Published in final edited form as:

J Epidemiol Community Health. 2012 April ; 66(4): 366–371. doi:10.1136/jech.2009.087304.

The effect of health promotion on diagnosis and management of diabetes

Jinkook Lee¹ and James P. Smith²

¹The RAND Corporation, Santa Monica, CA, USA

²The RAND Corporation, Santa Monica, CA, USA

Abstract

Background—Undiagnosed disease is one of the critical public health problems in the world. In 2002 South Korean introduced the nation's first comprehensive public health promotion policy, Health Plan 2010. The first phase of Health Plan 2010 started in 2002, promoting early detection of diseases and preventative care and continued until 2005.

Methods—Using the 2001 and 2005 Korean National Health and Nutrition Examination Surveys that were fielded before and after the health promotion program, we investigate changes in health care utilization and its impacts on the prevalence of diagnosed and undiagnosed diabetes as well as the good management of the disease.

Results—A significant rise in diabetes diagnoses has occurred during this time period, especially for those with low education and older age. We find that, during this time period, the prevalence of undiagnosed diabetes was significantly reduced especially among older and less educated Koreans, the principal targets of the program. We also find that this health promotion had significant positive effects on good management of diabetes.

Conclusions—The increase of preventative health care through medical check-up among less-educated, older people suggests that the implementation of free medical check-ups for age 40 and older may have a positive impact on those who had not previously used preventative care. The positive experience in South Korea indicates that similarly designed public health campaigns in other countries have enormous potential in improving the detection and management of chronic disease.

Keywords

Undiagnosed disease; health promotion

Diabetes is an important public health problem worldwide because of high lifetime prevalence, its contribution to mortality,[1,2] a diminished quality of life,[3] and high health care expenses.[4] Four of five people with diabetes live in low or middle income countries, where diabetes is often undiagnosed and untreated. Diagnosed diabetes is different from

Corresponding author: J P Smith, The RAND Corporation, 1776 Main Street, PO Box 2138, Santa Monica, CA 90407, USA; smith@rand.org; phone 310-451-6925; fax 310-451-6935.

Competing interests: None

License for Publication Statement

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd and its Licensees to permit this article (if accepted) to be published in JECH editions and any other BMJ PGL products to exploit all subsidiary rights, as set out in our licence (<http://jech.bmj.com/fora/license.pdf>).

prevalence based on lab tests.[5] Smith[6] reported that the fraction of American diabetics undiagnosed was one in two in mid 1970s, but then declined substantially to one in five. In developing countries, we expect even greater prevalence of undiagnosed diabetes. This study focuses on undiagnosed diabetes and whether it can be reduced using new data from a rapidly developing country—South Korea. The Korean National Health and Nutrition Survey (K-NHANES) provided clinical data based on lab testing alongside health interviews on diagnosed diabetes.

Since an important public policy innovation was implemented during this period, we used 2001 and 2005 waves of K-NHANES. The Korean Ministry of Health and Welfare launched the country's first comprehensive health promotion plan, Health Plan 2010, the first phase started in 2002 and continued until its revision in 2005.[7–9]

The following programs were implemented during 2002~2004 to promote early detection and good management of diabetes: (1) diabetes information on Internet; (2) public awareness by holding events on “Diabetes Day” and through mass-media coverage of high-risk factors of diabetes; (3) early diabetes detection through medical check-ups; (4) standardized “self-care” program for diabetics; and (5) preventative diabetes care through diet and health behavior” via “home visits,” targeting high-risk groups such as the obese. Early detection and treatment were emphasized, and free medical check-ups every two years were provided for everyone age 40 and older and every year for blue-color workers. To enhance accessibility to care, public health clinics implemented “home visits” to the poor, elderly and disabled, facilitating early detection and treatment.

There are no systematic evaluations of health promotion policy in Korea.[10] We analyzed effectiveness of health promotion plan by investigating changes in health care utilization and its effects on diabetes prevalence, both diagnosed and undiagnosed, and good disease management.

