

The background of the top banner features a photograph of several pink water lilies in bloom, surrounded by large green lily pads. The text is overlaid on this image.

Survey Shows...

The Hawaii Behavioral Risk Factor Surveillance System
Special Report

Year 2 Issue 1

September 2004

Adult Diabetes Prevalence Measured from the HBRFSS

Tianzhu 'Jack' Huang, M.Sc.

Florentina R. Salvail, M.Sc.

Hanh Nguyen, B.Sc.

Ann Pobutsky, Ph.D.

Acknowledgement

We would like to acknowledge the adult residents of Hawaii who voluntarily participated in the HBRFSS. Without their participation this report as well as other studies derived from HBRFSS would not have been made possible. We would also like to thank staff at the Department of Health especially Dr. Alvin T. Onaka, Chief of Office of Health Status Monitoring (OHSM) and OHSM staff for mortality statistics relevant to diabetes.

About the Hawaii Behavioral Risk Factor Surveillance System (HBRFSS)

The HBRFSS is an ongoing land-based random telephone survey of randomly selected adult residents 18 years and older on behaviors that affects health directly and indirectly. The HBRFSS is funded by the Centers for Disease Control and Prevention (CDC) as part of the national Behavioral Risk Factor Surveillance System (BRFSS). The HBRFSS has been in operation since 1986. For more information about HBRFSS results, please visit the following website: <http://www.hawaii.gov/health/statistics/brfss/index.html>. If the information you are looking is not on the website, you may contact the state BRFSS coordinator via e-mail at brfsshi@health.state.hi.us or via phone at 808-586-4509.

Suggested citation: Huang, Tianzhu, Salvail, Florentina R., Nguyen, Dung-Hanh and Pobutsky, Ann, *Adult Diabetes Prevalence Measured from the HBRFSS, Survey Shows...* The Hawaii Behavioral Risk Factor Surveillance System Special Report, Year 2 Issue 1, September 2004, Department of Health, State of Hawaii.

Introduction

Diabetes mellitus is a group of diseases characterized by high levels of blood glucose resulting from problems in insulin production, action, or both (Centers for Disease Control and Prevention, 2003). Type 2 diabetes was formerly referred to as adult onset diabetes and is now known as non-insulin-dependent diabetes mellitus (NIDDM), mainly because prevalence is increasing at younger ages. Type 2 diabetes could account for about 90% to 95% of all diagnosed cases of diabetes (<http://www.cdc.gov/diabetes/pubs/general.htm#what>). Type 1 diabetes was formerly referred to as juvenile onset diabetes and is now known as insulin-dependent diabetes mellitus (IDDM), and could account for 5% to 10% of all diagnosed cases of diabetes.

Type 2 diabetes was previously considered to be of minor significance to world health, but is now “one of the main threats to human health in 21st century (Zimmet, Alberti and Shaw, 2001)”. The past two decades have seen an explosive increase in diabetes worldwide due to pronounced changes in the human environment, behavior and lifestyle (King and Herman, 1998). Escalating rates of obesity have fueled this trend, such that obesity and diabetes have been called “twin epidemics” (American Public Health Association, 2000; CDC, 2001).

The National Institutes of Health estimates that the greatest costs of co-morbid diseases related to overweight and obesity were those related to type 2 diabetes, estimated at \$98 billion dollars in 1991. However, this figure underestimates the magnitude of the problem, since the prevalence of both diabetes and overweight/obesity has increased most dramatically since the early 1990’s (<http://www.niddk.nih.gov/health/nutrit/pubs/econ>). Current estimates suggest that 150 million people worldwide have diabetes and projections suggest that by the year 2010, 220 million people will have diabetes and by the year 2025, 300 million people will have diabetes. Ethnic differences are apparent in the increase in type 2 diabetes, which are most pronounced in non-European populations. It is anticipated that the largest increases in diabetes prevalence will be in Asia. In China, there has been a three-fold increase over the past two decades whereas previously, the prevalence was less than 1% (Zimmet, Alberti and Shaw, 2001).

The emergence of type 2 diabetes in children and adolescents is an emerging and serious public health problem (American Diabetes Association, 2000); type 2 diabetes may eventually become the predominant form of childhood diabetes within 10 years among certain ethnic groups. Type 2 diabetes in children has already been reported in Japan, the U.S., numerous Pacific islands, Hong Kong, Australia, and the UK. In Japan, type 2 diabetes is already more common than type 1 diabetes (among children) (Zimmet, Alberti and Shaw, 2001).

According to the CDC, over 17 million Americans have diabetes, and more than 200,000 people die every year of related complications, making it the sixth leading cause of death in the U.S. Diabetes is well known to cause pregnancy complications, blindness, kidney failure, and amputations of the lower extremities. Diabetes is also associated with cardiovascular disease conditions like coronary heart disease and stroke, which are the top two leading causes of death in the U.S. Likewise, diabetes is related to deaths due to flu or pneumonia. Although diabetes has become epidemic in the U.S., about one-third of adults with diabetes are unaware that they have diabetes because it is not been diagnosed (Harris et al, 1998); and this makes those undiagnosed particularly at risk for complications due to uncontrolled diabetes (Hirokawa, citing Nogues, personal communication). The number of U.S.

adults with diagnosed diabetes (including women with gestational diabetes) has increased 61% in the past 10 years, and is projected to more than double by 2050 (CDC, 2003).

Diabetes is generally more common among older people. The proportion of Hawaii residents aged 65 years and older rose from 5% in 1970, to 8% in 1980 to 14% in 1999 (HMSA Foundation, 2001), a growth rate 4 times higher than the whole population (US Census, 2000). Therefore, the state of Hawaii faces great challenges due to the diabetes burden among its relatively large population of middle-aged and elderly citizens.

Diabetes mortality, prevalence and complication rates differ among Hawaii's diverse ethnic populations, providing excellent opportunities to conduct public health research to better understand how diabetes affects these different ethnic groups, and how quality of care for adults with diabetes can be improved.

Research and data analysis on survey data from the Hawaii Behavioral Risk Factor Surveillance System (HBRFSS) and other sources can provide a sound understanding of the lifestyle factors associated with diabetes, as well as diabetes management and control practices among adults with diabetes in Hawaii. With this blueprint in hand, public health professionals can develop better strategies and standards of diabetes care, public health management/decision-makers can appropriately allocate public resources, and health care providers/educators can approach groups most at risk and groups most in need more efficiently. With appropriate action strategies, Hawaii's Healthy People 2010 diabetes objectives may be within our reach.

Healthy People 2010 Measurable Objectives for Diabetes in Hawaii

Objective 5-1: Increase the proportion of persons with diabetes who receive formal diabetes education to 60%

Objective 5-3: Reduce the overall rate of diabetes that is clinically diagnosed to 2.5%

Objective 5-12: Increase the proportion of adults with diabetes who have a glycosylated hemoglobin measurement at least once a year to 50%

Objective 5-13: Increase the proportion of adults (aged 18+) with diabetes who have an annual dilated eye examination to 75%

Objective 5-14: Increase the proportion of adults with diabetes who have at least an annual foot examination to 75%

Methodology

The information presented in this study is based on (1) mortality data for years 2000~2002, from the Office of Health Status Monitoring (OHSM), Department of Health, state of Hawaii; (2) Hawaii Behavioral Risk Factor Surveillance Survey (HBRFSS) data for years 2000~2002, and (3) CDC's web publications.

The survey population for HBRFSS is all civilian, non-institutionalized residents aged 18 years or older in the state of Hawaii who have land based telephones. People in households without telephones, people using cell phones exclusively, or people who live in non-traditional homes are not included. Following CDC's guidelines and standards, the HBRFSS uses the Disproportionate Stratified Sample (DSS) method to randomly select land-based telephone numbers throughout the state of Hawaii. Businesses and nonworking numbers are then excluded, and residential numbers are retained. Individuals aged 18 years and older are randomly selected from each household called. To ensure maximum data quality, interviewers are specially trained to ask questions exactly the same way for every call. Interviewers use a Computer Assisted Telephone Interview (CATI) program to dial telephone numbers and enter data directly into their computers. Once the survey data are edited, imputed, and weighted by CDC, the processed data set is sent back to Hawaii for data analysis and research on health status, and risk and protective factors that put people at risk for death and chronic disease.

For mortality data, Hawaii residents who died at age 18 years or older are included in the analysis. Proc FREQ of SAS is used to generate diabetes mortality frequencies where (1) diabetes was the underlying cause of death (UCD), which triggered the train of events leading to a death outcome, (2) diabetes was the contributory cause of death (CCD), which did not initiate the train of events leading to death, but resulted in death directly or indirectly, or resulted in any other significant conditions which unfavorably influenced the course of a morbid process and thus contributed to a fatal outcome, and (3) the underlying and contributory cause of death combined (UCD/CCD). Excel spread sheets were used to calculate mortality rates based upon the estimated average adult populations from year 2000 to year 2002.

For HBRFSS data, two kinds of rates are generated to measure diabetes: crude prevalence rates and age-adjusted prevalence rates, in order to serve different purposes. Crude prevalence rates estimate true rates, reflecting the real burden of disease in a population. Age-adjusted prevalence rates are synthetic indexes for rate comparisons between two populations or for rate comparisons within a single population over time. SUDAAN proc descript feature was used to calculate prevalence rates and age-adjusted prevalence rates and standard errors (SE) for those rates. For better layout and easier reference, tables and glossaries are placed in the appendix section.

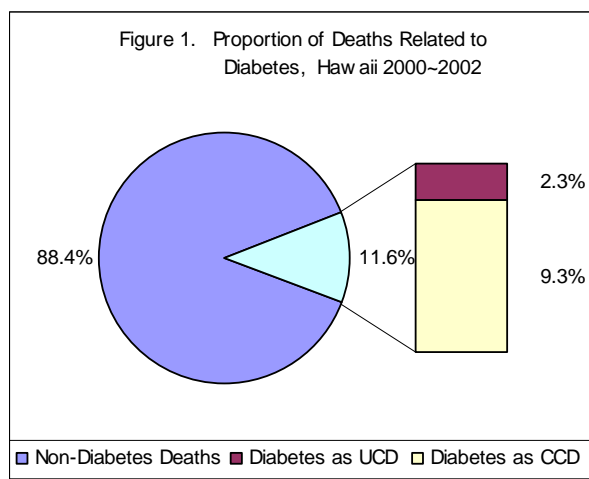
Results and Discussion

Part I. Adult Diabetes Mortality

From 2000 to 2002, on annual average, 8,185 Hawaii residents died at age 18 years or older, caused directly or indirectly by various kinds of diseases, injuries or poisoning, including 191 cases where diabetes was the underlying cause of death and 761 cases where diabetes was the contributory cause of death (Table 1).

