**Disease Detectives Attack
the Public Health Epidemic of Overweight**

(Suggested Time: 30 minutes)

During the past few decades, the prevalence of overweight has grown to epidemic proportions. Currently, more than 50% of the U.S. population is at least overweight, and approximately 20% is extremely overweight, or obese.

Body mass index (BMI), expressed as weight/height^2 (kg/m^2) is commonly used to classify overweight and obesity. Cutoff criteria are based on the 2000 CDC growth charts. Based on current recommendations of expert committees, children and adolescents with BMI values $\geq$ the 95th percentile of the age- and sex-specific values from the charts are categorized as overweight. Children with values between the 85th and 95th percentiles are classified as being "at risk for overweight." (Overweight for adults is defined as BMI from 25 kg/m^2 to 30 kg/m^2, and obesity is defined as BMI $\geq$ 30 kg/m^2.)

Obesity prevalence is increasing, not only in industrialized countries but also in non-industrialized countries, particularly in those undergoing economic transition. Worldwide, around 250 million people are obese, and the World Health Organization has estimated that in 2025, 300 million people will be obese. Childhood overweight can result in increased risk of obesity in adulthood and is associated with coronary heart disease (CHD) and diabetes.
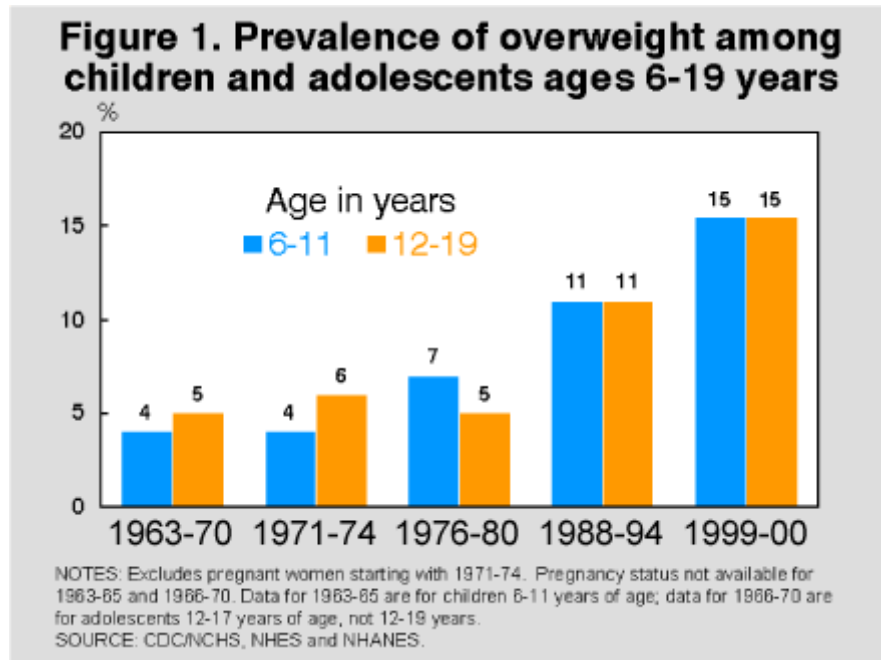
Part A — The Burden of the Problem

Background: In 2000, a news magazine featured a cover story on the increasing problem of overweight in children and adolescents in the United States. Health and other community officials have read the news magazine cover article and are concerned about the problem. The health department wants to know how to prevent overweight in children and adolescents and has asked you, a disease detective, to help.

You start by locating data regarding the increasing problem of overweight in children and adolescents in the United States. One source of data is CDC's periodic National Health and Nutrition Examination Survey (NHANES), which collects information on a sample of the civilian non-institutionalized United States population. This survey includes a household interview and a physical exam for each survey participant. During the physical examination, height and weight are measured as part of a more comprehensive set of body measurements. Trained health technicians who use standardized measuring procedures and equipment take these measurements.

✎**1. To identify people with disease or health conditions in an epidemiologic investigation, disease detectives frequently use a case definition. List the basic elements of case definitions.**

Figure 1, below, presents data from the NHANES survey on prevalence of overweight among children and adolescents in two age groups.

