervention 1	Not applicable	75% maximum heart rate Walking Strength/ resistance activity 60 minutes 3 days/week	8 weeks	Heart rate Leg extension strength Physical fitness [6 minute walk distance]	Not significant Not significant p = 0.02
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Aerobic capacity [modified Canadian Aerobic Fitness Test (mCAFT)]	Not significant

Table F-2. Physical fitness: cardiovascular, strength and flexibility (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Segal et al., 2003[91]	RCT Exercise facility	Prostate	Pre-planned exercise During treatment Coping	Individual (73) Comp 1 (82) Intervention 1	Not applicable	60-70% one repetition maximum Strength/ resistance: 9 exercises, 2 sets each, 8-12 repetitions Duration not reported 3 days/week	12 weeks	Muscular fitness [standard load test]	p<.009

Table F-3. Fatigue / tiredness

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1993[92]	Non-RCT Exercise facility	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 60 minutes 1day/week	4 weeks	Tiredness [no validity/ reliability measure scale]	p<.0005 *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Tiredness [no validity/ reliability measure scale]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-3. Fatigue / tiredness (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	Fatigue [Linear Analog Self-Assessment measure]	**ES 0.645**
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Fatigue [Fatigue Scale of FACT]	**ES 0.063**
Courneya, et al., 2002[82] Courneya et al., 2003[83]	RCT Home	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psychotherapy	65-75% maximum heart rate Aerobic activity 20-30 minutes 3-5 days/week	10 weeks	Fatigue [Fatigue Scale of FACT]	**ES 0.031**

Table F-3. Fatigue / tiredness (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Dimeo et al., 1999[106]	RCT Primary care	Solid tumors or breast carcinoma Metastatic breast carcinoma Seminoma Sarcoma/ adenocarci-noma Hodgkin's disease Non-Hodgkin's lymphoma Small cell lung carcinoma	Pre-planned exercise During treatment Coping	Individual (33) Comp 1 (29) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not reported/ hospital discharge	Fatigue [Profile of Mood Status measure (POMS)]	Increase in control group p=.02, no change in treatment group
Dimeo et al., 1997[102]	Non-RCT Primary care	Breast Non-small cell lung carcinoma Sarcoma Semioma Non-Hodgkin's lymphoma	Pre-planned exercise Post treatment Rehabilitation	Individual (16) Comp 1 (16) Intervention 1	Not applicable	80% maximum heart rate Walking 15-30 minutes 5 days/week	6 weeks	Fatigue [personal interview]	Qualitative report of improve-ment

Table F-3. Fatigue / tiredness (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
MacVicar et al., 1986[112]	Non-RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (4) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	60-85% maximum heart rate on pre-test aerobic assessment Aerobic activity 3 days/week	10 weeks	Fatigue [Profile of Mood States (POMS)]	Mean changes reported. Fatigue factors decreased in treatment and control groups.
Mock, et al., 1997[94] Mock et al., 1998[98]	Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks or 4-6 chemo-therapy cycles	Fatigue [Piper Fatigue Scale] Fatigue [Symptom Assessment Scales (SAS)]	p<.018 Correlated r=.92
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Fatigue [Symptom Assessment Scale]	Mid-treatment p<.02
Mock et al. 2001[95] Pickett et al. 2002[96]	RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking 15-30 minutes 5-6 days/week	6 weeks to 6 months	Fatigue [modified Piper Fatigue Scale (PFS)]	p<.001

Table F-3. Fatigue / tiredness (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Segal et al., 2003[91]	RCT Exercise facility	Prostate	Pre-planned exercise During treatment Coping	Individual (73) Comp 1 (82) Intervention 1	Not applicable	60-70% one repetition maximum Strength/ resistance: 9 exercises, 2 sets each, 8-12 repetitions Duration not reported 3 days/week	12 weeks	Fatigue [Functional Assessment of Cancer Therapy-Fatigue (FACT-F)]	**ES 0.130**

