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Factors Associated with Participation in Diabetes Education: The Korea National Health and Nutrition Examination Survey 2007 to 2009

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Background: A recent study revealed that the participation rate in diabetes education among diabetic patients was only about 50% in Korea. We investigated the factors associated with participation in diabetes education.
Methods: The study included 1,255 patients (≥19 years old) diagnosed with diabetes drawn from the total Korea National Health and Nutrition Examination Survey 2007 to 2009 population comprising 30,705 individuals. We compared age, sex, and age- and sex-adjusted clinical characteristics in patients who had received diabetes education versus those who had not.
Results: Of the 1,255 patients, 19.8% (n=248) had received diabetes education. Patients in the group who received diabetes education were younger, diagnosed at an earlier age, had a longer diabetes duration and were more likely to be using insulin therapy compared with the group who did not receive diabetes education (P<0.001). The group who received diabetes education included fewer manual workers (P<0.001) but more college graduates (P=0.004) compared with the group who did not receive diabetes education. Logistic regression analysis revealed that longer diabetes duration increased the likelihood of receiving diabetes education (odds ratio [OR], 1.04; 95% confidence interval [CI], 1.01 to 1.06; P=0.004). Junior high school (OR, 0.47; 95% CI, 0.24 to 0.91; P=0.026) and elementary school education levels (OR, 0.34; 95% CI, 0.17 to 0.65; P=0.001) versus college graduation were inversely correlated with participation in diabetes self-management education. Non-insulin therapy reduced the likelihood of receiving diabetes education (OR, 0.37; 95% CI, 0.21 to 0.64; P<0.001).
Conclusion: Longer diabetes duration, insulin therapy, and higher education level were positively associated with the completion of diabetes education.

Keywords: Diabetes; Education; Education level; Korea; Participation

INTRODUCTION

The International Diabetes Federation estimated that the global prevalence of diabetes was 285 million in 2010 and expected to rise to 552 million by 2030 [1,2]. In South Korea, the prevalence of diabetes rose dramatically from less than 1% in 1960 to 10% in 2010 [3], leading to an increase in diabetic complications and mortality. In 2010, diabetes was among the top five causes of death in Korea after deaths from cancer, cerebrovascular diseases, cardiovascular diseases, and suicide [4].

Diabetes self-management practices, including diet control, regular exercise, life-style modification, and adherence to medications, are necessary to achieve glucose control targets and reduce the treatment burdens of diabetes and diabetic complications [5,6]. Diabetes self-management education (DSME) involves teaching individuals to manage their diabe-

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tes through knowledge of the disease and development of the skills and abilities necessary for self-management [7]. Several previous studies have shown that DSME is associated with improvements in diabetes knowledge, self-care behavior, and quality of life, as well as reductions in glycosylated hemoglobin (HbA1c) levels and self-reported weight [5,8,9]. The American Diabetes Association recommends that self-management skills and diabetes knowledge be assessed at least annually and encourages continuing diabetes education [10]. Nonetheless, a recent study revealed that the participation rate in diabetes education programs was only 53% in Korea [11].

Most previous studies have sought to validate the effectiveness of diabetes education in improving diabetes management [12,13]. However, few studies have investigated the factors associated with patient participation in prescribed diabetes education programs [14-17].

We investigated the factors associated with participation in DSME among Korean patients with diabetes using data acquired from the 2007 to 2009 Korea National Health and Nutrition Examination Survey (KNHANES).

METHODS

Study population and data collection

We used data acquired from the 2007 to 2009 KNHANES, a cross-sectional, nationally representative survey conducted by the Korea Centers for Disease Control and Prevention. The KNHANES has been conducted periodically since 1998 to assess the health and nutritional status of the civilian, non-institutionalized population of Korea.

The survey participants were selected using proportional allocation-systemic sampling with multistage stratification. A standardized interview was conducted in the homes of the participants to collect information on demographic variables, family history, medical history, medications used, and a variety of other health-related variables. The health interview was an established questionnaire to determine the demographic and socioeconomic characteristics of the participants including age, education level, occupation, income, marital status, smoking habits, alcohol consumption, exercise, previous and current medical history, and family medical history.