Years:

The adult mortality rate from all causes was 893 per 100,000 during the years 2000-2002 (Table 1). Of this rate, 104 per 100,000 was the mortality rate attributed to diabetes as both the underlying and contributory cause of death, which was comprised of 21 cases per 100,000 of diabetes as the underlying cause of death, and 83 cases per 100,000 of diabetes as the contributory cause of death. Proportion wise, 2.3% of the total adult death rate was attributed to diabetes as the underlying cause of death, and another 9.3% as the contributory cause of death. Therefore, 11.6% of total adult deaths were involved in diabetes (Figure1).



County:

Honolulu City and County had the lowest mortality rates for diabetes as the underlying cause of death (20), contributory cause of death (80) or both (100). Hawaii County had the highest mortality rate for diabetes as the underlying cause of death (27). Kauai County topped the other counties in mortality rate for diabetes as both the underlying and contributory cause of death (123), although this was not statistically significantly different from that of Hawaii County. However, with age-adjustment, diabetes mortality rates in Kauai County's were not very different from those of Hawaii County, Maui County, or Honolulu City and County.

Ethnicity:

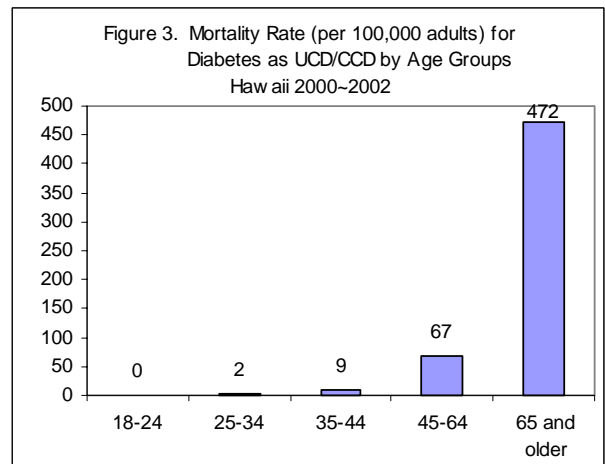
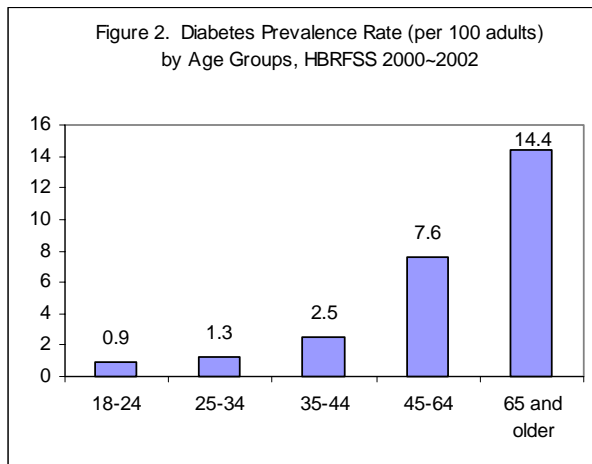
Hawaiians had the highest mortality rates for diabetes as the underlying cause of death (37), contributory cause of death (134) or the both (171), followed by Japanese, and Filipinos. Whites had the lowest diabetes mortality rates. When age-adjusted, Hawaiians still had the highest mortality rates for diabetes, followed by Filipinos, Japanese and Whites in descending order.

Gender:

Males had relatively higher diabetes mortality rates than females: 21 vs. 20 as the underlying cause of death; and 90 vs. 76 as the contributory cause of death. This is similar to the estimates from the HBRFSS for diabetes prevalence by gender (Table 5).

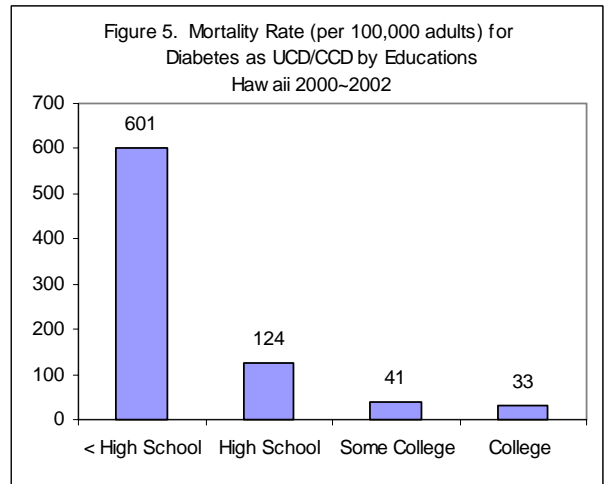
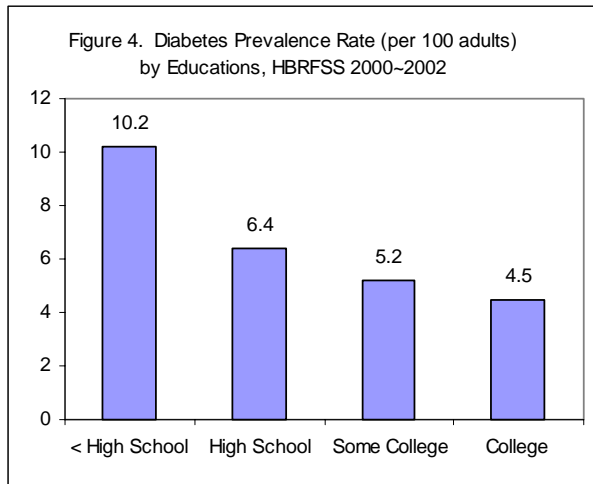
Age:

Figure 2 and Figure 3 illustrate that both the prevalence rate of diabetes and the mortality rate associated with diabetes rose with age. While both rates rose with age, the diabetes mortality rate rose up more sharply at older ages. The diabetes mortality rate among those aged 65 years or older was 6 to 7 fold greater than among those aged 45-64 years. On the other hand, diabetes prevalence among those aged 65 years or older was only 2 times greater than among those aged 45-64 years. Not everyone who has diabetes dies of the disease. In the state, the diabetes prevalence rate (5.7 per 100) is about 55 times that of diabetes mortality rate (104 per 100,000). However, there are diseases co-morbid with diabetes. Of the diabetes deaths that are classified as either the underlying cause of death or the contributory cause of death, 72.7% had heart diseases, 21.2% had cerebrovascular diseases, 20.6% had kidney diseases, 13.8% had hypertension and 9.3% had flu/pneumonia.



Education:

Diabetes prevalence rates and diabetes mortality rates decreased as the level of education completed increased. However, when the education level of less than high school was compared with other levels, the magnitude of change was more striking in mortality rates than in prevalence rates. This pattern held even with age-adjustment.



Part II. Adult Diabetes Morbidity

During the years 2000 to 2002, a total of 16,516 adults who completed the HBRFSS responded to the question: “*Have you had ever told by a doctor that you have diabetes?*” Of these respondents, 977 said “Yes”, 236 females said “Yes, but gestational diabetes”, 15,274 said “No”, and 29 answered ‘don’t know/not sure’ or refused to answer the question (Tables 2 and 3). Gestational diabetes was not the subject of interest in this study; therefore, the 326 cases of gestational diabetes were treated as non-diabetic. In addition, since the diabetes status of the 29 who answered ‘don’t know/not sure’ or ‘refused’ could not be determined, for the sake of convenience, they were excluded from the analysis.

A total of 16,487 records were used in the study (Table 3). Ethnicity was grouped as follows: Whites (including Portuguese), Hawaiians, Filipinos, Japanese, and others (including Chinese), while age was grouped as 18-24 years, 25-34 years, 35-44 years, 45-64 years, and 65 years or older in this part of the study.

The estimated number of adults with diabetes could be as low as 47,850 and as high as 57,192 using a 95% confidence interval, with an annual average of 52,521 from an estimated state adult population of 916,580 in the state (Table 2).

The average age of respondents when told of their diabetes diagnosis by a health care professional was about 49 years old. However, this varied among the major ethnicity groups in Hawaii: Hawaiians were the youngest to be diagnosed with diabetes at age 45, followed by Filipinos at age 48, Whites at age 51 and then Japanese at age 52 as shown in Table 4.

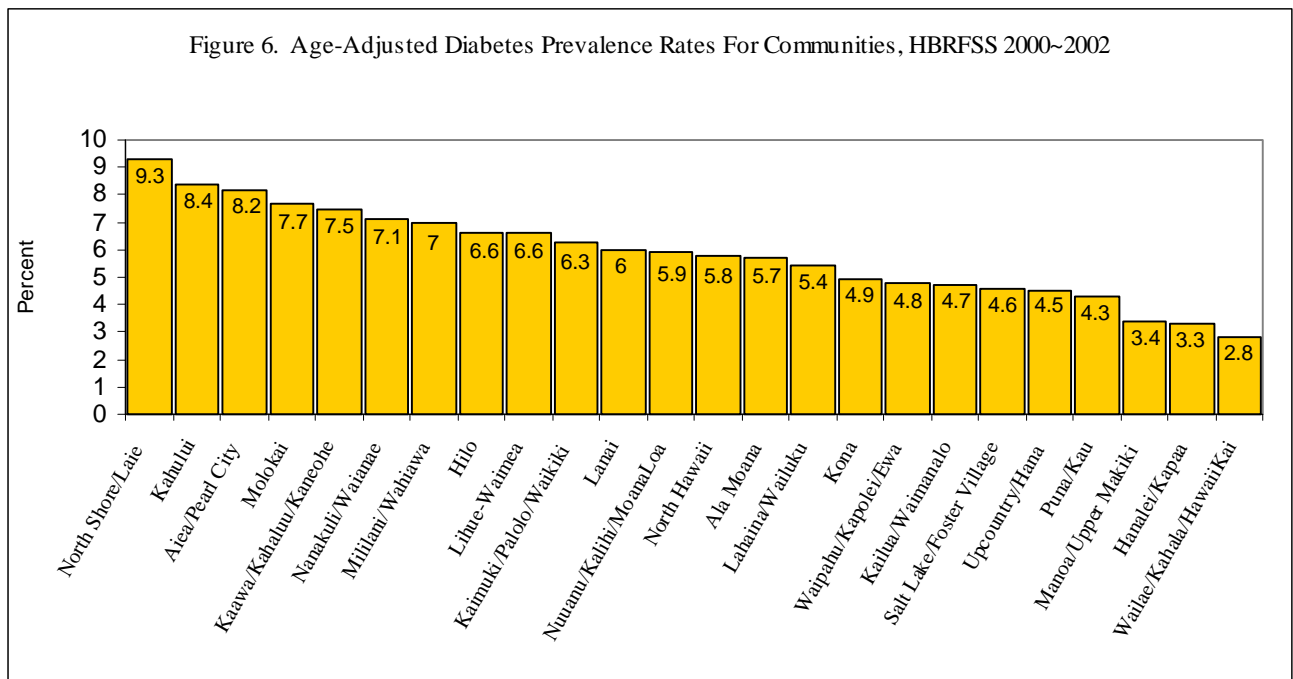
Years:

For the years 2000~2002, the year 2001 had the highest age-adjusted diabetic prevalence rate (6.1%), followed by 5.7% for 2002 and 5.2% for 2000. However, differences in prevalence between any two years were not statistically significant. The overall age-adjusted diabetes prevalence rate was 5.6%. If the age distribution of Hawaii's population were the same as the Distribution #9 of Year 2000 Projected U.S. Population, we would expect 56 adults to have diabetes for every thousand people who are 18 years or older in Hawaii.