METHODS

The Korean National Health and Nutrition Survey (K-NHANES), modeled on NHANES in America was a cross-sectional nationally representative survey, conducted in 2001 and 2005. K-NHANES sample was drawn from the 2000 Census to represent community-residing population. The Health Ministry oversaw recruitment of study participants and promoted program participation. Informed consent was obtained, and procedures followed are at <http://knhanes.cdc.go.kr/>. The health exam was carried out by public health clinics which sought cooperation from local governments to send recruitment letters and a nurse and health care professional team to conduct health exams.[7]

2001 data were collected during Fall of 2001. For health interviews, 13,200 households were selected from 600 Primary Sampling Units. Household response rates for 2001 health interviews were 92.3% and over 98% of individuals in these household consented. One third of participating households were randomly selected for health exams and individual response rates for 2001 health examinations were 77.3%.[8] 9,770 persons were given a health exam.

2005 data were collected during Spring 2005. For health interviews, 13,345 households were selected from 600 Primary Sampling Units. Household response rates for 2005 household surveys were 89.9% almost the same as in 2001 and over 99% of individuals consented. Once again, one third of households were randomly selected and individual response rates for health exams were 70.2%. This slightly lower response rate to health exams was likely due to health exams being free for many people by 2005. 8,633 persons were given a health exam.[9]

K-NHANES included respondent information on presence of chronic diseases, health services utilization, and health behaviors such as smoking, drinking, and exercise. Health exams included anthropometry and lab testing of fresh blood, measured cholesterol, fasting blood glucose and other biomarkers. K-NHANES target population was community-residing individuals and our study sample included those aged 30–70.

In our study, diagnosed diabetes prevalence in the population was based on whether respondents were ever doctor diagnosed. Undiagnosed diabetes in the population was defined by respondents' values of fasting plasma glucose ≥ 126 mg/dl and the respondent was not diagnosed by a doctor. Total prevalence in the population was defined as the sum of diagnosed and undiagnosed diabetes in the population. Good management was defined as a diagnosed diabetic whose clinical value was below 125 mg/dl threshold for fasting glucose. [11]

In addition to these population based statistics, we also define undiagnosed diabetics as a fraction of all diabetics. The value of examining the undiagnosed among all diabetics is that the strongest prediction of the health promotion program is that it will increase diagnosis among all diabetics. During this period of time, there was a secular increase in the total fraction of people who were diabetics. Anytime the total fraction of diabetics in the population increases, it is likely that both the fraction diagnosed and undiagnosed in the population will increase. Examining the fraction of undiagnosed among diabetics controls for this secular increase and provides the most direct test of the health promotion program on undiagnosed diabetes.

Similarly, recent diagnosed diabetes in 2005 was defined as diagnosed during the last three years, the closest approximation to the period covered by the health promotion campaign. Examining the recently diagnosed insures that this is most likely due to the health promotion plan since it can only really affect recent diagnosis. It is simply a check on that.

Education was low (less than high school); mid (high school education), and high (more than high school). Total household income was divided into three income terciles with one-third of sample in each group. The following variables were controlled as risk factors: education, age, gender, marital status, exercise, obesity, height, waist, diabetic parent, and rural residence. A binary variable for vigorous exercise indicated whether respondents engaged in vigorous exercise resulting in short breath and increased pulse, for more than 10 minutes during past week.

The following anthropometry variables were measured: weight, height, and waist circumference. Body Mass Index (BMI) was measured during health examinations to mitigate measurement problems with self-reports. WHO expert consultation recognized that Asians have higher percentage of body fat than white people of the same age, sex, and that proportions of Asians with risk factors for type 2 diabetes was substantial even below existing WHO BMI cut-off point of 25 kg/m^2 . [12] WHO guidelines suggested following categories for Asian population: less than 18.5 kg/m^2 underweight; $18.5\text{--}23 \text{ kg/m}^2$ increasing but acceptable risk; $23\text{--}27.5 \text{ kg/m}^2$ increased risk; and 27.5 kg/m^2 or higher high risk. A respondent was classified as obese if BMI was greater than or equal to 27.5 kg/m^2 and overweight if BMI was greater than or equal to 23 kg/m^2 but less than 27.5 kg/m^2 .

Waist circumference was measured in centimeters. Respondents were placed into three waist risk groups (low, medium, and high) where centimeters cut-off points differed by gender. [13,14,15] Male groups were low (<94 cm), moderate (94–101 cm) and high risk (≥ 102 cm), while female cutoff points were low (<80 cm); moderate (80–88cm) and high risk (≥ 88 cm).