Our study included 1,255 patients (≥19 years old) diagnosed with diabetes drawn from the total KNHANES 2007 to 2009 population of 30,705 individuals. Subjects were asked whether they had ever received any education about diabetes. In addition, they were asked whether they exercised at an intensity that left them sweating or with slight difficulty in breathing. Subjects who exercised regularly and at a moderate intensity were asked about the frequency with which they exercised per week and the length of time per exercise session. Regular exercise was defined as exercising five or more times per week. Alcohol consumption was assessed by questioning the subjects about their drinking behavior during the month before the interview. Heavy alcohol use was categorized as drinking four or more times per week. The presence of coronary heart disease, end-stage renal disease, and depression was based on self-report of previous diagnoses by a physician. Hypertension was defined as systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥90 mm Hg or use of antihypertensive medications irrespective of blood pressure. Diabetes was defined by fasting plasma glucose (FPG) levels ≥7.0 mmol/L, current antidiabetes medications, or a previous diagnosis of diabetes by a physician.

Height and weight were obtained using standardized techniques and equipment. Height was measured to the nearest 0.1 cm using a portable stadiometer (Seriter, Bismarck, ND, USA). Weight was measured to the nearest 0.1 kg using a Giant-150N calibrated balance-beam scale (Hana, Seoul, Korea). Body mass index (BMI) was calculated by dividing the patients' weight by the square of their height (kg/m^2). Systolic and diastolic blood pressure were measured by standard methods using a sphygmomanometer while the patients were seated. Three blood pressure measurements were taken at 5-minute intervals in all subjects, and the average of the second and third measurements was used in the analysis.

Laboratory methods

Blood samples were collected in the morning after fasting for at least 8 hours. The FPG analysis was performed using a Hitachi Automatic Analyzer 7600 (Hitachi, Tokyo, Japan). HbA1c was measured using a high performance liquid chromatography method (HLC-723G7; Tosoh, Tokyo, Japan). Total cholesterol (TC), triglyceride (TG), and high density lipoprotein cholesterol (HDL-C) levels were measured in a central and certified laboratory using an ADVIA 1650 analyzer (Siemens Diagnostic Solutions, Tarrytown, NY, USA). Low density lipoprotein cholesterol (LDL-C) was estimated indirectly using the Friedwald formula: LDL-C=TC–[HDL-C+(TG/5)] for subjects with TG levels <4.5 mmol/L.

Ethics statement

Our study was approved by the Institutional Review Board of Inje University Ilsan Paik Hospital, Republic of Korea (IB-2-1312-054). After the study proposal was approved, the KNHANES dataset was made available at the request of the investigator. Because the dataset did not include any personal information and the participants' consent had already been given for the KNHANES, our study was exempt from participant consent requirements.

Table 1. Age, gender, and age- and gender-adjusted clinical characteristics between patients who had and had not received diabetes education