Community:

It is important to know diabetes prevalence rates at the community level so that health education and promotion can be carried out efficiently and effectively. There are 24 communities in the state of Hawaii. The definition of sub-county areas or community areas are in Appendix I and can also be found at <http://www.hawaii.gov/health/statistics/brfss/others/subarea.html>. Diabetes prevalence rates vary within the sub-county areas as depicted in Figure 6. The prevalence of diabetes was lowest in the Waiialae/Kahala/Hawaii Kai area and highest in the North Shore/Laie area.

Diabetes prevalence rates in community areas at the lower ends from 2.8% to 3.4% the (e.g. Waiialae/Kahala/Hawaii Kai, Hanalei/Kapaa and Manoa/Upper Makiki) were statistically significantly different from areas at higher ends with prevalence ranges from 5.8% to 9.3% (e.g. from North Hawaii to North Shore/Laie in Figure 6). Values in areas with prevalence ranges of 4.3% to 4.9% were also statistically significantly different from areas with prevalence ranges from 8.2% to 9.3%. The value of 6.6% was not statistically significantly different from 4.6% but was statistically significantly different from 4.5% and lower.



County:

For the years 2000 to 2002, Honolulu City and County had the highest age-adjusted diabetes prevalence (5.8%), followed by 5.4% for both of Hawaii County and Kauai County, and 5.2% for Maui County. However, differences in prevalence between any two counties were not statistically significant.

Ethnicity:

Age distributions are different among ethnic groups in Hawaii, with Hawaiians having the youngest age distribution and Japanese the oldest one. Previous publications of HBRFSS used prevalence rates which were not adjusted for age effects. For example, on the webpage (<http://www.hawaii.gov/health/statistics/brfss/brfss1999/home.html#diabete>) of the HBRFSS in 1999, Section 5: Diabetes Awareness, Japanese have the highest reported diabetes prevalence, followed by Hawaiians. Diabetes prevalence estimates by ethnicity from the HBRFSS in Table 5 confirm this pattern. However, if the effects of different age distributions on diabetes occurrence are removed by applying age-adjusted methods, rate comparisons between two different ethnicities become more meaningful. The age-adjusted diabetes prevalence for Whites was significantly lower than that of Hawaiians, Japanese, Filipinos and others ($p < .01$). In descending order, Hawaiians had the highest age-adjusted diabetes prevalence (7.9%), followed by Filipinos (7.5%), Japanese (6.6%), others (5.5%) and Whites (3.8%).

The diabetes prevalence for Whites dropped to 2.8% when Portuguese were excluded from the White category. Portuguese had the highest prevalence of diabetes (8.2%), suggesting that attention should be focused on diabetes awareness and control among people of Portuguese descent. Chinese are usually incorporated within the catch all category of ‘others’, but when examined separately, had a prevalence rate significantly lower than Filipinos (4.9% vs. 7.5%, $p < .05$), but significantly higher than for Whites (4.9% vs. 2.8%, $p < .01$).

Age:

The prevalence of diabetes increases with age. People aged 45-64 years and 65 years or older had a prevalence of 7.6% and 14.4%, respectively, and both prevalence rates were significantly higher than for those at younger ages ($p < .01$). Statistically, age 45 was an “age threshold” or risk marker for the potential onset of diabetes.

Gender:

Though men showed higher age-adjusted prevalence than women (6.0% vs. 5.3%), a statistically significant difference was not found in this study.

Education:

Patterns of age-adjusted diabetes prevalence plotted by educational attainment levels show that people with at least a college degree had significantly lower prevalence than those of with only a high school education (4.4% vs. 6.6%, $p < .01$).

Income:

Patterns of age-adjusted prevalence rates plotted by household income were similar to that of education. People with annual household incomes of \$50,000~\$74,999 and at least \$75,000 had age-adjusted prevalence of 4.5% and 3.9%, respectively, and both prevalence rates were significantly lower than among those at lower income levels ($p < .05$).

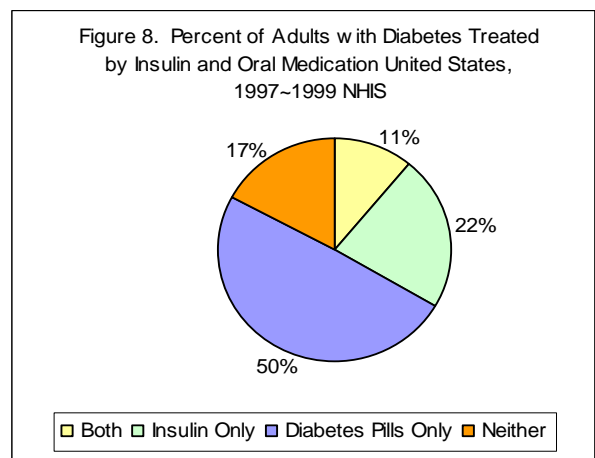
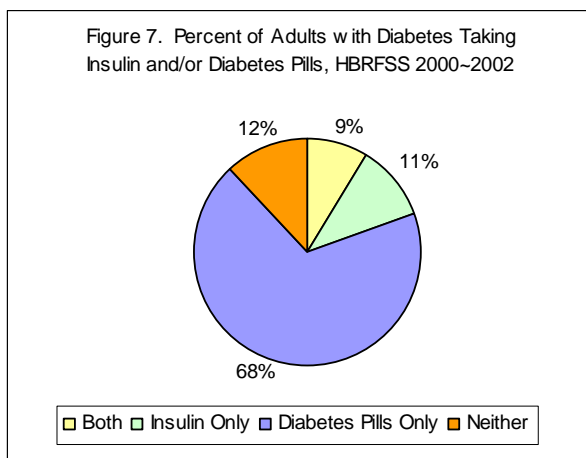
Part III. Diabetes Management

For people with diabetes, taking medication, controlling blood glucose levels, receiving medical services and maintaining a healthy weight through better nutrition and physical activity can delay the progression of diabetes. Many complications of diabetes can be prevented through regular self-management, monitoring and regular medical examinations.

Among the 977 sampled adults with diabetes, there were only 34 Portuguese and 53 Chinese; and there were only 2 at age 18-24 years, and 32 at age 25-34 years. To safeguard confidentiality and to avoid possible misleading interpretation from such small sample size, ethnicities were grouped as Whites (including the Portuguese), Hawaiians, Filipinos, Japanese, and the others (including Chinese), while age was grouped as 18-44 years, 45-64 years, and 65 years or older in this part of the study.

1. Types of Medication Used:

Among the estimated 52,521 adults with diabetes in Hawaii, 68% of them were taking oral medication, and this was about 18% higher than the national average of 50% (National Health Interview Survey (NHIS) 1997~1999, Centers for Disease Control and Prevention). In contrast, the percentage of insulin takers was only half that of the national average (11% vs. 22%). However, the percentage of adults with diabetes taking insulin and/or oral medicine in Hawaii was higher than the national average (89% vs. 78%) as depicted in Figures 7 and 8.



Ethnicity:

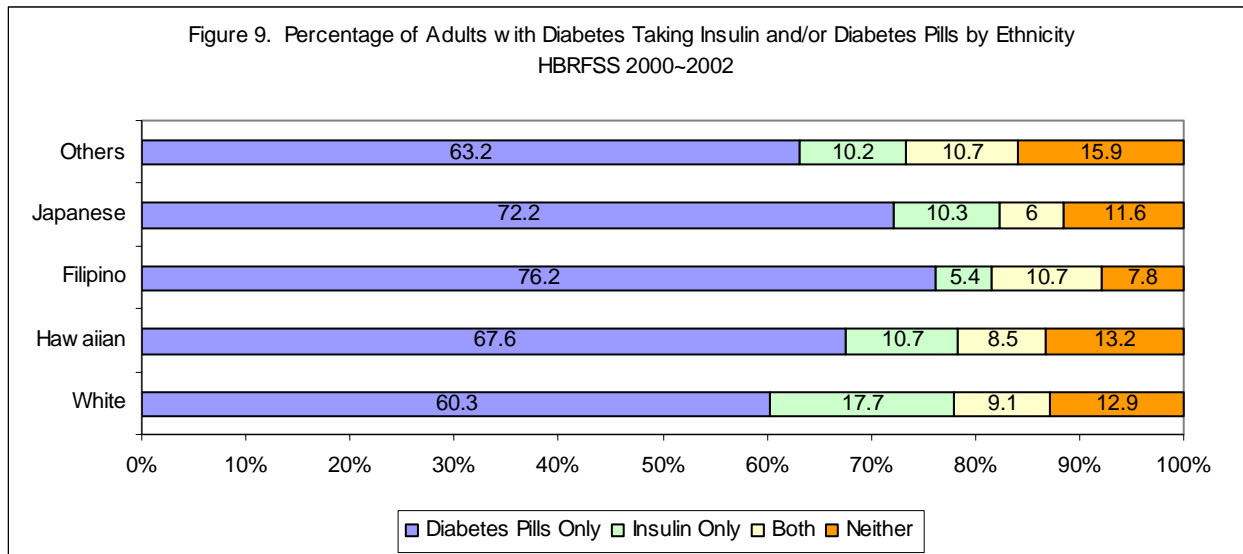
The types of medication used to control/treat diabetes varied among the major ethnic groups in Hawaii. Whites were more likely to report taking insulin to control/treat diabetes than other ethnic groups, and its percentage was significantly higher than that of Filipinos (17.7% vs. 5.4%, $p < .01$). Concomitantly, Whites were less likely to take oral medication to control/treat diabetes than other ethnic groups, and the percentage was significantly lower compared to both Filipinos (60.3% vs. 76.2%, $p < .01$), and Japanese (60.3% vs. 72.2%, $p < .01$). Since the BRFSS does not distinguish between the two types of diabetes (type 1 diabetes and type 2 diabetes), it is not known whether the types of medication used are related to the type of diabetes the person has. However, use of insulin is a proximate measure for the severity and progression of the disease, regardless of the type of disease, whereas use of pills is a proximate measure for type 2 diabetes (Hirokawa, 2003, personal communication).