Table F-4. Body image / dissatisfaction

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1993[92]	Non-RCT Exercise facility	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 60 minutes 1day/week	4 weeks	Body image problems [no validity/ reliability measure scale]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Body image problems [no validity/ reliability measure scale]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months
Mock, et al., 1997[94] Mock et al., 1998[98]	Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks or 4-6 chemo-therapy cycles	Body dissatisfaction [Symptom Assessment Scales (SAS)]	p<.033

Table F-4. Body image / dissatisfaction (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Body image [Body Image Visual Analogue Scale]	**ES 0.301**
								Body image [physical self subscale of the Tennessee Self-Concept Scale]	**ES 0.318**

Table F-5. Quality of life

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1993[92]	Non-RCT Exercise facility	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 60 minutes 1day/week	4 weeks	Physical strength problems [self report] Global health [no validity/ reliability measure scale] QOL [scale no validity/ reliability measure]	p<.0001 p<.01 Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Physical strength problems [self report] QOL [scale no validity/ reliability measure]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-5. Quality of life (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	QOL [QOL Index for Cancer Patients]	**ES 1.689**

Table F-5. Quality of life (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	General health [Functional Assessment of Cancer Therapy-General (FACT-G scale)]	**ES 0.183**
								Physical well-being [Functional Assessment of Cancer Therapy-Breast (FACT-B scale)]	**ES 0.00**
								QOL (overall) [Functional Assessment of Cancer Therapy-Breast (FACT-B scale)]	**ES 0.239**
								FACT-B Breast cancer subscale	**ES 0.338**

Table F-5. Quality of life (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2002[82] Courneya et al., 2003[83]	RCT Home	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psycho-therapy	65-75% maximum heart rate Aerobic activity 20-30 minutes 3-5 days/ week	10 weeks	Physical well-being [Functional Assessment of Cancer Therapy-General (FACT-G scale)] Functional well-being [Functional Assessment of Cancer Therapy-General (FACT-G scale)]	**ES 0.02** **ES 0.049**
McKenzie et al., 2003[107]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (7) Comp 1 (7) Intervention 1	Not applicable	Intensity not reported Aerobic activity Strength/ resistance Stretching 30-60 minutes 3 days/week	8 weeks	General health QOL [SF-36] Physical functioning QOL [SF-36]	p<.048 p<0.05
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support Group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Physical functioning (daily activities) [Karnofsky Performance Status Scale (KPS)]	**ES 1.155**

Table F-5. Quality of life (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Mock et al., 2001[95] Pickett et al., 2002[96]	RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking 15-30 minutes 5-6 days/week	6 weeks to 6 months	QOL emotional [MOS SF-36] QOL social [MOS SF-36] QOL physical [MOS-SF 36 subscale]	Not significant Not significant p<.00
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	General health QOL [SF-36] Physical functioning [SF-36] QOL [Functional Assessment of Cancer Therapy-Breast (FACT-B scale)] QOL [Functional Assessment of Cancer Therapy-(FACT-G scale)]	p=.04 p<0.04 Not significant Not significant

Table F-5. Quality of life (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Segal et al., 2003[91]	RCT Exercise facility	Prostate	Pre-planned Exercise During treatment Coping	Individual (73) Comp 1 (82) Intervention 1	Not applicable	60-70% one repetition maximum Strength/ resistance: 9 exercises, 2 sets each, 8-12 repetitions Duration not reported 3 days/week	12 weeks	QOL health-related [Functional Assessment of Cancer Therapy-Prostate (FACT-P)]	**ES 0.168**

Table F-6. Confusion

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	Confusion [Linear Analog Self-Assessment measure]	**ES 0.402**
MacVicar et al., 1986[112]	Non-RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (4) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	60-85% maximum heart rate on pre-test aerobic assessment Aerobic activity 3 days/week	10 weeks	Confusion/ bewilderment [Profile of Mood States POMS]	Mean changes reported. Confusion factors decreased.