Figure 1. Prevalence of overweight among children and adolescents ages 6-19 years

NOTES: Excludes pregnant women starting with 1971-74. Pregnancy status not available for 1963-65 and 1966-70. Data for 1963-65 are for children 6-11 years of age; data for 1966-70 are for adolescents 12-17 years of age, not 12-19 years.
SOURCE: CDC/NCHS, NHES and NHANES.

Source: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/over99fig1.htm.

✎ **2. Define** *prevalence rate*.

✎ **3. You observe from Figure 1 that, overall, prevalence of overweight has increased in the past 25 years. Give two reasons why this apparent pattern may not reflect a true increase in prevalence.**

(a)

(b)

✎4.   Supposing that Figure 1 reflects true changes in prevalence over time, list three possible explanations for this trend.

(a)

(b)

(c)

Background: Further analysis of the NHANES data yields the results in Table 1 below.

Table 1. Overweight children and adolescents 6-19 years of age, according to sex, age, race, and Hispanic origin: United States, selected years, 1963-1965 through 1999-2000

[Data are based on physical examinations of a sample of the civilian noninstitutionalized population]

Age, sex, race, and Hispanic origin[1]	1963–65 1966–70[2]	1971–74	1976–80[3]	1988–94[4]	1999–2000[4]
6–11 years of age		Percent of population (standard error)			
Both sexes	4.2	4.0	6.5	11.3 (1.0)	15.3 (1.7)
Boys	4.0	4.3	6.6	11.6 (1.3)	16.0 (2.3)
White	4.4	4.1	6.7	11.3 (1.7)	- - - - - -
Black	1.6	5.3	6.7	12.3 (1.4)	- - - - - -
White, non-Hispanic	- - -	- - -	6.1	10.7 (2.0)	*12.0 (3.0)
Black, non-Hispanic	- - -	- - -	6.8	12.3 (1.4)	17.1 (2.7)
Mexican	- - -	- - -	13.3	17.5 (2.4)	27.3 (3.1)
Girls	4.5	3.6	6.4	11.0 (1.4)	14.5 (2.4)
White	4.5	3.7	5.7	9.8 (1.7)	- - - - - -
Black	4.5	3.3	11.1	16.7 (1.5)	- - - - - -
White, non-Hispanic	- - -	- - -	5.2	*9.8 (2.0)	*
Black, non-Hispanic	- - -	- - -	11.2	17.0 (1.6)	22.2 (3.3)
Mexican	- - -	- - -	9.8	15.3 (2.5)	19.6 (3.1)
12–19 years of age					
Both sexes	4.6	6.1	5.0	10.5 (0.9)	15.5 (1.2)
Boys	4.5	6.1	4.8	11.3 (1.3)	15.5 (1.6)
White	4.7	5.5	4.6	12.1 (1.7)	- - - - - -
Black	3.1	5.0	4.8	10.4 (1.4)	- - - - - -
White, non-Hispanic	- - -	- - -	3.6	11.6 (1.9)	12.8 (2.4)
Black, non-Hispanic	- - -	- - -	4.9	10.7 (1.4)	20.7 (2.6)
Mexican	- - -	- - -	7.7	14.1 (1.8)	27.5 (3.0)
Girls[5]	4.7	6.2	5.3	9.7 (1.1)	15.5 (1.6)
White	4.5	6.1	4.7	9.0 (1.4)	- - - - - -
Black	6.4	10.1	10.0	16.3 (2.0)	- - - - - -
White, non-Hispanic	- - -	- - -	5.0	8.9 (1.7)	12.4 (2.1)
Black, non-Hispanic	- - -	- - -	10.3	16.3 (2.1)	26.6 (2.7)
Mexican	- - -	- - -	9.1	*13.4 (3.1)	19.4 (2.8)

* Estimates are considered unreliable. Data preceded by an asterisk have a relative standard error of 20–30 percent.
- - - Data not available.
[1]The race groups, white and black, include persons of Hispanic and non-Hispanic origin. Conversely, persons of Hispanic origin may be of any race.
[2]Data for 1963–65 are for children 6–11 years of age; data for 1966–70 are for adolescents 12–17 years of age, not 12–19 years.
[3]Data for Mexicans are for 1982–84. See Appendix I, National Health and Nutrition Examination Survey (NHANES).
[4]Standard errors of estimates for 1988–94 and 1999–2000 are shown. 1999–2000 estimates are based on a smaller sample size than estimates for earlier time periods and therefore are subject to greater sampling error.
[5]Excludes pregnant women starting with 1971–74. Pregnancy status not available for 1963–65 and 1966–70.