Age, Gender, Education, and Income:

In general, the types of medication used were not as influenced by age, gender, education or household income as they were by ethnicity (Table 7). However, diabetic adults at age 18-44 years had significantly higher percentage of not taking medication to control/treat their diabetes than those at age 65 years or older (21.7% vs. 8.1%, $p < .01$).

2. Diabetic Retinopathy

Diabetes predisposes people to diabetic retinopathy, a disorder characterized by micro vascular changes and hemorrhage in the retina. According to the CDC, 25~50% of adults with diabetes may have diabetic retinopathy, making diabetes the major cause of visual impairment and blindness in the United States.



Diabetic retinopathy is often asymptomatic in its most treatable stages. Unfortunately, only about half of adults with diabetes receive adequate eye care. Early detection of diabetic retinopathy is critical to prevent visual impairment and blindness. Based on the answers of 977 adults with diabetes to the question “*Has a doctor ever told you that diabetes has affected your eyes or that you had retinopathy?*” the prevalence of diabetic retinopathy among persons with diabetes was about 22% in Hawaii (Table 8).

Ethnicity:

Among those with diabetes who also had diabetic retinopathy, the percentage among Hawaiians was significantly higher than that of Whites (28.7% vs. 16.5%, $p<.05$), but no statistically significant difference was found when it was compared to Filipinos (18.3%) or Japanese (19.8%).

Age:

Diabetic retinopathy can be proliferative or non-proliferative; proliferative diabetic retinopathy increases as the duration of diabetes increases (Centers for Disease Control and Prevention). Generally speaking, older adults with diabetes have a longer duration of diabetes. In this study, the duration of diabetes was 5.8 years for those at younger ages (18-44 years), 9.6 years for the middle ages (45-64 years) and 14.5 years for the elderly (65 year or older).

The percentage of adults with diabetes who also had diabetic retinopathy was lowest younger ages (13.7%), higher in elderly (20.2%), and highest in middle ages (26.6%), and the difference between the lowest and the highest was statistically significant ($p<.05$). Furthermore, when age group 45-64 years and age group 65 years or older were combined into a new age group 45 years or older, the percentage for the new age group was still significantly higher than that of age group 18-44 years (23.3% vs. 13.7%, $p<.01$).

Gender, Education, and Income:

Gender and education did not affect the percentage of adults with diabetes who had diabetic retinopathy. Men with diabetes are just as likely as women with diabetes to develop retinopathy (24.0% vs. 19.7%).

Although the percentage of adults with diabetes with diabetic retinopathy declined with increasing educational attainment, the decline was not significantly different for each educational level, i.e., the percentage of adults with diabetes with diabetic retinopathy who did not graduate from high school was not significantly different from those who graduated from college (24.8% vs. 19.4%, $p>.05$). However, household income was associated with the percentage of diabetic retinopathy among adults with diabetes. Those adults with diabetes with diabetic retinopathy with annual household incomes lower than \$15,000 had higher prevalence rates (33.9%) than those adults with diabetes with diabetic retinopathy with higher household incomes ($p<.05$) (Table 8).

3. Diabetic Foot Problems

Among adults with diabetes, nerve damage, circulation problems, and infections can cause serious foot problems. The HBRFSS asked the following question among adults with diabetes “*Have*

you ever had any sores or irritations on your feet that took more than four weeks to heal?” Analysis of the responses to this question showed that 9% of the adults with diabetes in Hawaii have foot problems (Table 8). In addition, there are variations in the prevalence of foot problems by demographic and socio-economic factors.

Ethnicity:

Among those with diabetes who also had diabetic foot problems, there was a statistically significant difference between Whites and Japanese (9.6% vs. 3.3%, $p < .05$). Filipinos and Hawaiians bridged the gap between Whites and Japanese with percentages of 7.8% and 6.5%, respectively.

Age:

Similar to diabetic retinopathy, the percentage of adults with diabetes who had foot problems among those aged 45-64 years was 11.1%, slightly higher than that of adults with diabetes aged 65 years or older (8.2%), but 3 times significantly higher than that of the combined age group of 18-44 years (11.1% vs. 3.0%, $p < .01$).

Gender, Education and Income:

Diabetic foot problems had little to do with gender or education, yet were somewhat associated with household income. Adults with diabetes with low household incomes (lower than \$15,000), had higher proportions with diabetic foot problems (16.2%). This was 4 times higher than that of adults with diabetes with slightly higher household incomes (between \$15,000 and \$24,999), and 3 times higher than that of adults with diabetes with highest household incomes (more than \$75,000) and both differences were statistically significant ($p < .01$) as shown in Table 8.

4. Diabetes Self Care Classes

It is important for adults with diabetes to have knowledge about diabetes self management. One way to acquire such knowledge is to take a course or class on diabetes self care and management. Over 50% of the adults with diabetes reported taking a course/class when asked by the question “*Have you ever taken a course or class in how to manage your diabetes yourself?*” as shown in Table 8.

Ethnicity:

The percentage of adults with diabetes who attended course/classes for Japanese was significantly lower than that for Hawaiians (42.5% vs. 58.5%, $p < .05$), or for Whites (42.5% vs. 56.0%, $p < .05$). Filipino adults with diabetes stayed close to the overall average.

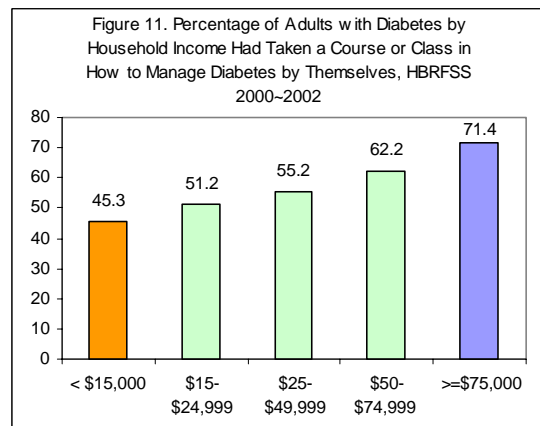
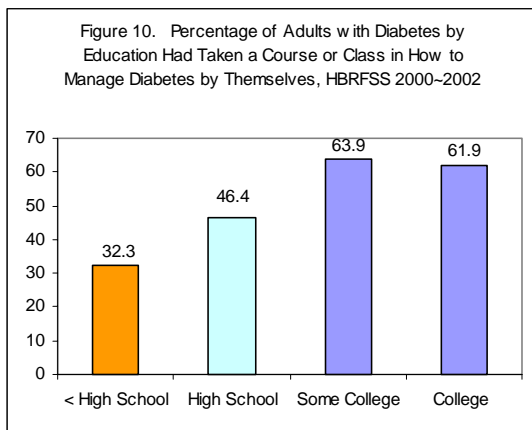
Age, Gender:

The percentage of adults with diabetes who attended course/classes for those aged 45-64 years was significantly higher than for those aged 65 years or older (63.2% vs. 42.5%, $p < .01$). Gender did not show significant effect on class attendance.

Education, Income:

As illustrated in Figure 10 and Figure 11, as the level of educational attainment or the household income increased, the percentage of adults with diabetes who attended class also increased. The percentage of adults with diabetes who attended class for those with post high school education was almost twice that of those with less than a high school education ($p < .01$), and it was also significantly higher than for those with a high school diploma ($p < .01$). The difference in class attendance between those with diabetes with less than a high school education and those with a high school diploma was also statistically significant (46.4% vs. 32.3%, $p < .05$).

The percentage of adults with diabetes who attended class for those with low household incomes of less than \$15,000 was significantly lower than those with a household incomes \$50,000-\$74,999 (45.3% vs. 55.2%, $p < .5$) and those with a household incomes of \$75,000 or more (45.3% vs. 71.4%, $p < .01$). In addition, difference in class attendance between those with diabetes with mid-level incomes (\$25,000-\$49,000) and those with diabetes with high household income (more than \$75,000) was also statistically significant (55.2% vs. 71.4%, $p < .05$).



5. Daily Self-Blood-Glucose-Check

A daily self-blood-glucose-check is essential to successful management and control of diabetes. By monitoring blood glucose levels on a daily basis, people with diabetes can adjust medications or diets according to their health professional's recommendations or instructions.

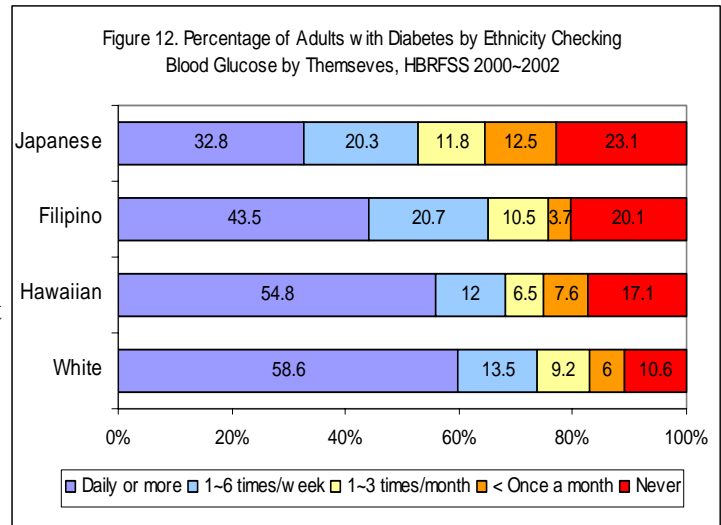
Adults with diabetes were asked, "About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do not include times when checked by a health professional." From the responses of the 977 sampled adults with diabetes who answered the question, close to one-half (45.4%) of the adults with diabetes in Hawaii checked their blood glucose on a daily basis (Table 9). In addition, 18.8% checked at least once a week, 8.9% checked 1~3 times per month, 7.3% checked less than once a month; and 18.0% never checked their own blood glucose levels.