We included in diabetes prevalence models these risk factors: education, height in centimeters; gender; parent diabetic, rural residence, and marital status, allowing effects of marital status to differ by gender. We tested effects of income terciles and past and current smoking behavior, but these were not statistically significant in any models so we excluded them.

RESULTS

Table 1 displays diabetes prevalence and health care utilization stratified by two age groups—30–49 and 50–70 using 2001 and 2005 K-NHANES, alongside chi-square tests and p values of differences between two K-NHANES. Overall, diagnosed diabetes prevalence in the population increased by 22% from 4.5% in 2001 to 5.5% in 2005. The largest and statistically significant increase in diagnosed diabetes occurred amongst those 50–70 years old, (39% rise) with no statistically significant change in younger samples. In contrast, total diabetes prevalence in the population increased by only 14%—8.5% in 2001 and 9.7% in 2005. The reason was that undiagnosed diabetes among all diabetics fell by 13% among diabetics; almost half were undiagnosed in 2001, compared to 43.5% in 2005. Reductions in undiagnosed diabetes among diabetics were completely concentrated and only statistically significant among those ages 50–70, the health promotion campaign target. Similarly, only this age group experienced a statistically significant increase in medical exams associated with health campaign.

Table 2 displays similar data on diabetes prevalence and health care utilization now stratified by three education groups and age with Chi-square tests and p values of tests of differences across K-NHANES years. Over all ages, a strong negative education gradient existed in population based diagnosed and total prevalence in both years.[16] In 2005 using total prevalence rates, 15.2% of those with less than high school were diabetics, almost three times the 5.3% rate of those with college educations. But age stratification in Table 2 shows that some of steep negative prevalence gradients with education reflected strong negative correlations of age with schooling. Statistical tests (not shown) indicated that all education gradients were strongly statistically significant.

P-values in Table 2 clearly indicate that increases in diagnosed prevalence in the population and declines in undiagnosed diabetes in the population and among diabetics were most pronounced and most statistically significant for less educated groups especially within the older age groups—explicit targets of health promotion campaigns. No changes over time in the highest educated group were statistically significant.

A key question was whether increases in diagnosed diabetes and reductions in undiagnosed diabetes reflected changes in medical care provision due to health promotion campaigns. Since medical checks-up was free for those 40 or older, we anticipated differential utilization changes by age. Tables 1 and 2 demonstrate that take up of medical check-ups in the past two years was highly concentrated among older and less educated Koreans consistent with trends for diagnosed and undiagnosed diabetes.

Table 3 examines changes over time in undiagnosed, recently diagnosed, and good diabetes management among diabetics. Undiagnosed diabetes fell most dramatically among the least educated who also exhibited a sharp increase in the fraction of diabetics who were recently diagnosed. Table 3 also demonstrate that between two K-NHANES percent in good management rose from 16% to over one-fourth and that the largest improvements in good management took place among the less educated and older respondents.

Table 4 presents estimated odds ratios, z statistics, and 95% confidence intervals obtained from logistic models of diagnosed in the population, undiagnosed among diabetics and total

prevalence in the population rates for each K-NHANES wave. Odds ratios statistically significant than '1' at five percent level are highlighted in bold. STATA software was used in estimation.

Three alternative prevalence models each illuminated different dimensions of behavior. By including both diagnosed and undiagnosed diabetes, the most comprehensive total prevalence in the population model estimated relationships of covariates to actual diabetes presence. Diagnosed models capture that component of diabetes that has been detected while undiagnosed models model that component not yet diagnosed. Since total undiagnosed diabetes will generally be higher when total diabetes is higher, we focus instead of the odds of being undiagnosed among those who are diabetics in order to detect the impact of the promotion campaign..

DISCUSSION

Consider results obtained using 2001 K-NHANES for diagnosed and total diabetes, pre Health Promotion Programs. Consistent with existing literature, diagnosed diabetes rose sharply with age, was lower among the taller, higher among those with a diabetic parent [6], married men, and much higher among those with high or moderate waist. These waist risk anthropometric measures were more important than obesity and over-weight which were never statistically significant in any models and were deleted from Table 4.[14,15] These diagnosed diabetes relationships with age, married men, and a diabetic parent are not as strong in the total diabetes model indicating that these attributes are related to the probability of undiagnosed diabetes, a result that is confirmed by the middle undiagnosed diabetes panel in Table 4.