NOTES: Overweight is defined as body mass index (BMI) at or above the sex- and age-specific 95th percentile BMI cutoff points from the 2000 CDC Growth Charts: United States. Advance data from vital and health statistics; no. 314. Hyattsville, Maryland: National Center for Health Statistics. 2000. Age is at time of examination at mobile examination center. Crude rates, not age-adjusted rates, are shown. Some data for 1988–94 have been revised and differ from the previous edition of *Health, United States*.

SOURCES: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey, Hispanic Health and Nutrition Examination Survey (1982–84), and National Health Examination Survey (1963–65 and 1966–70).

✎5. For respondents aged 12-19 years in all racial and gender groups, which single group of those listed below had the greatest relative increase between the 1988-1994 and 1999-2000 surveys? Show your calculations for each category and then circle the correct category.

(a) White, non Hispanic boys

(b) Black, non Hispanic boys

(c) Mexican boys

(d) White, non Hispanic girls

(e) Black, non Hispanic girls

(f) Mexican girls

✎6. Give a likely explanation for the missing data in Table 1.



✎7. Name the study design used for NHANES.

✎8. List 2 advantages and 2 disadvantages of this study design for understanding the problem of overweight in children and adolescents. (Note: A disadvantage is not merely the opposite of an advantage).

Advantages

Disadvantages

Background: You locate another data source, the Youth Risk Behavior Surveillance System (YRBSS), relevant to the problems of overweight among adolescents. The YRBS is conducted by CDC in collaboration with federal, state, and private-sector partners. Conducted primarily in public and some private school settings, the YRBSS provides vital information on risk behaviors among young people to more effectively target and improve health programs. Figure 2 below presents data from this system showing the trend in three health risk behaviors.

Figure 2. Health Risk Behaviors among U.S. High School Students, 1991–1999
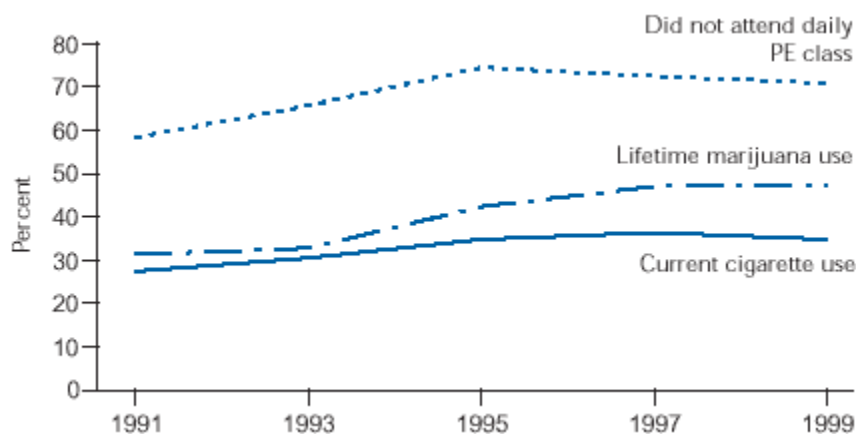
Source: CDC, Youth Risk Behavior Surveillance System

✎**9. What conclusions can you draw by taking into account data from Figure 1 and Figure 2 together? Justify your answer.**

Background: Your investigation to this point underscores the magnitude of the problem of obesity among adolescents and the importance of finding an intervention. You find information on the Bogalusa Heart Study. Bogalusa, a community of approximately 40 000 people, is 70 miles northeast of New Orleans and is fairly typical of semi-rural towns in the Southern United States. In this investigation, the disease detectives assessed the impact of childhood overweight on adult levels of blood fat (lipids), blood proteins (insulin), and blood pressure among 2617 participants.