Ethnicity:

The percentage of adults with diabetes who checked their blood glucose was highest among Whites (58.6%), followed by Hawaiians at 54.7% and lowest among the Japanese (32.8%) as shown in Figure 12.

Age:

Older adults with diabetes are the least likely to perform daily blood glucose checks. The percentage of adults with diabetes aged 65 or older who checked their blood glucose daily was significantly lower than those aged 45-64 (38.8% vs. 48.6%, $p < .05$), and those aged 18-44 years (38.8% vs 54.8%, $p < .05$).



Gender, Education, Income:

There was no statistically significant difference in the percentage of adults with diabetes who checked their blood glucose daily in terms of gender, education or income. Men with diabetes are just as likely as women to check their blood glucose level daily (46.2% vs. 44.5%). Similarly, adults with diabetes with lower education are just as likely as those with higher education levels to check their blood glucose level daily. Household income of adults with diabetes was not associated with the daily checking of blood glucose levels.

6. Daily Foot Self-Check

Nerve damage, circulation problems, and infections can cause serious foot problems among adults with diabetes. For early detection of foot problems, it is important for adults with diabetes to check by themselves daily for any numbness, sores or discoloring on their feet.

Adults with diabetes were asked “About how often do you check your blood for glucose or sugar? Include times when checked by a family member or friend, but do not include times when checked by a health professional.” Almost one-half of adults with diabetes in Hawaii (45.4%) checked their feet daily (Table 9). However, 1.6% of adults with diabetes in Hawaii were without feet; in other words, among the estimated 52,521 adults with diabetes in Hawaii, about 800 had lost their feet to diabetes.

Ethnicity:

The percentage of adults with diabetes who checked their feet daily was highest among Whites (79.4%), followed by Filipinos (68.7%), Hawaiians (65.1%), and Japanese (63.6%); the percentage difference between White and Filipino or Japanese was statistically significant ($p < .01$).

Age, Gender, Education, Income:

There were no statistically significant differences among adults with diabetes in the percentage checking their feet daily in terms of age, gender, education and household income (Table 9).

7. Regular visit to Health Professional for Diabetes

It is recommended that adults with diabetes see their doctors every three months. During such visits, health professionals can check the patient's feet for sores or irritation, or test for hemoglobin "A1C" for the average blood sugar level. With such visits, patients will know their health status, and get medical advice or medications from the doctor to control or manage diabetes more effectively.

Adults with diabetes were asked the question "*About how many times in the past 12 months have you seen a doctor, nurse, or other health professional for your diabetes?*" More than two-thirds of the respondents reported having visited health professionals for their diabetes at least 4 times a year (70.2%) as shown in Table 9.

Age:

There was a statistically significant difference by age in the percentage of adults with diabetes seeing health professionals on a regular basis. Older adults with diabetes are more likely to see health professionals on a regular basis. The percentage of those aged 65 years and older who visited a health professional at least 4 times a year was significantly higher than among those aged 45-64 years (76.2% vs. 67.6%, $p < .05$), or those aged 18-44 years (76.2% vs. 60.3%, $p < .05$).

Ethnicity, Gender, Education, Income:

The percentage of adults with diabetes who visited a health professional at least 4 times a year was not significantly different by ethnicity, gender, education or household income (Table 9).

Part IV. Health Care Coverage, Health Status and Health Related Quality of Life among Adults With and Without Diabetes

In order to have a complete picture about the population of adults with diabetes in Hawaii, health care access, health status and health related quality of life indicators will be compared between adults with and without diabetes in this part of study.

1. Health Care Coverage

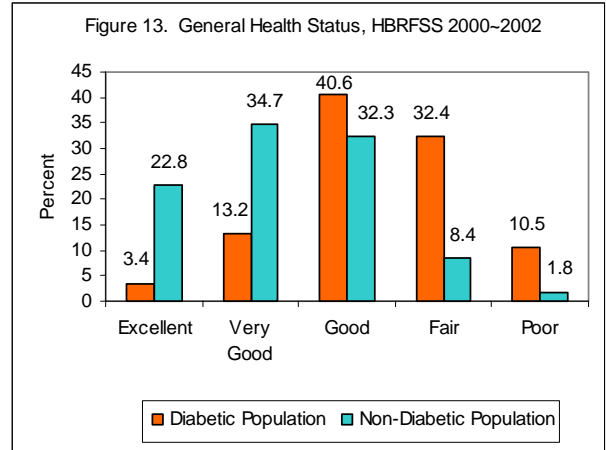
The majority of Hawaii's residents have health coverage. However, there was a statistically significant difference between adults with and without diabetes in health care coverage (Table 10). Adults with diabetes were more likely to have health care coverage than those without diabetes (98.0% vs. 92.0%, $p < .01$).

2. Health Status

All respondents were asked about their general health status: “Would you say that in general your health is: 1) Excellent, 2) Very Good, 3) Good, 4) Fair, or 5) Poor?” Adults with diabetes had significantly lower percentage reporting “Excellent” or “Very Good” health, and significantly higher percentage reporting “Good”, “Fair” or “Poor” health, than those without diabetes ($p < .01$) (Figure 13).

When “Excellent”, “Very Good” and “Good” were combined as a new category “Satisfactory”, and “Fair” and “Poor” grouped as “Unsatisfactory”, the result was that over 40% of the adults with diabetes had

“Unsatisfactory” health, 4 times higher than that of non-adults with diabetes (Table 10).



3. Unhealthy Days

The average number of unhealthy days was derived from a series of questions:

“Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?”

“Now thinking about your mental health, which includes stress, depression, and problems with emotion, for how many days during the past 30 days was your mental health not good?”

“During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?”

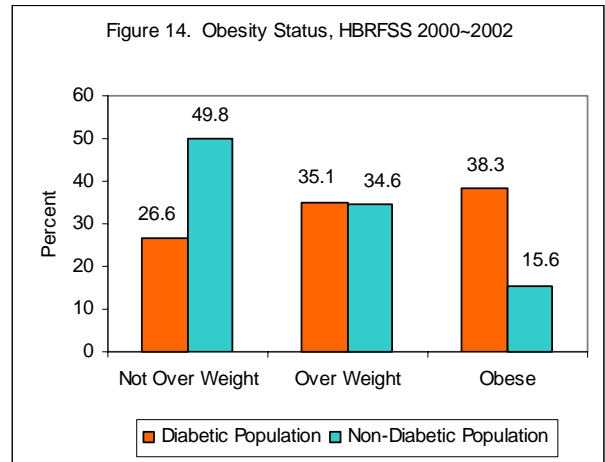
Overall, the adults with diabetes had an average number of 6.2 unhealthy days during the past 30 days prior to their interviews, which was 2.5 days longer than that for the adults without diabetes (3.7 days), and the difference was statistically significant ($p < .01$) as shown in Table 10.

Part VI. Management and Prevention of Diabetes

It is known that type 2 diabetes may be delayed, is likely preventable, is manageable and is controllable in 9 out of 10 cases through weight control, exercise, a healthy diet and not smoking <http://www.hsph.harvard.edu/nutritionsource/diabetes.html>.

1. Obesity

Obesity is closely associated with diabetes, and among adults with diabetes, the percentage of those who are obese is much higher than that among people without diabetes (Figure 14). While the percentage of people who were overweight but not obese was matched closely at about one-third (35%) among those with and without diabetes, the percentage of people who were obese among adults with diabetes, was more than twice that among people without diabetes (38.3% vs. 15.6%, $p < .01$) as shown in Table 10. Alternatively, the percentage of people who were not overweight/obese and did not have diabetes was about half that among adults with diabetes (26.6% vs. 49.8%, $p < .01$)

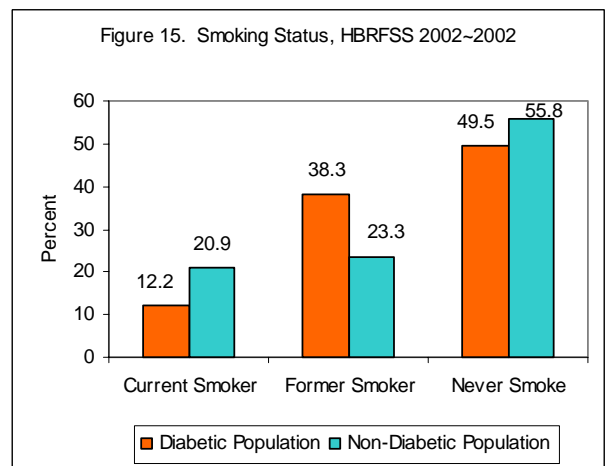


2. Leisure Time Physical Activities

Exercise is good for one's health, and it is particularly true for adults with diabetes. Even modest increases in physical activity can prevent or delay the development of diabetes among those at risk (Sheard, 2003; Kriska, 2002). All interviewees were asked: "During the past month, other than your regular job, did you participate in any physical activities or exercise such as running, calisthenics, golf, gardening, or walking for exercise?" More than one-fourth of adults with diabetes did not report any leisure time physical activity, which was significantly higher than that of people without diabetes (27.4% vs. 18.9%, $p < .01$). However, with age adjustment, this significant difference disappeared as shown in Table 10.

3. Smoking Status

The percentage of adults who quit smoking for those with diabetes was 1.6 times that of those without diabetes (38.3% vs. 23.3%, $p < .01$) as shown in Table 10. The percentage of current smoking among those with diabetes was lower than those without diabetes (12.2% vs. 20.9%, $p < .01$). Finally, adults with diabetes were more likely to be former smokers.



4. Eating at Least 5 Servings of Fruits/Vegetables a Day

Healthy People 2010 goals aim to increase consumption of complex carbohydrates and fiber-rich foods in the diets of people aged 2 years or older, to an average of five or more daily servings for vegetables and fruits. The percentage of people who ate at least 5 servings of fruit and vegetables every day was slightly higher among adults with diabetes (25.6%) than among those without diabetes (21.2%), leaving lots of room for future improvement (Table 10).

5. Flu and Pneumonia Vaccinations

According to the CDC, deaths among adults with diabetes increase 5~15% during flu epidemics, and adults with diabetes are 3 times more likely to die with complications of flu or pneumonia. Despite this, half of the adults with diabetes still did not received an annual flu shot, and about two thirds of adults with diabetes never had a pneumonia shot in their lifetime (Centers for Disease Control and Prevention).