While it seems anomalous that vigorous exercise was associated with higher diagnosed diabetes, there was no statistically significant association of vigorous exercise with total 2001 diabetes prevalence in the population. People engaging in physical exercise likely engaged in other good behaviors, including getting examined for disease including diabetes. Those engaging in vigorous exercise were not more susceptible to diabetes, but were more likely to have diabetes diagnosed.

Using married women as the reference group, diagnosed diabetes was higher among unmarried but particularly married men. Differences between married and unmarried men were much smaller for total diabetes prevalence indicating that part of this 2001 male differential in diagnosed diabetes was due to much lower rates of undiagnosed diabetes among married men, consistent with evidence that wives encouraged better health behaviors among men.

Next consider changes in estimated effects between 2001 and 2005 K-NHANES. As a precaution against possible differential selection into the surveys, we first conducted an analysis that compared those who participated in the health exam and those who did not. We found that with the exception of household size none of the variables used in our models (age, education, gender, rural residence, or marital status) was related to the probability of taking the health exam. We also found that the attributes of non-respondents in 2005 were not statistically different than non-respondents in 2001 suggesting that our results are not biased due to differential sampling success in the two years.

Compared to 2001, by 2005 diagnosed diabetes was more strongly positively related to age especially among those in their fifties—perhaps because blue collar workers in this age group were entitled to exams yearly instead of biannually. Undiagnosed diabetes among diabetes was much lower among older respondents in 2005. Protective effects of education

on diagnosed diabetes were also higher in 2005, a reflection of increased diagnosed among less educated.

If Health promotion plans had impacts, we should observe increased recent diagnosis between two K-NHANES surveys and improved good management. The data presented in Table 3 indicated that increases in recent diagnosis (0–3 years—time after initiation of Health Promotion Plan) were larger among those older than 49 and the least educated.

Contrary to 2001, married and unmarried men differed little in log odds of diagnosed diabetes by 2005 reflecting increased diagnosis of unmarried men. Similarly, those engaging in physical exercise were no longer more likely to be diagnosed by 2005, a possible reflection of improved diagnosis among those not engaging in vigorous exercise. The country wide campaign to improve detection eliminated these differentials.

An effective good management program should show greater improvements among those doing least well pre-program which is what Table 3 indicates. Improvements in good disease management were larger among older diabetics and the least educated where fractions in good management doubled.

Despite recent progress in the US and some Western European countries, undiagnosed disease remained high throughout the world and diseases undiagnosed typically were not treated. Diabetes with its high and growing prevalence and severe consequences is an important case. The American success in reducing undiagnosed diabetes from one-half to one-fifth of all diabetics in a 30 year time span suggests that reducing undiagnosed disease is not an insurmountable problem and much can be accomplished worldwide.

We analyzed here impacts of an important public health campaign in South Korea designed to improve detection and good management of diseases, especially diabetes. Using two waves of Korean NHANES fielded before and after program implementation, we analyzed program impacts on diagnosed and undiagnosed diabetes and good management of diabetes.

With increasing recognition of preventative care's value, population health screening programs have become key components of public health care. Screening for type-2 diabetes was recently implemented in U.K. and Japan,[17] but response rates to medical screening were notably lower among socially deprived groups, where screening benefits are greatest. [17] Special attention must to be paid to these groups in health promotion campaigns.

Another study demonstrated a potential to reach those at higher diabetes risk through a community-based diabetes prevention program.[18] While the study sample was small and limited to a single ethnic group, a team of community investigators and academics translated the Diabetes Prevention Program into this community and demonstrated its effectiveness. Similarly, Taking Action Together (another community-based intervention program by community collaborators and academic research teams), was successful in reaching out to low-income high BMI inner-city African American children.[19] Such findings suggest that such collaborative partnerships can implement targeted programs to reach high risk groups.

There were several limitations of our study. Program cost was not known so we cannot establish cost-effectiveness. While undiagnosed disease significantly decreased, we were unable to isolate specific program features most beneficial in producing this result. Only one reading of fasting blood glucose > 125 mg/dl was used to label a subject as poorly controlled diabetes and other parameters like post- prandial blood glucose and HbA1c were not been. Finally, the absence of a control group and a panel survey were limitations.