Table F-7. Difficulty sleeping

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Mock, et al., 1997[94] Mock et al., 1998[98]	Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks or 4-6 chemotherapy cycles	Difficulty sleeping [Symptom Assessment Scales (SAS)]	p<.027
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Difficulty sleeping [Symptom Assessment Scale]	p<.04

Table F-8. Self-esteem

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2003[90] Fairey et al. , 2003[100]	RCT Exercise Facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Self-esteem [Rosenberg Self-Esteem Scale]	**ES 0.044**
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Self-esteem/ concept [Tennessee self-concept scale]	**ES 0.154**
Segar et al., 1998[84]	RCT Home Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (10) Comp 1 (10) Intervention 1 (10) Intervention 2: exercise and behavior modification	Behavior modification	≥60% maximum heart rate Aerobic activity 30 minutes 4 days/week	10 weeks	Self-esteem [Rosenberg Self-Esteem Inventory (RSE)]	Not significant

Table F-9. Psychosocial outcomes

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1993[92]	Non-RCT Exercise Facility	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 60 minutes 1day/week	4 weeks	Activities in community [measure not reported] Activities in the home [measure not reported] Change of lifestyle [measure not reported] Participation in patient organization [measure not reported] Satisfaction about informa-tion given [6-item scale] Sick leave [actual count of participants] Work status [actual count of participants]	p<.05 Not significant p<.005 p<.05 p<.0001 Not significant Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-9. Psychosocial outcomes (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Cognitive functioning [physical symptoms related to breast cancer scale]	Not significant
								Communication with staff [scale]	Not significant
								Information problems [satisfaction (6-item scale)]	p<00001
								Problems with activities at home [scale]	Not significant
								Problems with activities in community	Not significant
								Sick leave [actual count of participants]	Not significant
								Work status [actual count of participants]	Not significant
									*all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-9. Psychosocial outcomes (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Happiness [Happiness Measure] Social/family well-being [Functional Assessment of Cancer Therapy – Breast (FACT-B scale)]	**ES 0.302** **ES 0.113**
Courneya et al., 2002[82] Courneya et al., 2003[83]	RCT Home	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psycho-therapy	65-75% maximum heart rate Aerobic activity 20-30 minutes 3-5 days/ week	10 weeks	Satisfaction with life [Satisfaction with Life Scale] Social/family well-being [Functional Assessment of Cancer Therapy-(FACT-G scale)] Spiritual well-being [Functional Assessment of Cancer Therapy-(FACT-G scale)]	**ES 0.028** **ES 0.005** **ES 0.00**

Table F-9. Psychosocial outcomes (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Role limitations, emotional [SF-36] Role limitations, physical [SF-36] Social Functioning [SF-36]	Not significant Not significant Not significant
Wall, 2000[213]	RCT	Lung	Pre-planned exercise Pre treatment Buffering	Individual (51) Comp 1 (53) Intervention 1	Not applicable	Low intensity Aerobic activity Strength/ resistance Duration not reported 7 days/week	7-10 days	Hope [Herth Hope Index HHI] Power (personal not PA related) [PKPCT - semantic differential test]	**ES 0.280** **ES 0.612**

Table F-10. Physiological outcomes

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Insulin (pmol/liter) Glucose (mmol/liter) Insulin resistance index IGF-I (ng/ml) IGF-II (ng/ml) IGFBP-1 (ng/ml) IGFBP-3 (ng/ml) IGF-I:IGFBP-3 molar ratio	**ES -0.300** **ES -0.301** **ES -0.324** **ES 0.414** **ES -0.475** **ES 0.025** **ES 0.425** **ES 0.657**
Cunningham et al., 1986[85]	RCT Primary care	Acute leukemia	Pre-planned exercise During treatment Coping	Individual (10) Comp 1 (10) Intervention 1 (10) Intervention 2	Not applicable	**Intervention 1:** Intensity not reported Calisthenics 30 minutes 3 days/week **Intervention 2:** Intensity not reported Calisthenics 30 minutes 5 days/week	35 days	Changes in 3-methylhistidine as a percent of admit measure Changes in excretion of creatinine as a percent of admit measures Weekly nitrogen balance (G) Weekly temperature	Not significant p<.05 Not significant Not significant