In the state of Hawaii, about 75% of adults with diabetes had flu shot in the past 12 months, which was 2 times higher ($p<.01$) than that of the adults without diabetes (34.5%). More than half of adults with diabetes (56.7%) in Hawaii had pneumonia vaccination, 3.5 times higher ($p<.01$) than that of adults without diabetes as shown in Table 10.

Summary

As the 6th leading cause of death in Hawaii, diabetes initiated the death event in 191 deaths, and was involved in another 761 deaths every year in the years 2000 to 2002. Therefore, more than one in ten deaths in the state of Hawaii was diabetes related, for a diabetes mortality rate of 104 per 100,000 in the adult population. Mortality (and morbidity) rates for diabetes rise up significantly with age, such that diabetes as an underlying or contributory cause of death results in a mortality rate for people 65 years or older at 472 per 100,000. Further, cardiovascular diseases of all types were contributory to death rates among adults with diabetes. Lower education was associated with increased mortality, and both lower income and lower education were associated with the prevalence of diabetes.

The average age of respondents when told of their diabetes diagnosis by a health professional was about 49 years old, although Hawaiians and Filipinos were diagnosed at younger ages than other groups. Hawaiians had the highest age-adjusted diabetes prevalence rate at 7.9%, followed by Filipinos (7.5%), Japanese (6.6%), others (including the Chinese) (5.5%) and Whites (including the Portuguese) (3.4%). The overall age-adjusted diabetes prevalence rate in Hawaii was 5.6%, which was more than twice the prevalence rate objective of Healthy People 2010.

Variations in age-adjusted diabetes prevalence rates exist between different ethnic groups, different levels of education attainment, as well as different levels of household income. Communities with higher poverty rates had higher diabetes prevalence rates. Regardless of ethnicity and gender, risk markers or thresholds for the potential onset for diabetes include middle age (45 years or above), lower education (high school or less), low annual household income (less than \$50,000), and obesity.

Age and ethnicity were the most influential factors in many observations about adults with diabetes, including types of medication used, the presence of diabetic retinopathy, and/or diabetic foot problems, followed by household income, education attainment, and gender (Table 11). Hawaiians with diabetes had higher percentages with diabetic retinopathy, and diabetic retinopathy was more common among those with lower incomes and those at older ages. Whites and those with lower incomes reported more diabetic foot problems.

Hawaiians and Whites, as well as those with more than high school education and those who were middle aged were more likely to attend diabetes management classes. Attendance at classes was lower among those at older ages and among those with low to middle incomes. Regular visits to health professionals increased with age.

Compared to those without diabetes, adults with diabetes had higher percentages who are obese and in unsatisfactory health. However, adults with diabetes had higher percentage of smoking cessation, were more likely to get flu and pneumonia vaccinations, and had higher consumption of fruits and vegetables (5 servings a day), compared to adults without diabetes.

It is known that type 2 diabetes may be delayed, is likely preventable, is manageable and is controllable in 9 out of 10 cases through weight control, exercise, a healthy diet and not smoking <http://www.hsph.harvard.edu/nutritionsource/diabetes.html>. One key to a successful battle with diabetes is to raise the awareness of people about this deadly and costly disease, and provide self-

management training to diabetic patients through more diabetes awareness and management programs (CDC, 2002; Task Force on Community Preventive Services, 2002). Hawaii has a very high proportion of people with health care coverage, and this resource should be used as an important vehicle to disseminate diabetes information to Hawaii's general public.

Limitations of the Study

HBRFSS 2000~2002 did not include homeless people, prisoners, and people without a land-base telephone. It is believed that these people generally have poorer health and may be more susceptible to diabetes. According to Harris et al., 1998, about one-third of persons with diabetes are unaware they have diabetes because their diabetes has not been diagnosed (Harris, 1998). Therefore, this study may underestimate the true burden of diabetes in the adult population of Hawaii.

References

- American Diabetes Association (2000). Type 2 diabetes in children and adolescents. Diabetes Care, Vol. 23, No. 3, March.
- American Public Health Association (2000). Rising obesity linked to increase in diabetes. The Nations Health, October. Washington, DC: APHA.
- Centers for Disease Control and Prevention (2001). Twin epidemics of diabetes and obesity continue to threaten the health of Americans CDC says. Press Release, Atlanta, GA:DHHS-CDC, September 11, 2001.
- Centers for Disease Control and Prevention (2003). Accessed 10/24/03. (<http://www.cdc.gov/diabetes/pubs/general.htm#what>).
- Centers for Disease Control and Prevention (2003). The Promise of Prevention: Reducing the Health and Economic Burden of Chronic Disease, Atlanta, GA DHHS-CDC, February.
- Centers for Disease Control and Prevention (2002). Effectiveness of diabetes self-management education interventions. Guide to Community Preventive Services, December 27th. <http://www.thecommunityguide.org/diabetes/> .
- Department of Business, Economic Development and Tourism (2001). State of Hawaii Data Book. <http://www.hawaii.gov/dbedt/db01/index.html>.
- Harris MI, Flegal KM, Cowie CC, Eberhardt MS, Goldstein DE, Little RR, Wiedmeyer HM, Byrd-Holt DD. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey, 1988-1994. Diabetes Care 1998; 21:518-24.
- Hirokawa, R. (2003). Diabetes Prevalence, Risk Factors and Complications in Hawai'i. Powerpoint presentation, Hawai'i State Department of Health, Community Health Division, Chronic Disease Management and Control Branch.
- HMSA Foundation (2001). Health Trends in Hawaii, 5th Edition. P.O. Box 860, Honolulu, HI 96808.
- King, H. R.E. Aubert and W.H. Herman. (1998).Global burden of diabetes, 1995-2025: Prevalence, numerical estimates and projections. Diabetes Care, Vol. 21, No. 9, September.
- Kriska, A. (2002). Striving for a more active community: Lessons from the diabetes prevention program and beyond. American Journal of Preventive Medicine, Vol. 22 (4), supplement.
- Mokdad, A.H., E.S. Ford, B.A. Bowman, W.H. Dietz, F. Vinicor, V.S. Bales and J.S. Marks (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. Journal of the American Medical Association, Vol. 289, No. 1.
- National Institutes of Health (Accessed 10/20/03) (<http://www.niddk.nih.gov/health/nutrit/pubs/econ>).
- Shalala DE. HHS policy for changing the population standard for age adjusting death rates. Memorandum from the Secretary. August 26, 1998.
- Task Force on Community Preventive Services (2002). Recommendations for healthcare system and self-management education interventions to reduce morbidity and mortality from diabetes. American Journal of Preventive Medicine, Vol. 22, no. 4 (Supplement).

Appendix I: Glossary and Data Definition

Age-Adjusted Prevalence Rate

Often, we want to compare diabetes rates of different populations and/or years. However, since diabetes rates increase with age, a higher diabetes rate in one population than in another may simply reflect that the first population is older than the second. Statistical techniques are used to adjust or standardize the rates in the populations being compared, which eliminates the effects of different age distributions in the different populations. Prevalence rates computed with such techniques are called age-adjusted or age-standardized prevalence rates. An age-adjusted prevalence rate is not a real measure of the disease on a population, but rather an artificial measure that is used for comparative purposes.

In this study, age adjusted prevalence rates employed the age distribution #9 of the Year 2000 Projected U.S. Population (DHHS/CDC/NCHS, 2001).

Communities

Communities in this study were defined by the aggregation of adjacent zip codes with at least one school complex in the area. The list community zip codes can be found on this web site: <http://www.hawaii.gov/health/statistics/brfss/others/subarea.html> .

Contributory Cause of Death

Contributory cause of death refers to diseases which do not initiate the train of events leading to death, but result in death directly or indirectly; it can also refer to any other significant condition which unfavorably influences the course of the morbid process and contribute to the fatal outcome.

Current and Former Smokers

A current smoker is a person who responded that they smoke everyday or some days in response to the questions “*Have you smoked at least 100 cigarettes in your life time? Do you smoke everyday, some days, or not at all?*” A former smoker is a person who smoked a least 100 cigarettes before, but does not smoke anymore.

Diabetes

Adult respondents were asked: “*Have you ever been told by a doctor that you have diabetes?*” If the respondent is a female and her answer to that question was “Yes”, then she was further asked: “*Was this only when you were pregnant?*” Those with gestational diabetes were excluded from this study.

Eating 5 Servings of fruits and Vegetables Daily (5aDay)

The average number of daily servings of fruit and vegetable is derived from the following series of questions “Not counting juice, how often do you eat fruit? How often do you eat green? How often do you eat potatoes not including French fries, fried potatoes, or potato chips? How often do you eat carrots? Not counting carrots, potatoes, or salad, how many serving of vegetables do you usually eat?”

One serving of fruit is equal to:

Half cup cutup fruit (fresh or canned)
One apple banana, orange, apple, mango, etc.
A quarter cup dried fruit (mango, raisins, etc.)
Six oz (3/4 cup) of 100% fruit juice

One serving of vegetable is equal to:

Half cup beans or peas
Half cup cooked vegetable (tomato sauce)
One cup raw, leafy greens (tossed salad)
Six oz (3/4 cup) of 100% vegetable

Ethnicity

Respondents were asked to choose one race to answer the question: “*What is your race?*” The race list include Caucasian, Hawaiian, Chinese, Filipino, Japanese, Korean, Samoan, Black, American Indian/Alaska native/Eskimo/Inuit, Vietnamese, Asian Indian, Portuguese, Guamanian/Chamorro, Puerto Rican, Mexican, Tongan, Laotian, Cambodian, Malaysian, Fijian, Micronesian, Other Asian. In addition, they can specify their own ethnicity if it is not listed, or they can say they don’t know, they are not sure, or they can refuse to answer. For simplicity, we re-categorized ethnicity into White (including Portuguese), Hawaiian, Filipino, Japanese, and Others (including Chinese), capturing the main ethnic groups in the state of Hawaii.

Health Care Coverage

Thos having health care coverage answered “Yes” to question “Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?”

Mortality Rate

The mortality rate is the frequency of occurrence of death in a defined population. In this study, the estimated 916,580 adults from the HBRFSS 2000~2002 were used for the population denominator.

No Leisure-Time Physical Activity

Those without leisure time physical activity were persons who responded that they do not engage in any physical activities during leisure time by the question “*During the past month, other*

than your regular job, did you participate in any physical activities or exercise such as running, calisthenics, golf, gardening, or walking for exercise?"