We found significant increases in diagnosed diabetes with little change in total diabetes prevalence, implying that undiagnosed diabetes declined—reductions concentrated on populations Health Plan 2010 targeted—the old and less educated. Medical checkups increased raising odds of detection and expanding numbers of Koreans who successfully managed their disease. The increase of preventative health care through medical check-up among less-educated, older people suggested that implementation of free medical check-ups for age 40 and older may have positive impacts on those not previously using preventative care. The positive Korean experience indicates that similarly designed public health campaigns in other countries have enormous potential in improving detection and management of chronic disease.

Acknowledgments

Funding: This work was supported by the National Institute on Aging, National Institutes of Health (Grants K01 AG21531).

References

1. Flegal KM. Waist circumference of healthy men and women in the United States. *Int J Obes*. 2007; 31:1134–39.
2. Chao C, Page JH. Type 2 diabetes mellitus and risk of non-Hodgkin lymphoma: a systematic review and meta-analysis. *Am J Epidemiol*. 2008; 168:471–80.
3. US Department of Health and Human Services. Diabetes: a national plan for actions: steps to a healthier US. Washington, DC: US Department of Health and Human Services; 2004.
4. Wild S, Sicree R, Roglic G, et al. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004; 27:1047–53. [PubMed: 15111519]
5. Cowie CC, Rust K, Byrd-Holt DD, et al. Prevalence of diabetes and impaired fasting glucose in adults in the U.S. population: National Health and Nutrition Examination Survey, 1999–2002. *Diabetes Care*. 2006; 29:1263–68. [PubMed: 16732006]
6. Smith JP. Nature and causes of trends in male diabetes prevalence, undiagnosed diabetes, and the socioeconomic status health gradient. *Proc Natl Acad Sci USA*. 2007; 104:13225–31.
7. Ministry of Health and Welfare (MOHW). Health Plan 2010. Seoul, Korea: 2003.
8. Korean Institute of Health and Social Affairs. 2001 National Health and Nutrition Survey—Overview prepared for the Ministry of Health and Social Welfare. 2002. Downloaded from <http://knhanes.cdc.go.kr/>
9. Korean Institute of Health and Social Affairs. The Third Korea National Health and Nutrition Examination Survey (KNHANES III)—Summary prepared for the Ministry of Health and Welfare. 2006. Downloaded from <http://knhanes.cdc.go.kr/>
10. Nam EW, Engelhardt K. Health promotion capacity mapping: the Korean situation. *Health Promot Int*. 2007; 22:155–62. [PubMed: 17341492]
11. Goldman D, Smith JP. Can patient self-management help explain the SES health gradient? *Proc Natl Acad Sci USA*. 2002; 99:10929–34.
12. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004; 363:157–63. [PubMed: 14726171]
13. Lean ME, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. *Br Med J*. 1995; 311:158–61. [PubMed: 7613427]
14. Flegal KM. Waist circumference of healthy men and women in the United States. *Int J Obes*. 2007; 31:1134–39.
15. Banks, J.; Kumari, M.; Smith, JP., et al. The case of diabetes. Nov. 2009 What explains the American disadvantage in health?.
16. Gregg E, Cadwell B, Cheng Y, et al. Obesity and Undiagnosed Diabetes in the U.S. *Diabetes Care*. 2004; 27:2806–12. [PubMed: 15562189]

17. Marteau TM, Mann E, Vasconcelos JC, et al. Impact of an informed choice invitation on uptake of screening for diabetes in primary care (DICISION): randomized trial. *Brit Med J*. 2010; 340:c2138. [PubMed: 20466791]
18. Mau MK, Kaholokula JK, West MR, et al. Translating diabetes prevention into native Hawaiian and Pacific islander communities: the PILI 'Ohana pilot project. *Prog Community Health Partnership*. 2010; 4:7–16.
19. Ritchie LD, Sharma S, Ikeda JP, et al. Taking action together: A YMCA-based protocol to prevent type-2 diabetes in high-BMI inner-city African American children. *Trials*. 2010; 11:60. [PubMed: 20492667]

What is already known on this subject

- Undiagnosed disease remains high throughout the world.
- A government-initiated comprehensive health promotion campaign promoted awareness and treatment of diabetes—on the Internet, through mass-media, and public health clinics.

What this study adds

- Undiagnosed prevalence declined from 2001 to 2005. A greater proportion of diabetics were successfully managing the disease in 2005 compared to 2001.
- Health promotion campaign was most effective among less educated and older adults.
- Government-led health promotion program can enhance diagnosis and good management of diabetes.