All participants were initially examined at ages 2 to 17 years and were reexamined at ages 18 to 37 years; the mean follow-up interval was 17 years.

✎**10. Name the study design used for the Bogalusa Study.**

✎**11. List 2 advantages and 2 disadvantages of this study design in studying the health effects of overweight in adolescents. (Note: A disadvantage is not merely the opposite of an advantage).**

   Advantages

   Disadvantages

Background: Consider Table 2 below containing results from the Bogalusa Study.

TABLE 2.   Association Between BMI in Childhood and Adulthood

Childhood BMI Percentiles	Adult BMI (kg/m²)			Total
	<25 (Normal Weight)	25–29.9 (Overweight)	≥30 (Obese)	
<50th (normal weight)	950 (72)*	271 (21)	96 (7)	1317
50th–74th	301 (47)	205 (32)	132 (21)	638
75th–84th	64 (29)	79 (35)	80 (36)	223
85th–94th	40 (16)	84 (33)	129 (51)	253
≥95th (overweight)	12 (6)	30 (16)	144 (77)	186
Total	1367	669	581	2617

* Values in parentheses represent row percentages. For example, of the 1317 normal-weight children, 7% ($n = 96$) became obese adults.

✎**12. What main conclusion can you draw about the relationship between childhood BMI and adult BMI? Provide data to support your conclusion.**

Part B – Interventions for this Public Health Problem

✎**13.** **Based on your analysis of the epidemiology of overweight and obesity in Part A, list three strategies that families could implement in their homes to prevent this problem among children and adolescents.**

(a)

(b)

(c)

✎**14.** **Based on your analysis of the epidemiology of overweight and obesity in Part A, list three strategies that schools and communities could implement to prevent this problem among children and adolescents.**

(a)

(b)

(c)

✎**15.** **The health department asks you, a disease detective, to design a study to determine whether any of these intervention methods work to decrease overweight in adolescents.**

(a) Name the study design that you would use.

(b) List four elements of the study design that you have just named that would be critical to a valid evaluation of the effectiveness of the intervention.

**Disease Detectives Attack
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Answer Key

✎**1. To identify people with disease or health conditions in an epidemiologic investigation, disease detectives frequently use a case definition. List the basic elements of case definitions.**

Answer (4 points, 1 for each element)

· Clinical information on the disease
· Characteristics of the people affected

· Information about location or place
· Time during which the outbreak occurred

✎**2. Define *prevalence rate*.**

Answer (3 points)

Prevalence rate is a measurement of the frequency with which a health problem or health event (e.g., obesity or illness) exists in a population during a given time. In calculating prevalence, the numerator is the total number of cases existing in the population during the time in question, and the denominator is the total population at risk (including people who have the condition) during that time.

Note: Look for key words such as existing (total) cases, population at risk, over time. (1 pt each for these 3 concepts: numerator = number of cases, denominator = population at risk, time aspect = specific time period).

✎**3. You observe from Figure 1 that, overall, prevalence of overweight has increased in the past 25 years. Give two reasons why this apparent pattern may not reflect a true increase in prevalence.**

Possible Answers (2 points, 1 for each reason)

· Change in case definition
· Change in ascertainment

· Change in measurement
· Change in sample characteristic

✎**4. Supposing that Figure 1 reflects true changes in prevalence over time, list three possible explanations for this trend.**

Possible Answers (3 points, 1 for each explanation)

· Caloric intake greater than caloric expenditure through physical activity
· Poor diet (e.g., dietary intake high in calories from sugar and fat)
· Cultural or social pressure to gain weight
· Decreased exercise because of lack of encouragement or opportunity (e.g., reduction in school

PE resources, sports programs, community elimination of bike paths, closed stairwells in public buildings, lack of initiative ("couch potato syndrome")
· Poor urban planning or neighborhood safety

✎**5. For respondents aged 12-19 years in all racial and gender groups, which single group of those listed below had the greatest relative increase between the 1988-1994 and 1999-2000 surveys? Show your calculations for each category and then circle the correct category.**

Answer (7 points, 1 for each calculation and 1 for answer; calculation should show numerator, denominator and quotient.)

a) White, non Hispanic boys $12.8/11.6 = 1.10$ **d)** White, non Hispanic girls $12.4/8.9 = 1.39$
b) Black, non Hispanic boys $20.7/10.7 = 1.93$ **e)** Black, non Hispanic girls $26.6/16.3 = 1.63$
c) Mexican boys $27.5/14.1 = 1.95$ **f)** Mexican girls (unstable) $19.4/13.4 = 1.44$

For overall answer, accept category b, c, or both.