Obesity

Obesity is measured by Body Mass Index (BMI). BMI is defined as weight in kilograms divided by square of height in meters (kg/m²). Based on federal guidelines, bodyweight was categorized by BMI as follows:

Not Overweight/Obese	BMI < 25.0
Overweight	25.0 ≤ BMI < 30.0
Obese	BMI ≥ 30.0

Prevalence Rate

A prevalence rate is the ratio (for a given time period) of the number of occurrences of a disease or event, to the number of people at risk in the population.

All percentages or prevalence rates presented in all the tables except the mortality table are weighted percentages, meaning that they are based on the estimated population after the sample has been weighted. Thus the weighted percentages are considered estimates for the many observed demographic populations of Hawaii in general.

Underlying Cause of Death

A disease that initiates the train of events leading to death constitutes the underlying cause of death.

Appendix II Tables

Table 1: Mortality Counts, Mortality Rates per 100,000, and Age-Adjusted Mortality Rates per 100,000, HBRFSS 2000~2002

Table 2: Number of Households/Adults Surveyed, Estimated Adult Population and Estimated Adults with Diabetes, HBRFSS 2000~2002

Table 3: Have You Ever Been Told by a Doctor That You Have Diabetes?

Table 4: Age When Diagnosed With Diabetes, HBRFSS 2000~2002

Table 5: Prevalence of Diabetes (%) by Demographic Characteristics, HBRFSS 2000~2002

Table 6: Prevalence of Diabetes (%) by Geographic Area, HBRFSS 2000~2002

Table 7: Percentage of Adults with Diabetes Taking Insulin and/or Diabetes Pills, HBRFSS 2000~2002

Table 8: Percentage of Adults with Diabetes with Eye or Foot Symptoms Who Took a Class to Manage Diabetes, HBRFSS 2000~2002

Table 9: Percentage of Adults with Diabetes Who Perform Self Examination Daily or Visit Health Professionals for Diabetes 4 Times in the Last 12 Months, HBRFSS 2000~2002

Table 10: Prevalence of Healthy Behaviors and Lifestyles among Adults With and Without Diabetes, HBRFSS 2000~2002

Table 11: Significance of Socioeconomic Factors among Adults with Diabetes HBRFSS 2000~2002

Table 1: Mortality Counts, (Mortality Rates per 100,000) and {Age-Adjusted Mortality Rates per 100,000}, HBRFSS 2000~2002

Demography	Population Denominator	Non-Diabetes	Diabetes as UNDERLYING CAUSE OF DEATH	Diabetes as CONTRIBUTORY CAUSE OF DEATH	Diabetes as UNDERLYING CAUSE OF DEATH/CONTRIBUTORY CAUSE OF DEATH
Annual Avg.	916580	7233 (789){784}	191 (21){21}	761 (83){82}	952(104){103}
Year 2000	897110	7058 (787){806}	202 (23){23}	724 (81){81}	926 (104){104}
Year 2001	922470	7146 (775){770}	171 (19){18}	783 (84){84}	954 (103){102}
Year 2002	930162	7496 (806){792}	198 (21){21}	777 (84){82}	975 (105){103}
Honolulu	668720	5123 (766){775}	132 (20){20}	533 (80){81}	665 (100){101}
Hawaii	109169	1029 (942){866}	30 (27){25}	103 (94){86}	133 (121){111}
Kauai	43187	371 (859){787}	10 (23){20}	43 (100){90}	53 (123){110}
Maui	95504	710 (744){748}	19 (20){20}	82 (86){86}	101 (106){106}
White	304306	1705 (560){603}	21 (7){7}	86 (28){31}	107 (35){38}
Hawaiian	127203	1087 (855){1067}	47 (37){47}	170 (134){169}	217 (171){216}
Filipino	136457	1011 (741){815}	27 (20){22}	115 (84){94}	142 (104){116}
Japanese	193613	2222 (1147){751}	55 (28){19}	245 (137){81}	300 (155){100}
Others	155001	1208 (780){949}	41 (26){32}	145 (94){116}	186 (120){148}
18-24	112202	74 (66)	0 (0)	0 (0)	0 (0)
25-34	170424	122 (71)	2 (1)	2 (1)	4 (2)
35-44	188348	278 (147)}	5 (3)	12 (6)	17 (9)
45-64	289706	1319 (455)}	45 (15)	150 (52)	195 (67)
>=65	155900	5440 (3490)	139 (89)	597 (383)	736 (472)
Male	459898	4008 (872){937}	98 (21){23}	416 (90){98}	514 (111){121}
Female	456682	3225 (706){649}	93 (20){19}	345 (76){69}	438 (96){88}
<High School	62054	2458 (3961){1888}	75 (121){60}	298 (480){219}	373 (601){279}
High School	307231	2534 (825){796}	72 (24){23}	277 (90){88}	349 (124){111}
Some College	270018	981 (363){425}	18 (7){8}	93 (34){40}	111 (41){48}
College	275256	994 (361){448}	20 (7){9}	72 (26){33}	92 (33){42}
Unknown*	2021	266	6	21	27

Mortality rate was not appropriate for the deaths with unknown education level.

Table 2: {Number of Households/Adults Surveyed}, (Estimated Adults Population) and [Estimated Adults with Diabetes], HBRFSS 2000~2002

	Year 2000	Year 2001	Year 2002	Average
State of Hawaii	{6016} (897110) [46839]	{4500} (922470) [57033]	{6000} (930162) [53692]	{5505} (916580) [52521]
Honolulu C&C	{2805} (660171) [32834]	{1920} (672784) [42972]	{2812} (673206) [40108]	{2512} (668720) [38638]
Hawaii County	{1454} (104201) [6582]	{1020} (109822) [6391]	{1379} (113484) [6073]	{1284} (109169) [6348]
Kauai County	{587} (41732) [2154]	{549} (43514) [2702]	{601} (44317) [2598]	{579} (43187) [2482]
Maui County	{1170} (91006) [5278]	{1011} (96350) [4969]	{1208} (99155) [4913]	{1130} (95504) [5053]

**Table 3: Have You Ever Been Told by a Doctor That You Have Diabetes?
(Sample Cell Size)**

	Year 2000	Year 2001	Year 2002	Total [Cum.]	Average
1=Yes	339	262	376	977 [977]	326
2=Yes, But Gestational Diabetes	73	53	110	236 [1213]	79
3=No	5599	4185	5490	15274 [16487]	5090
7=Don't Know/Not Sure	5	0	4	9 [16496]	3
9=Refused	0	0	20	20 [16516]	7

Table 4: Age When Diagnosed With Diabetes, HBRFSS 2000~2002

Ethnicity	Average Age (SE)
All Races (Total)	49.3 (0.5)
White (incl. Portuguese)	51.2 (1.0)
Hawaiian	44.6 (1.1)
Filipino	48.1 (1.2)
Japanese	52.2 (0.9)

Table 5: Prevalence of Diabetes (%) by Demographic Characteristics, HBRFSS 2000~2002

Demography	Prevalence Rate (SE)	Age-Adjusted Prevalence Rate (SE)
Average	5.7 (0.3)	5.6 (0.3)
Year 2000	5.2 (0.4)	5.2 (0.4)
Year 2001	6.2 (0.6)	6.1 (0.6)
Year 2002	5.8 (0.4)	5.7 (0.4)
Honolulu C&C	5.8 (0.3)	5.8 (0.3)
Hawaii County	5.8 (0.4)	5.4 (0.4)
Kauai County	5.8 (0.7)	5.4 (0.6)
Maui County	5.3 (0.5)	5.2 (0.4)
White (+Portuguese)	3.4 (0.3)	3.4a (0.3)
Hawaiian	7.0 (0.7)	7.9b (0.8)
Filipino	7.1 (1.0)	7.5b (1.0)
Japanese	8.5 (0.6)	6.6b (0.5)
White (-Portuguese)	2.8 (0.3)	2.8 (0.3)
Portuguese	10.6(2.6)	8.2 (1.9)
Chinese	5.7 (0.9)	4.9 (0.8)
18-24	0.9a (0.9)	
25-34	1.3a (0.3)	
35-44	2.5a (0.3)	
45-64	7.6b (0.5)	
65 and older	14.4b(0.9)	
Male	5.8 (0.4)	6.0 (0.4)
Female	5.7 (0.3)	5.3 (0.3)
<High School	10.2(1.1)	6.1ab (0.9)
High School	6.4 (0.4)	6.6a (0.5)
Some College	5.2 (0.6)	5.5ab (0.6)
College	4.5 (0.4)	4.4b (0.4)
<\$15,000	8.0 (0.9)	7.8a (0.9)
\$15,000-\$24,999	6.5 (1.1)	6.4a (1.0)
\$25,000-\$49,999	6.0 (0.5)	6.4a (0.5)
\$50,000-\$74,999	4.1 (0.5)	4.5b (0.6)
>=\$75,000	4.7 (0.7)	3.9b (0.6)

Within the same column and demographic category, **values** with different letters differed from each other at 1% or 5% level.

Table 6: Prevalence of Diabetes (%) by Geographic Area, HBRFSS 2000~2002

Demography	Sample size	Crude Prevalence Rate (SE)	Age-Adjusted Prevalence Rate (SE)
Average		5.7 (0.3)	5.6 (0.3)
North Shore/Laie	240	7.1 (1.8)	9.3 (2.1)
Kaawa/Kahaluu/Kaneohe	428	7.7 (1.6)	7.5 (1.5)
Kailua/Waimanalo	569	5.3 (1.1)	4.7 (1.0)
Wailae/Kahala/HawaiiKai	508	3.4 (0.9)	2.8 (0.7)
Kaimuki/Palolo/Waikiki	862	7.1 (1.1)	6.3 (1.0)
Manoa/Upper Makiki	719	3.8 (0.9)	3.4 (0.8)
Ala Moana	432	5.4 (1.1)	5.7 (1.2)
Nuuanu/Kalihi/MoanaLoa	704	6.4 (1.0)	5.9 (0.9)
Salt Lake/Foster Village	427	2.9 (0.8)	4.6 (1.4)
Aiea/Pearl City	702	9.0 (1.2)	8.2 (1.1)
Mililani/Wahiawa	688	5.2 (1.0)	7.0 (1.3)
Waipahu/Kapolei/Ewa	916	4.1 (0.7)	4.8 (0.8)
Nanakuli/Waianae	281	6.7 (2.0)	7.1 (2.0)
North Hawaii	768	6.1 (1.0)	5.8 (0.9)
Hilo	1203	7.2 (0.8)	6.6 (0.8)
Puna/Kau	846	4.4 (0.8)	4.3 (0.8)
Kona	1046	5.1 (0.8)	4.9 (0.7)
Hanalei/Kapaa	759	3.3 (0.8)	3.3 (0.8)
Lihue-Waimea	972	7.3 (0.9)	6.6 (0.9)
Lahaina/Wailuku	818	5.6 (0.9)	5.4 (0.9)
Kahului	894	8.1 (3.1)	8.4 (2.5)
Upcountry/Hana	882	4.6 (0.8)	4.5 (0.8)
Lanai	366	7.0 (1.4)	6.0 (1.2)
Molokai	398	8.6 (1.6)	7.7 (1.5)