Table 1

Diabetes prevalence and health care utilization, by age groups

	2001	2005	chi-sq	p-value
% Diagnosed in population				
Age 30–49	1.7 (3,184)	1.9 (2,563)	0.87	0.351
Age 50–70	8.7 (1,882)	12.1 (1,797)	12.02	0.001
All ages	4.5 (5,066)	5.5 (4,380)	17.75	0.000
% Undiagnosed in population				
Age 30–49	2.5	3.5	0.39	0.531
Age 50–70	6–4	5.5	1.80	0.180
All ages	4.0	4.2	0.11	0.737
% Undiagnosed among diabetes				
Age 30–49	60.0	65.1	0.09	0.759
Age 50–70	41.1	31.3	8.90	0.003
All ages	47.4	43.5	8.20	0.004
% Total prevalence in population				
Age 30–49	4.2	5.4	1.16	0.282
Age 50–70	14.8	17.6	4.13	0.042
All ages	8.5	9.7	9.39	0.002
% Medical check-up in population				
Age 30–49	49.7	50.9	0.01	0.875
Age 50–70	53.3	58.2	12.43	0.000
All ages	50.9	52.4	5.05	0.025

N's are in parenthesis next to percent in first panel. Numbers in bold are statistically significant differences between two NHANES surveys.

Table 2

Diabetes prevalence and health care utilization, by education and age

Education	2001 K-NHANES			2005 K-NHANES			chi-sq (*p<.10, **p<.05, ***p<.01)		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
% Diagnosed in population									
Age 30 – 49	3.8	0.9	1.4	3.9	1.9	1.1	0.33	3.92**	0.03
Age 50 – 70	8.9	9.1	7.0	12.3	12.1	10.2	10.05***	1.37	0.66
All ages	7.2	2.7	2.6	10.1	4.1	2.2	15.31***	7.87***	0.03
% Undiagnosed in population									
Age 30 – 49	2.7	3.0	1.6	5.5	3.7	2.6	0.35	2.79	0.07
Age 50 – 70	7.4	4.3	4.6	5.0	6.5	6.2	17.77***	0.16	0.08
All ages	5.9	3.3	2.2	5.2	4.3	3.1	10.25***	0.96	0.61
% Undiagnosed among diabetics									
Age 30 – 49	41.1	77.6	52.0	58.6	65.4	70.1	0.11	2.85*	0.52
Age 50 – 70	43.8	31.4	40.0	29.0	35.0	38.0	12.98***	0.16	0.08
All ages	44.7	54.5	45.4	33.9	51	58.2	10.66***	1.68	0.20
% Total prevalence in population									
Age 30 – 49	6.5	3.9	3.0	9.4	5.6	3.7	1.25	1.05	0.45
Age 50 – 70	15.7	13.3	11.7	17.4	18.6	16.5	1.24	3.42*	0.62
All ages	13.1	6.0	4.8	15.2	8.4	5.3	5.47**	7.12***	0.49
% Medical check-up in population									
Age 30 – 49	43.2	46.8	58.5	45.4	43.6	61.8	0.33	4.62**	0.33
Age 50 – 70	48.2	62.9	65.9	55.1	62.0	70.1	17.85***	0.21	0.21
All ages	46.1	50.2	59.9	52.4	47.5	62.8	18.11***	2.53	0.40

Numbers in bold are statistically significant differences between two NHANES surveys.

Table 3

Un-diagnosis and good management among diabetes by age and education

	N		% undiagnosed among diabetes			% recently diagnosed among diabetes			% good management among diabetes		
	2001	2005	2001	2005	p-value	2001	2005	p-value	2001	2005	p-value
All diabetes	441	450	47.4	43.5	0.001	32.9	43.6	0.042	12.1	26.1	0.000
Age											
30-49	140	126	60.0	65.1	0.759	63.6	59.4	0.000	8.8	15.6	0.022
50-70	301	324	41.1	31.3	0.003	23.1	39.2	0.005	13.5	32.0	0.000
Education											
Low	261	256	44.7	33.9	0.001	30.4	41.2	0.201	12.7	33.3	0.000
Mid	112	133	54.5	51.0	0.156	36.1	50.7	0.229	8.9	21.7	0.026
High	56	61	45.4	58.2	0.658	39.2	37.9	0.271	15.7	12.3	0.502

Numbers in bold are statistically significant differences between two NHANES surveys.