Table F-10. Physiological outcomes (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Dimeo et al., 1997[101]	RCT Primary care	Breast Germ cell Sarcoma Lung Adenoscarci-noma Neuroblas-toma	Pre-Planned Exercise During treatment Coping	Individual (37) Comp 1 (33) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not clear/ day of hospital discharge	Blood transfusions (U) Hematocrit Hemoglobin In-hospital days Loss of physical performance during hospitalization Platelets transfusions (U)	**ES 0.00** **ES 0.00** **ES 0.198** **ES 0.528** **ES 0.494** **ES 0.430**
Dimeo et al., 1997[102]	Non-RCT Primary care	Breast Non-small cell lung carcinoma Sarcoma Semioma Non-Hodgkin's lymphoma	Pre-planned exercise Post treatment Rehabilitation	Individual (16) Comp 1 (16) Intervention 1	Not applicable	80% maximum heart rate Walking 15-30 minutes 5 days/week	6 weeks	Cardiac function and dimensions ECG function Hemoglobin	Not significant Not significant **ES 0.822**

Table F-10. Physiological outcomes (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Segal et al., 2003[91]	RCT Exercise facility	Prostate	Pre-planned exercise During treatment Coping	Individual (73) Comp 1 (82) Intervention 1	Not applicable	60-70% one repetition maximum Strength/ resistance: 9 exercises, 2 sets each, 8-12 repetitions Duration not reported 3 days/week	12 weeks	PSA levels Testosterone	Not significant Not significant

Table F-11. Body size

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	*Goal of body size change* Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	*Decrease body weight/fat:* Body fat percent Body weight	 **ES -0.153** **ES 0.636**
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	*Decrease body weight/fat:* Body Mass Index Body weight Sum of skinfolds	 **ES 0.103** **ES 0.015** **ES 0.115**
Courneya et al., 2002[82] Courneya et al., 2003[83]	RCT Home	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psycho-therapy	65-75% maximum heart rate Aerobic activity 20-30 minutes 3-5 days/ week	10 weeks	*Decrease body weight/fat:* Body fat composition [calipers]	 **ES 0.101**

Table F-11. Body size (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	*Goal of body size change* Outcomes Reported	Significant Results
Djuric et al., 2002[81]	RCT Community	Breast	Behavioral Post treatment Behavioral and health promotion	Individual (13) Comp 1 (10) Intervention 1: Weight Watchers exercise points system (13) Intervention 2: individualized (11) Intervention 3: intervention 1 plus intervention 2	Diet	Moderate intensity PA mode not reported 30-45 minutes 5-7 days/ week	12 weeks	*Decrease body weight/fat:* Body weight change [beam scale] Body weight loss percent achieving 10% [beam scale]	 p<.05 p<.016
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	*Decrease body weight/fat:* Body weight	 Not significant

Table F-11. Body size (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	*Goal of body size change* Outcomes Reported	Significant Results
Winningham et al., 1988[89] Winningham et al., 1989[108]	RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (12) Comp 1 (14) Intervention 1 (16) Intervention 2	Not applicable	**Intervention 1:** Intensity not reported Stretching Duration not reported 3 days/week **Intervention 2:** 60-85% maximum heart rate Aerobic activity 20-30 minutes 3 days/week	10 weeks	*Decrease body weight/fat:* Percent body fat Body weight Lean body weight Subcutaneous body fat distribution Sum of skinfolds ≤45 years >45 years	 p<.033 Not significant Not significant p<.008 p<.0009 Not significant
Cunningham et al., 1986[85]	RCT Primary care	Acute leukemia	Pre-planned exercise During treatment Coping	Individual (10) Comp 1 (10) Intervention 1 (10) Intervention 2	Not applicable	**Intervention 1:** Intensity not reported Calisthenics 30 minutes 3 days/week **Intervention 2:** Intensity not reported Calisthenics 30 minutes 5 days/week	35 days	*Increase or maintain muscle mass* Body weight [percent of admission measures] Arm fat area [percent of admission measures] Arm muscle area [percent of admission measures]	 Not significant Not significant Not significant