Table 7: Percentage of Adults With Diabetes Taking Insulin and/or Diabetes Pills, HBRFSS 2000~2002

Demography	Diabetes Pills & Insulin (SE)	Insulin only (SE)	Diabetes Pills only (SE)	Neither (SE)
Average	8.6 (1.2)	10.9 (1.3)	68.6 (2.0)	12.0 (1.3)
White	9.1 (2.6)	17.7b (3.3)	60.3a (4.5)	12.9 (3.0)
Hawaiian	8.5 (3.0)	10.7ab (3.0)	67.6ab (4.8)	13.2 (3.3)
Filipino	10.7 (3.6)	5.4a (1.9)	76.2b (4.8)	7.8 (2.4)
Japanese	6.0 (1.7)	10.3ab (2.3)	72.2b (3.3)	11.6 (2.2)
18-44*	5.3 (2.5)	8.6 (2.6)	64.4 (6.4)	21.7b (4.8)
45-64	10.8 (2.1)	9.6 (1.9)	67.1 (3.2)	12.5ab (2.2)
65 and older	7.5 (1.7)	12.9 (2.0)	71.4 (2.8)	8.1a (1.5)
Male	6.8 (1.4)	10.9 (1.8)	71.2 (2.8)	11.1 (1.9)
Female	10.4 (2.0)	10.9 (1.7)	65.8 (2.8)	12.9 (1.8)
<High School	10.3 (4.2)	15.3 (4.3)	64.9 (5.6)	9.6 (3.2)
High School	7.9 (1.8)	10.3 (2.0)	71.4 (3.0)	10.4 (1.7)
Some College	5.8 (2.0)	8.8 (2.2)	72.1 (4.3)	13.4 (3.1)
College	11.9 (2.9)	12.2 (2.6)	62.2 (4.0)	13.7 (2.8)
<\$15,000	11.0 (4.0)	14.7 (3.5)	62.0 (5.3)	12.4 (3.4)
\$15,000-\$24,999	5.7 (3.0)	10.5 (3.4)	74.0 (5.8)	9.8 (2.7)
\$25,000-\$49,999	10.0 (2.5)	10.1 (2.5)	69.2 (3.9)	10.6 (2.3)
\$50,000-\$74,999	8.8 (4.1)	7.2 (3.4)	71.5 (5.8)	12.5 (3.6)
>=\$75,000	7.1 (3.3)	8.1 (2.7)	69.4 (6.3)	15.3 (5.4)

*Among the 977 adults with diabetes, there were only 2 adults in 18-24 age group, 32 adults in 25-34 age group, and 105 adults in 35-44 age group. To avoid misleading results from sample size smaller than 50, a combined age group of 18-44 was used in this table.

Within the same column and demographic category, **values** with different letters differed from each other at 1% or 5% level.

Table 8: Percentage of Adults with Diabetes Who Had Eye or Foot Symptoms/Took Class to Manage Diabetes, HBRFSS 2000~2002

Demography	Had Affected Eyes or Retinopathy (SE)	Had Sores /Irritations on Feet (SE)	Had Taken Class to Manage Diabetes (SE)
Average	21.9 (1.9)	8.6 (1.4)	53.0 (2.3)
White	16.5a (3.1)	9.6b (2.5)	56.0b (4.7)
Hawaiian	28.7b (5.00)	6.5ab (1.7)	58.5b (5.1)
Filipino	18.3ab (4.4)	7.8ab (2.6)	53.9ab (6.9)
Japanese	19.8ab (3.1)	3.3a (0.9)	42.5a (3.7)
18-44	13.7a (3.7)	3.0a (1.4)	55.6ab (7.4)
45-64	26.6b (3.2)	11.0b (2.2)	63.2b (3.3)
65 and older	20.2ab (2.8)	8.2ab (2.3)	42.0a (3.3)
Male	24.0 (3.1)	11.1 (2.4)	51.7 (3.6)
Female	19.7 (2.3)	6.0 (1.2)	54.3 (3.0)
<High School	24.9 (5.3)	5.1 (1.9)	32.3a (5.4)
High School	24.3 (3.1)	8.7 (2.0)	46.4b (3.6)
Some College	19.5 (4.3)	12.7 (3.9)	63.8c (4.8)
College	19.4 (3.4)	5.7 (1.7)	61.9c (4.1)
<\$15,000	33.9b (5.4)	16.2b (4.7)	45.3a (5.6)
\$15,000-\$24,999	17.2a (4.7)	3.3a (1.7)	51.2abc (9.0)
\$25,000-\$49,999	18.9a (3.6)	8.8ab (2.3)	55.2b (4.4)
\$50,000-\$74,999	19.8ab (5.1)	8.8ab (3.8)	62.2bc (6.4)
>=\$75,000	18.3a (5.6)	4.5a (2.4)	71.4c (6.0)

Within the same column and demographic category, **values** with different letters differed from each other at 5% level.

Table 9: Percentage of Adults With Diabetes Who Performed Self Examination Daily or Visited Health Professionals for Diabetes 4 Times in the Last 12 Months, HBRFSS 2000~2002

Demography	Daily Check Feet for Any Sores or Irritations (SE)	Daily Check for Blood Glucose or Sugar (SE)	Visited Health Professionals 4 Times in the Last 12 Months (SE)
Average	69.4(2.0)	45.4 (2.4)	70.2 (2.1)
White	79.4b (3.4)	58.6 (4.8)	70.7 (4.2)
Hawaiian	65.1ab (5.5)	54.8 (5.2)	73.4 (4.5)
Filipino	68.7a (5.6)	43.5 (7.6)	63.2 (6.1)
Japanese	63.6a (3.6)	32.8 (3.5)	74.9 (3.2)
18-44	65.7 (6.5)	54.8a (7.4)	60.3a (6.9)
45-64	70.1 (3.2)	48.6b (3.5)	67.6b (3.2)
65 and older	70.1 (2.8)	38.8c (3.1)	76.2c (2.9)
Male	66.9 (3.2)	46.2 (3.7)	67.2 (3.2)
Female	72.0 (2.6)	44.5 (3.1)	73.3 (2.5)
<High School	69.5 (4.9)	37.9 (5.6)	73.9 (5.3)
High School	66.5 (3.4)	44.0 (3.5)	71.9 (3.1)
Some College	76.2 (3.9)	48.5 (5.7)	66.5 (5.0)
College	66.8 (4.0)	48.4 (4.2)	70.4 (3.7)
<\$15,000	65.0 (4.9)	45.2 (5.5)	77.4 (4.2)
\$15,000-\$24,999	71.3 (6.6)	54.7 (8.5)	73.8 (6.3)
\$25,000-\$49,999	66.3 (4.2)	45.4 (4.4)	73.6 (3.6)
\$50,000-\$74,999	77.7 (5.1)	45.5 (6.5)	73.6 (5.4)
>=\$75,000	72.8 (6.0)	50.6 (7.1)	63.6 (6.7)

Within the same column and demographic category, **values** with different letters differed from each other at 5% level.

Table 10: Healthy Behaviors and Lifestyles in Among People With and Without Diabetes, HBRFSS 2000~2002

	Percentage in the Adults with diabetes(SE)	Percentage in the Non-Adults with diabetes(SE)
Excellent Health	3.4a (0.8) 3.1a (0.8)	22.8b (0.5) 22.7b (0.4)
Very Good Health	13.2a (1.4) 14.7a (2.2)	34.7b (0.5) 34.5b (0.5)
Good Health	40.6a (2.3) 35.3 (2.6)	32.3b (0.5) 32.5 (0.5)
Fair Health	32.4a (2.4) 38.7a (2.7)	8.4b (0.3) 8.6b (0.3)
Poor Health	10.5a (1.4) 8.2a (1.3)	1.8b (0.1) 1.8b (0.1)
Average Number of Unhealthy Days *	6.2a (0.5) 6.6a (0.6)	3.7b (0.1) 3.8b (0.1)
Not Overweight/Obese	26.6a (1.9) 17.1a (1.5)	49.8b (0.6) 49.9b (0.6)
Overweight	35.1 (2.2) 31.5 (2.7)	34.6 (0.5) 34.6 (0.5)
Obese	38.3a (2.5) 51.4a (2.8)	15.6b (0.4) 15.5b (0.4)
Current Smoker	12.2a (1.38) 14.4a (2.22)	20.9b (0.5) 20.7b (0.5)
Former Smoker	38.3a (2.4) 39.8a (2.2)	23.3b (0.5) 23.5b (0.5)
Never	49.5a (2.3) 45.8a (2.7)	55.8b (0.6) 55.8b (0.6)
Have Health Insurance	98.0a (0.5) 96.6a (1.1)	92.0b (0.3) 92.2b (0.3)
Had Flu Shot in The Past 12 Months	74.9a (2.3) 64.2a (2.9)	34.5b (0.7) 35.2b (0.6)
Had Pneumonia Shot Before	56.7a (2.9) 45.5a (2.3)	16.17b (0.5) 16.90b (0.5)
No Leisure Time Physical Activity	27.4a (1.9) 22.8 (2.1)	18.9b (0.4) 18.9 (0.4)
Eat at Least 5 Servings of Fruits/Vegetables a Day	25.6 (2.4) 31.0a (2.0)	21.2 (0.5) 21.3b (0.5)

* Figures in the row of Average Number of Unhealthy Days are number of days, not percentages.

Values in **bold** were age-adjusted.

Values in the same raw with different letters differed at 1% level.

Table 11: Significance of Socioeconomic Factors Among Adults With Diabetes, HBRFSS 2000~2002

	Ethnicity	Age	Gender	Education	Income
Medication Preference	✓	✓			
Had Diabetic Retinopathy	✓	✓			✓
Had Sores/Irritations on Feet	✓	✓			✓
Took Class to Manage Diabetes	✓	✓		✓	✓
Daily Self-Feet-Check	✓				
Daily Self-Blood-Glucose-Check		✓			
Visited Doctors 4 Times/Year		✓			