Characteristic	Diabetes education (–)	Diabetes education (+)	*P* value
No./weighted no.	1,007/1,740,621	248/410,111	
Age, yr	60 (59–61)	57 (55–59)	<0.001
Male sex, %	51.9 (48.1–55.6)	53.4 (46.0–60.7)	0.727
Household income, 10 thousands KRW/mo	241.7 (192.3–291.1)	234.5 (196.7–272.2)	0.823
Rural resident, %	23 (19–27)	19 (13–25)	0.154
Manual worker, %	30.7 (26.8–34.6)	17.5 (11.9–23.1)	<0.001
College graduation, %	12.0 (9.2–14.7)	21.7 (15.8–27.6)	0.004
Alcohol ≥4/wk, %	8.7 (6.6–7.6)	7.4 (3.7–11.1)	0.555
Current smoking, %	23.1 (19.9–26.3)	17.3 (11.9–22.6)	0.055
Regular exercise ≥5/wk	13 (11–16)	14 (8–19)	0.940
Daily calories intake, kcal/day	1,770 (1,693–1,848)	1,661 (1,560–1,763)	0.090
Daily carbohydrate intake, g/day	305.0 (292.0–317.9)	286.1 (269.3–302.8)	0.089
Daily protein intake, g/day	61.5 (58.8–64.3)	61.2 (56.5–65.9)	0.886
Daily fat intake, g/day	27.8 (25.9–29.8)	29.1 (25.9–32.3)	0.491
Diabetes duration, yr	7.1 (6.6–7.6)	10.0 (9.0–11.1)	<0.001
Diabetes diagnosed age, yr	52.6 (52.1–53.1)	49.6 (48.5–50.6)	<0.001
Insulin treatment, %	5 (4–7)	20 (14–25)	<0.001
Hypertension, %	52 (49–56)	49 (42–56)	0.410
Hypercholesterolemia, %	20 (17–23)	23 (17–29)	0.386
Stroke, %	6 (4–8)	5 (3–8)	0.579
Coronary heart disease, %	5 (4–7)	8 (5–11)	0.150
End stage renal disease, %	1 (0–2)	3 (1-5)	0.082
Depression, %	4 (3–5)	5 (2–7)	0.670
Body mass index, kg/m^2	25.1 (24.8–25.3)	24.9 (24.5–25.4)	0.643
Waist circumference, cm	87.6 (86.9–88.4)	87.3 (86.0–88.6)	0.656
Systolic blood pressure, mm Hg	126.4 (125.1–127.6)	126.7 (124.0–129.4)	0.819
Diastolic blood pressure, mm Hg	77.9 (77.1–78.8)	77.8 (76.3–79.4)	0.916
Total cholesterol, mg/dL	190.1 (187.1–193.0)	185.9 (179.5–192.3)	0.226
HDL-C, mg/dL	45.0 (44.0–46.0)	44.7 (43.1–46.2)	0.730
Triglyceride, mg/dL	177.7 (167.2–188.1)	201.4 (159.6–243.2)	0.289
Fasting plasma glucose, mg/dL	139.1 (135.2–143.0)	153.5 (143.8–163.2)	0.008
HbA1c, %	7.4 (7.2–7.5)	7.6 (7.4–7.9)	0.051

Values are presented as median (range).
KRW, Korean won; HDL-C, high density lipoprotein cholesterol; HbA1c, glycosylated hemoglobin.

Statistical analyses

The KNHANES participants were not sampled randomly. The survey was designed using a complex, stratified, multistage probability-sampling model; thus, individual participants were not equally representative of the Korean population. To obtain representative prevalence rates from the dataset, it was necessary to consider the power of each participant (sample weight) as representative of the Korean population. Following approval from the Korea Centers for Disease Control and Prevention, we received a survey dataset that included information about the survey location, strata by age, sex, and various other factors, and the sample weight for each participant. The survey sample weights, which were calculated by taking into account the sampling rate, response rate, and age/sex proportions of the reference population (2005 Korean National Census Registry), were used in all of the analyses to provide representative estimates of the non-institutionalized Korean civilian population.

We compared age- and sex-adjusted clinical characteristics, using analysis of covariance, between patients who had and had not received diabetes education. A logistic regression analysis was used to evaluate the odds ratio (OR) for participation in diabetes education using age, sex, diabetes duration, FPG levels, alcohol <4 times/week, non-smoking, occupation, education level, and non-insulin therapy as covariates.

All of the tests were two-tailed, and *P* values <0.05 were considered to indicate statistical significance. The SPSS version 21.0 (IBM Co., Armonk, NY, USA) was used to conduct the statistical tests.

RESULTS

Of the 1,255 patients with diabetes, 19.8% (*n*=248) had received DSME. We compared age, sex, and age- and sex-adjusted clinical characteristics between patients who had received diabetes education and those who had not (Table 1).