Table F-11. Body size (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	*Goal of body size change* Outcomes Reported	Significant Results
Dimeo et al., 1997[102]	Non-RCT Primary care	Breast Non-small cell lung carcinoma Sarcoma Semioma Non-Hodgkin's lymphoma	Pre-planned exercise Post treatment Rehabilitation	Individual (16) Comp 1 (16) Intervention 1	Not applicable	80% maximum heart rate Walking 15-30 minutes 5 days/week	6 weeks	*Avoid muscle loss* Body Mass Index	Not significant
McKenzie et al., 2003[107]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (7) Comp 1 (7) Intervention 1	Not applicable	PA intensity not reported Aerobic activity Strength/ resistance Stretching 30-60 minutes 3 days/week	8 weeks	*Avoid increases in arm volume* Arm volume by circumference Arm volume by water displacement	**ES 1.642** **ES 1.262**
Segal et al., 2003[91]	RCT Exercise facility	Prostate	Pre-planned exercise During treatment Coping	Individual (73) Comp 1 (82) Intervention 1	Not applicable	60-70% one repetition maximum Strength/ resistance: 9 exercises, 2 sets each, 8-12 repetitions Duration not reported 3 days/week	12 weeks	*Avoid muscle mass loss* BMI Body weight Skinfolds Waist circumference	 Not significant Not significant Not significant Not significant

Table F-12. Pain

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1993[92]	Non-RCT Exercise facility	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 60 minutes 1day/week	4 weeks	Pain [no validity/ reliability measure scale]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Pain [no validity/ reliability measure scale]	p<.0001 *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3,6 & 12 months
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Bodily pain [SF-36]	Not significant

Table F-13. Vigor / vitality

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	Personal energy [Linear Analog Self-Assessment measure]	**ES 1.265**
Dimeo et al., 1999[106]	RCT Primary care	Solid tumors or breast carcinoma Metastatic breast carcinoma Seminoma Sarcoma/ adenocarci-noma Hodgkin's disease Non-Hodgkin's lymphoma Small cell lung carcinoma	Pre-planned exercise During treatment Coping	Individual (33) Comp 1 (29) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not reported/ hospital discharge	Vigor [Profile of Mood Status measure (POMS)]	**ES 0.434**

Table F-13. Vigor / vitality (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
MacVicar et al., 1986[112]	Non-RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (4) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	60-85% maximum heart rate on pre-test aerobic assessment Aerobic activity 3 days/week	10 weeks	Vigor/activity [Profile of Mood States (POMS)]	Mean changes reported. Vigor increased in treatment group.
McKenzie et al., 2003[107]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (7) Comp 1 (7) Intervention 1	Not applicable	PA Intensity not reported Aerobic activity Strength/ resistance Stretching 30-60 minutes 3 days/week	8 weeks	Vitality QOL [SF-36]	p<.023
Mock et al., 2001[95] Pickett et al., 2002[96]	RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking 15-30 minutes 5-6 days/week	6 weeks to 6 months	Vigor [Profile of Moods States (POMS)]	p<.00
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Vitality QOL [SF-36]	Not significant