✎**6. Give a likely explanation for the missing data in Table 1.**

Possible Answers (1 point)
· Changing definition of racial/ethnic categories
· Data may not have been collected.

✎**7. Name the study design used for NHANES.**

Answer (1 point)
Cross-sectional or survey

✎**8. List 2 advantages and 2 disadvantages of this study design for understanding the problem of overweight in children and adolescents. (Note: A disadvantage is not merely the opposite of an advantage).**

Answer (4 points, 1 for each valid answer)
Advantages: quick, relatively cheap, allows collection of multiple covariates
Disadvantages: cannot assess causality, confounding, bias.

✎**9. What conclusions can you draw by taking into account data from Figure 1 and Figure 2 together? Justify your answer.**

Answer (2 points, 1 for conclusion and 1 for justification)
None
There is no data on individuals. The two figures cover different periods. (Might be used to generate hypothesis that other unhealthy behaviors are related to overweight.)

✎**10. Name the study design used for the Bogalusa Study.**

Answer (1 point)
Cohort, prospective, or longitudinal

✎**11. List 2 advantages and 2 disadvantages of this study design in studying the health effects of overweight in adolescents. (Note: A disadvantage is not merely the opposite of an advantage).**

Answer (4 points, 1 point for each valid answer)
Advantages:
▪ More likely to support causality
▪ Reduces some forms of bias, controls confounders
Disadvantages:
▪ Expensive   ▪ Lengthy
▪ Study subjects lost to follow-up   ▪ Bias due to multiple measures on risk
.

✎**12. What main conclusion can you draw about the relationship between childhood BMI and adult BMI? Provide data to support your conclusion.**

Answer (2 points, 1 for conclusion and 1 for support data)
Childhood overweight is a risk factor for adult obesity; this relationship is direct. Of the overweight kids, 77% remained obese as adults; only 7% of normal weight kids were obese as adults.

✎**13. Based on your analysis of the epidemiology of overweight and obesity in Part A, list three strategies that families could implement in their homes to prevent this problem among children and adolescents.**

Answer (3 points, 1 for each valid strategy)
▪ Healthy meals and snacks   ▪ Family physical activity
▪ Restrictions on TV/Video game time   ▪ Parent role models
▪ Social support for physical activity

✎**14. Based on your analysis of the epidemiology of overweight and obesity in Part A, list three strategies that schools and communities could implement to prevent this problem among children and adolescents.**

Answer (3 points, 1 for each valid strategy)
▪ Inexpensive, healthy choices for   ▪ Nutrition and cardiovascular education
  school food and vending machines   ▪ Recreational facilities
▪ Physical activity requirements

✎15. **The health department asks you, a disease detective, to design a study to determine whether any of these intervention methods work to decrease overweight in adolescents.**

a) **Name the study design that you would use.**

Answer (1 point)

Randomized control trial, cohort, case control

b) **List four elements of the study design that you have just named that would be critical to a valid evaluation of the effectiveness of the intervention.**

Possible Answers (4 points, 1 for each element)

Randomized Control Trial	Cohort	Case-Control
Randomization	—	Randomization
Determine exposure/outcome	Determine exposure/outcome	Determine exposure/outcome
Measure exposure/outcome	Measure exposure/outcome	Measure exposure/outcome
Study horizon	Study horizon	—
Lost to follow-up	Lost to follow-up	
—	—	Non response
—	—	Selection of comparison/control group
Systematic/standardized data collection	Systematic/standardized data collection	Systematic/standardized data collection
Response rate	Response rate	Response rate
Acceptable methodology	Acceptable methodology	Acceptable methodology
Confounders	—	Confounders

Bias – must specify type & relation to study design

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