Patients who had received diabetes education were younger than those who had not (*P*<0.001). The group who received diabetes education comprised fewer manual workers (*P*<0.001) and more college graduates (*P*=0.004) compared with the group who did not receive diabetes education; however, household income was not significantly different between the groups. Patients in the group who received diabetes education were diagnosed at a younger age, had a longer disease duration, and were more likely to use insulin compared with those in the group who did not receive diabetes education (*P*<0.001). Smoking habits, alcohol consumption, exercise, and daily caloric intake, including carbohydrates, protein, and fat, did not differ between the groups. Levels of FPG were higher in the group who did receive diabetes education versus those who did not; however, BMI, waist circumference, blood pressure, TC, HDL-C, and TG were not significantly different between groups. Furthermore, medical history (hypertension, hypercholesterolemia, stroke, coronary heart disease, end-stage renal disease, and depression) was not significantly different between groups.

Logistic regression analysis revealed associations between receiving diabetes education and diabetes duration, education level, and insulin therapy (Table 2). A longer duration of diabetes increased the likelihood of receiving diabetes education (OR, 1.04; 95% confidence interval [CI], 1.01 to 1.06; *P*=0.004). Junior high school (OR, 0.47; 95% CI, 0.24 to 0.91; *P*=0.026) and elementary school (OR, 0.34; 95% CI, 0.17 to 0.65; *P*=0.001) education levels versus college education were inversely correlated with participation in diabetes education. Non-insulin therapy reduced the likelihood (OR, 0.37; 95% CI, 0.21 to 0.64; *P*<0.001) of receiving diabetes education. Age, FPG lev-

Table 2. Odds ratio for participation in diabetes education

Variable	Odds ratio (95% CI)	*P* value
Age	0.99 (0.97–1.01)	0.209
Female sex	0.91 (0.57–1.45)	0.695
Diabetes duration	1.04 (1.01–1.06)	0.004
Fasting plasma glucose	1.00 (1.00–1.01)	0.074
Alcohol ≥4/wk	0.84 (0.43–1.65)	0.617
Non-smoking	1.42 (0.87–2.32)	0.156
Occupation		
White collar vs. blue collar	0.73 (0.39–1.35)	0.315
None	1.41 (0.81–2.46)	0.228
Household income		
Highest quartile vs. 3rd quartile	0.89 (0.52–1.53)	0.680
2nd quartile	0.87 (0.54–1.39)	0.548
1st quartile	0.69 (0.42–1.14)	0.146
Educational backgrounds		
College vs. senior high school	0.61 (0.34–1.12)	0.112
Junior high school	0.47 (0.24–0.91)	0.026
Elementary school	0.34 (0.17–0.65)	0.001
Non-insulin treatment	0.37 (0.21–0.64)	<0.001

CI, confidence interval.

els, occupation, and household income had no significant effect on receiving diabetes education.

DISCUSSION

We found that 19.8% of the Korean patients with diabetes in our sample had received diabetes education. Furthermore, we found that diabetes duration, insulin therapy, and education level were associated with participation in diabetes education.

The prevention of diabetes complications requires a multiinterventional approach that includes learning self-management strategies. Our study showed that fewer than 20% of Korean patients with diabetes participated in diabetes education, which was lower than expected. According to KNHANES 2005, approximately 25% (95% CI, 22.2 to 27.7) of patients received diabetes education [18]. Previous studies conducted in the United States and Germany found that 50% to 65% of eligible patients did not attend diabetes education programs, although the reasons for non-participation may vary among countries [19,20]. Thus, to improve patient participation in diabetes education, it is important to understand the factors associated with attending education programs.

We found that a long diabetes duration and insulin therapy were associated with a higher diabetes education participation rate. Bos-Touwen et al. [2] reported that a short disease duration was associated with low activation for self-management interventions in patients with diabetes. Moreover, insulin use has been shown to be associated positively with participation in diabetes education programs [15,17]. It may be that severe disease status, as indicated by receiving insulin therapy and a long disease duration, causes increased concern and prompts participation in diabetes education.