Table F-14. Symptoms / side effects

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Aversions [physical symptoms related to breast cancer scale]	Not significant
								Mixed symptoms A [physical symptoms related to breast cancer scale]	Not significant
								Mixed symptoms B [physical symptoms related to breast cancer scale]	Not significant
								Mucous membrane disturbances frequent [physical symptoms related to breast cancer scale]	Not significant
								Sexual problems frequency [physical symptoms related to breast cancer scale]	Not significant
								Surgery effects [physical symptoms related to breast cancer scale]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-14. Symptoms / side effects (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Dimeo et al., 1999[106]	RCT Primary Care	Solid tumors or breast carcinoma Metastatic breast carcinoma Seminoma Sarcoma/ adenocar-cinoma Hodgkin's disease Non-Hodgkin's lymphoma Small cell lung carcinoma	Pre-planned exercise During treatment Coping	Individual (33) Comp 1 (29) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not reported/ hospital discharge	Somatization [Symptom Check List SCL-90-R]	**ES 0.547**
Dimeo et al., 1997[101]	RCT Primary Care	Breast Germ cell Sarcoma Lung Adenoscar-cinoma Neuro-blastoma	Pre-planned exercise During treatment Coping	Individual (37) Comp 1 (33) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not clear/ day of hospital discharge	Severity of diarrhea [toxicity of high dose chemotherapy (HDC)] Severity of infection [toxicity of HDC] Severity of mucositis [toxicity of HDC] Severity of pain [toxicity of HDC]	**ES 0.507** **ES 0.225** **ES -0.130** **ES 0.849**
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Nausea [Symptom Assessment Scale] Vomiting [Symptom Assessment Scale]	Not significant Not significant

Table F-14. Symptoms / side effects (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Winningham et al., 1988[89] Winningham et al., 1989[108]	RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (12) Comp 1 (14) Intervention 1 (16) Intervention 2	Not applicable	**Intervention 1:** Intensity not reported Stretching Duration not reported 3 days/week **Intervention 2:** 60-85% maximum heart rate Aerobic activity 20-30 minutes 3 days/week	10 weeks	Nausea [Symptom Checklist 90-Revised SCL-90-R] Somatization [Symptom Checklist 90-Revised SCL-90-R]	p<.032 p<.04

Table F-15. Immune parameters

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Dimeo et al., 1997[101]	RCT Primary care	Breast Germ cell Sarcoma Lung Adenoscar-cinoma Neuroblastoma	Pre-planned exercise During treatment Coping	Individual (37) Comp 1 (33) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not clear/day of hospital discharge	Duration of neutropenia (days) Duration of thrombopenia (days)	**ES 0.643** **ES 0.442**
Hayes et al., 2003[104]	Non-RCT Primary care	Acute myeloid leukemia Breast Multiple myeloma Non-Hodgkin's lymphoma Lymphoblastic lymphoma/ leukemia Rhabdomyo-sarcoma	Pre-planned exercise During treatment Rehabilitation	Individual (6) Comp 1 (6) Intervention 1	Not applicable	**Intervention 1:** 70-90% maximum heart rate HR Aerobic activity Strength 20-40 minutes 3 days/week **Comparison 1:** Intensity not reported Stretching 20-40 minutes 3 days/week	3 months	CD3+ (helper/ suppressor T-cell) CD4+ (helper T-cells) CD8+ (suppressor T-cell) Lymphocytes Ratio CD4+/CD8+ T cell function adjusted for CD3+ Total t-cell function White blood cells	Not significant Not significant Not significant Not significant Not significant Not significant Not significant Not significant

Table F-15. Immune parameters (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Na, 2000[105]	RCT Primary care	Stomach	Pre-planned exercise During treatment Rehabilitation	Individual (18) Comp (17) Intervention	Not applicable	Intensity not reported Aerobic activity 60-90 minutes 4-5 days/ week	2 weeks	Natural killer cell cytotoxic activity	p<.05
Nieman et al., 1995[103]	RCT Unknown	Breast	Pre-planned exercise Post treatment Survival	Individual (8) Comp 1 (8) Intervention 1	Not applicable	75% maximum heart rate Aerobic activity Strength/ resistance 60 minutes 3 days/week	8 weeks	E: T20: 1 (mononuclear cells to cancer cell ratio NKCA percent lysis)	**ES 1.047**
								E: T40:1 (mononuclear cells to cancer cell ratio NKCA percent lysis)	**ES 0.636**
								Lymphocytes	**ES -0.799**
								Neutrophils	**ES -0.580**
								Natural killer cells	**ES -0.417**
								T cells	**ES -0.765**
								Total leukocytes	**ES -0.705**