Table 4

Logistic models for diabetes prevalence

KNHANES-2001	Diagnosed			Undiagnosed among diabetics			Total			
	Odds Ratio	z	[95% Conf. Interval]	Odds Ratio	z	[95% Conf. Interval]	Odds Ratio	z	[95% Conf. Interval]	
Age 50–59	2.46 ***	4.27	1.63	3.72	0.65	1.47	1.86 ***	4.03	1.37	2.52
Age 60–70	4.86 ***	7.82	3.27	7.22	0.48	2.77	3.37 ***	8.15	2.51	4.51
Education mid	0.72*	1.66	0.49	1.06	1.08	0.26	0.69 *	2.52	0.52	0.92
Education high	0.61*	2.00	0.37	0.99	0.96	0.10	0.53 ***	3.36	0.36	0.77
Male married	4.77 ***	6.11	2.89	7.88	0.35	2.63	3.57 ***	6.58	2.44	5.22
Male unmarried	1.88	1.13	0.63	5.61	0.99	0.02	2.34 ***	2.43	1.18	4.65
Vigorous exercise	1.60 ***	2.89	1.16	2.20	0.57	2.25	1.17	1.20	0.91	1.50
Height	0.95 ***	3.26	0.93	0.87	1.06	2.88	0.98	2.23	0.96	1.00
High waist risk	3.98 ***	6.10	2.55	6.20	0.99	0.02	4.72 ***	9.03	3.37	6.61
Mod waist risk	2.43 ***	4.57	1.66	3.56	1.06	0.20	2.84 ***	7.20	2.14	3.77
Parent diabetic	3.44 **	6.72	2.40	4.94	0.53	2.21	2.75 ***	6.84	2.06	3.68
LR	–736.25			–251.3			–1170.23			
LR chi2(15)	255			35.19			345.71			

KNHANES-2005	Diagnosed			Undiagnosed			Total			
	Odds Ratio	z	[95% Conf. Interval]	Odds Ratio	z	[95% Conf. Interval]	Odds Ratio	z	[95% Conf. Interval]	
Age 50–59	4.26 ***	7.26	2.88	6.29	0.461	–2.71	3.03 ***	6.96	2.22	4.14
Age 60–70	6.02 ***	8.49	3.98	9.11	0.338	–3.62	4.07 ***	8.18	2.91	5.69
Education mid	0.85	0.98	0.60	1.18	1.229	0.78	0.82	1.34	0.62	1.10
Education high	0.47 ***	3.04	0.29	0.77	1.892	1.72	0.51 ***	3.40	0.34	0.75
Male married	2.55 ***	3.11	1.42	4.60	0.502	–1.67	3.37 ***	4.61	2.01	5.66
Male unmarried	2.98 ***	2.98	1.45	6.12	0.665	–0.76	3.76 ***	4.15	2.01	7.02
Vigorous exercise	0.88	0.80	0.64	1.21	1.427	1.45	0.90	0.75	0.70	1.18
Height	0.99	0.67	0.97	1.02	0.998	–0.12	0.99	1.18	0.97	1.01
High waist risk	2.31 ***	2.91	1.32	4.06	0.912	–0.20	2.45 ***	3.67	1.52	3.96

KNAHNES-2005	Diagnosed			Undiagnosed			Total		
	Odds Ratio	z	[95% Conf. Interval]	Odds Ratio	z	[95% Conf. Interval]	Odds Ratio	z	[95% Conf. Interval]
Mod waist risk	1.77 ^{***}	2.82	1.19 2.64	0.951	-0.16	0.513 1.764	1.81 ^{***}	3.42	1.29 2.53
Parent diabetic	3.08 ^{***}	7.53	2.30 4.13	0.576	2.32	0.362 0.918	2.95 ^{***}	8.46	2.30 3.80
LR	-827.99			-260.8			-1088.21		
LR chi2(15)	287.85			46.3			335.55		

*** Odds ratio statistically significant than 1 at 1% level.

** Odds ratio statistically significant than 1 at 5% level.

* Odds ratio statistically significant than 1 at 10% level. Coefficients in bold are statistically significant at 5% level. Models also control for unmarried female, over-weighted, obesity, and rural residence—none of which are statistically significant and are thus not displayed in the Table.