We found that education level was a significant factor associated with receiving diabetes education. We found that patients with an elementary school education or less had a nearly 3-fold increase in the likelihood of perceiving a barrier to diabetes education, and this was consistent with previous studies showing an association between education level and diabetes education. Rhee et al. [16] found a nearly 5-fold increase in the likelihood of perceiving a barrier to diabetes education in respondents with an elementary school education or less, whereas individuals with a college education had significantly lower odds of expecting to face such barriers. Another study found that individuals with 9 to 12 years of education were 53% more likely to have attended a diabetes education program than were those with <9 years of education (OR, 1.53; 95% CI, 1.07 to 2.20), and the probability of having received diabetes education was more than 2-fold higher among that of those with >12 years of education (OR, 2.11; 95% CI, 1.32 to 3.38) [17]. It may be that patients with a higher education level have more insight into the disease, and the desire to increase their knowledge motivates them to seek diabetes education. These behaviors lead to better self-management of diabetes and glucose control, which decreases the incidence of morbidity and mortality associated with diabetic complications. Furthermore, education status has been shown to have a significant influence on total and active life expectancies [21].

Our finding that age, sex, and employment status were not associated with participation in diabetes education is not consistent with previous studies. Rhee et al. [16] reported that increasing age was a barrier to participation in diabetes education among urban-dwelling patients with diabetes, which may be related to poor vision and hearing impairments associated with aging. A previous study found that the most common potential obstacles to diabetes education were poor vision (74%), followed by "cannot read well" (29%), and hearing problems (19%) [16]. We found that in the unadjusted analysis, the patients who had received diabetes education were younger than those who had not received it; however, logistic regression analysis revealed that age was not a barrier to participation in diabetes education.

Sex and employment status factors affecting participation in diabetes education have not been investigated previously. Graziani et al. [15] reported that being of the female sex was positively associated with education program attendance. Another study also showed that male participants were associated with greater odds of anticipating a barrier to diabetes education [16].

Although we found that manual workers were less likely to have received diabetes education, employment status did not influence the diabetes education participation rate. However, Rhee et al. [16] found that employment status (employed, unemployed, retired, and disabled) led to a significant difference in the perception of obstacles to diabetes education.

Our study has several limitations. First, the KNHANES dataset did not allow us to evaluate the reasons for not receiving diabetes education. A previous study of patients who refused diabetes education at an academic medical center found that the common reasons for rejecting diabetes education were having attended previous diabetes education programs, cost,

and the impression that they had sufficient knowledge of diabetes [22]. Other studies have identified time constraints, stress, transportation problems, functional limitations, no interest, and feeling sufficiently informed as barriers to patient participation in diabetes education [15,23]. Second, we were not able to differentiate between patients who chose not to participate in a prescribed diabetes education program and those who had not been recommended to attend diabetes education by their physician. The recommendation of a physician has been shown to be an important factor for participation in diabetes education; thus, encouragement or recommendation by a physician may itself increase diabetes education attendance rates [24,25]. Third, we were unable to determine the type of diabetes education offered; that is, whether it was conducted in a group or individual setting or by a physician or a non-physician specialist and/or nurse. Finally, the cross-sectional design of our study did not allow us to establish causal relationships.

Nevertheless, the major strength of our study was the large, nationally representative sample of adult Koreans. To our knowledge, few studies have investigated the factors associated with patient participation in diabetes education using a national-level assessment that includes demographic and socioeconomic characteristics.

In conclusion, the diabetes education participation rate was only 19.8% in Korean patients with diabetes, based on the data acquired from the KNHANES 2007 to 2009 study. Longer diabetes duration, insulin treatment, and a higher education level were positively associated with the completion of diabetes education programs.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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Kim J.M., Hong J.W., and Kim D.J. researched the data and wrote the manuscript. Noh J.H. contributed to the discussion and reviewed/edited the manuscript.

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