Table F-16. Mental / emotional / psychological well-being

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1993[92]	Non-RCT Exercise facility	Breast Ovarian Testicular	Pre-planned exercise Post treatment Rehabilitation	Individual (30) Comp 1 (30) Intervention 1	Relaxation training Information Coping strategies	Intensity not reported Aerobic activity Strength/ resistance Stretching 60 minutes 1day/week	4 weeks	Depressive symptoms [modified HAD-scale no validity/ reliability measure]	p<.01
								Anxiety Symptoms [modified HAD-scale no validity/ reliability measure]	p<.01 *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Berglund et al., 1994[93]	RCT Unknown	Breast Ovarian Undefined	Pre-planned exercise Post treatment Rehabilitation	Individual (101) Comp 1 (98) Intervention 1	Relaxation Diet Life coping skills	Intensity not reported Aerobic activity Strength training Stretching 60 minutes 1 day/week	4 weeks	Avoidance	Not significant
								Fatalistic	Not significant
								Fighting spirit	Not significant
								Hopeless *all used mental adjustment to cancer scale	Not significant
								Anxiety scale [modified HAD-scale]	Not significant
								Anxious preoccupation [mental adjustment to cancer scale]	Not significant
								Worry [physical symptoms related to breast cancer scale]	Not significant
								Depression [Modified HAD-scale]	Not significant *all results are from a repeated measures ANOVA from 5 time points: baseline, post, 3, 6 & 12 months

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Burnham & Wilcox, 2002[86]	RCT Exercise facility	Breast Colon	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (6) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	**Intervention 1:** 25-40% heart rate reserve Aerobic activity 14-32 minutes 3 days/week **Intervention 2:** 40-60% heart rate reserve Aerobic activity 14-32 minutes 3 days/week	10 weeks	Depression [Linear Analog Self-Assessment measure] Anxiety [Linear Analog Self-Assessment measure] Anger [Linear Analog Self-Assessment measure]	**ES 1.279** **ES 0.901** **ES -0.114**
Courneya et al., 2002[82] Courneya et al., 2003[83]	RCT Home	All cancers possible Breast	Behavioral Post treatment Coping and rehabilitation	Group (11) Comp 1 (11) Intervention 1	Group psycho-therapy	65-75% maximum heart rate Aerobic activity 20-30 minutes 3-5 days/ week	10 weeks	Depression [CES-D scale] Anxiety [State-Trait Anxiety Inventory] Emotional well-being [Functional Assessment of Cancer Therapy-General (FACT-G Scale)]	**ES 0.005** **ES 0.000** **ES 0.000**

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Courneya et al., 2003[90] Fairey et al., 2003[100]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (28) Comp 1 (25) Intervention 1	Not applicable	70-75% maximum VO2 Aerobic activity 15-35 minutes 3 days/week	15 weeks	Emotional well-being [Functional Assessment of Cancer Therapy-Breast (FACT-B scale)]	**ES 0.375**
								Trial Outcome Index (TOI) score [well-being with breast cancer subscale]	**ES 0.200**

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Dimeo et al., 1999[106]	RCT Primary Care	Solid tumors or breast carcinoma Metastatic breast carcinoma Seminoma Sarcoma/ adenocar-cinoma Hodgkin's disease Non-Hodgkin's lymphoma Small cell lung carcinoma	Pre-planned exercise During treatment Coping	Individual (33) Comp 1 (29) Intervention 1	Not applicable	50% heart rate reserve Aerobic activity 15 minutes 7 days/week	Not reported/ hospital discharge	Global psychologic distress [Symptom Check List SCL-90-R]	**ES 0.253**
								Anxiety [Symptom Check List SCL-90-R]	**ES 0.278**
								Phobic anxiety [Symptom Check List SCL-90-R]	**ES 0.154**
								Depression [Profile of Mood States POMS]	**ES 0.079**
								Depression [Symptom Check List SCL-90-R]	**ES 0.263**
								Anger/hostility [Profile of Mood States POMS]	**ES 0.063**
								Hostility [Symptom Check List SCL-90-R]	**ES 0.266**

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
MacVicar et al., 1986[112]	Non-RCT Unknown	Breast	Pre-planned exercise During treatment Coping	Individual (4) Comp 1 (6) Intervention 1 (6) Intervention 2	Not applicable	60-85% maximum heart rate on pre-test aerobic assessment Aerobic activity 3 days/week	10 weeks	Total Mood Disturbance [Profile of Mood States (POMS)] Tension/anxiety [Profile of Mood States (POMS)] Depression [Profile of Mood States (POMS)] Anger/hostility [Profile of Mood States (POMS)]	Mean changes reported. Total mood disturbance, tension/ anxiety, depression, and anger/ hostility all decreased in treatment group.
McKenzie et al., 2003[107]	RCT Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (7) Comp 1 (7) Intervention 1	Not applicable	PA Intensity not reported Aerobic activity Strength/ resistance Stretching 30-60 minutes 3 days/week	8 weeks	Mental health QOL [SF-36]	p<.019

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Mock et al., 1994[99]	RCT Home	Breast	Behavioral During treatment Coping	Individual (5) Comp 1 (9) Intervention 1	Support group	Self-paced Walking 10-45 minutes 4-5 days/week	4-6 months	Depression [Symptom Assessment Scale]	p=.01
								Impact of medical illness on subject [Psychosocial Adjustment to Illness Scale]	**ES 0.413**
								Psychologic distress [Brief Symptom Inventory]	**ES 0.896**
								Anxiety [Symptom Assessment Scale]	Not significant
Mock, et al., 1997[94] Mock et al., 1998[98]	Non-RCT Home	Breast	Behavioral During treatment Coping	Individual (24) Comp 1 (22) Intervention 1	Not applicable	Self-paced Walking 20-30 minutes 4-5 days/week	6 weeks or 4-6 chemo-therapy cycles	Depression [Symptom Assessment Scales (SAS)]	p<.104
								Anxiety [Symptom Assessment Scales (SAS)]	p<.029

Table F-16. Mental / emotional / psychological well-being (continued)

First Author/Year	Study Design Intervention Setting	Cancer Diagnoses	Intervention Type Timing PEACE Framework Category	Sampling Individual/Group (n) Per Group	Non Exercise Intervention Elements	PA Intensity PA Mode PA Frequency/ Duration	Length of Intervention	Outcomes Reported	Significant Results
Mock et al., 2001[95] Pickett et al., 2002[96]	RCT Home	Breast	Behavioral During treatment Coping	Individual (25) Comp 1 (23) Intervention 1	Not applicable	50-80% maximum heart rate Walking 15-30 minutes 5-6 days/week	6 weeks to 6 months	Depression [Profile of Mood States (POMS)] Total Mood Disturbance [Profile of Moods States (POMS)] Anxiety [Profile of Mood States (POMS)]	p<.001 p<.001 p<.001
Segal et al., 2001[87]	RCT Primary care Home	Breast	Behavioral and pre-planned exercise During treatment Coping	Individual (41) Comp 1 (40) Intervention 1: self-directed exercise (42) Intervention 2: supervised preplanned exercise	Not applicable	50-60% maximum VO2 Walking Duration not reported 5 days/week	26 weeks	Mental health [SF-36]	Not significant
Segar et al., 1998[84]	RCT Home Exercise facility	Breast	Pre-planned exercise Post treatment Rehabilitation and health promotion	Individual (10) Comp 1 (10) Intervention 1 (10) Intervention 2: exercise and behavior modification	Behavior modification	≥60% maximum heart rate Aerobic activity 30 minutes 4 days/week	10 weeks	Depression [Beck Depression Inventory (BDI)] Anxiety [Strait Anxiety Inventory (STAI)]	p<.05 p<.04

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