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Diabetes Health Literacy, Drug Adherence and Factors Associated with Them among Urban Patients in Kerala, India

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Abstract

Aims—The study aimed to assess diabetes health literacy, adherence to diabetes medication, and its associated factors in Kerala, India, the most advanced Indian state in epidemiological transition with the highest literacy level in India.

Materials and methods—We conducted a community-based cross-sectional study among 280 diabetes patients (mean age 62 years, male 42%) selected by multistage cluster sampling. Information on sociodemographic variables was collected using a pretested structured interview schedule. Diabetes health literacy was assessed using the revised Michigan Diabetes Knowledge test. Adherence to diabetes medication was assessed using the Hill-Bone subscale. Binary logistic regression analysis was done to find out the factors associated with diabetes health literacy and medication adherence.

Results—Good diabetes health literacy was reported by 35.7% [95% confidence interval (CI): 30.1–41.6] of the patients. Perfect adherence to diabetes medication was reported by 33.2% of patients (CI: 27.7–39.1). Patients who reported regular newspaper reading [adjusted odds ratio (AOR) 3.16; CI: 1.57–6.30], using the internet (AOR 2.23; CI: 1.11–4.50) and insulin use (AOR 2.60; CI: 1.35–5.00) were more likely to report good diabetes health literacy compared to their counterparts. Patients who reported reading health magazines (AOR 2.75; CI: 1.01–7.60) were more likely to report perfect medication adherence compared to those who did not.

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Conclusion—Why diabetes health literacy and medication adherence were low among diabetes patients in the most literate state needs further investigation. Interventions to enhance diabetes health literacy and medication adherence may be undertaken among diabetes patients encouraging them to read newspapers and health magazines regularly and use the internet.

Keywords

Diabetes health literacy; Diabetes patients; India; Kerala; Medication adherence

Introduction

The Indian state of Kerala has the highest prevalence of 19.2% type 2 diabetes mellitus among adults, which is more than double the prevalence of 9.3% for India having 74.2 million people with diabetes.^{1–3} Awareness about diabetes among the general population in India is only 43%.⁴ Low health literacy is consistently associated with poor diabetes knowledge, although evidence for the association between poor diabetes knowledge and processes or outcome related to diabetes care is insufficient.⁵ Adherence to diabetes medication is only 50% in a hospital-based study from Uttarakhand, India, and 32% among patients attending a North Indian tertiary care hospital.^{6,7} Kerala is the most advanced Indian state in epidemiological and demographic transition and has the highest literacy level of 94% in the country.^{8,9} In a community-based study in Kerala good knowledge of diabetes was found among 56% of participants higher than the knowledge level of 43% at the national level.¹⁰ Good adherence to diabetes medication in Kerala was 26% in a community-based study that used the Morisky eight-item scale and 60% in another study that used a different method of assessment of adherence.^{11,12} Lee et al. defined diabetes-related health literacy as “the extent to which patients with diabetes have the required skills and abilities to seek, understand, analyze, communicate, and enumerate diabetes-related information both in the healthcare environment and daily lives for treating, and self-managing their condition.”¹³ Comprehensive studies on diabetes health literacy, drug adherence and factors associated with them are limited in India and Kerala. We conducted this study to find out the level of diabetes health literacy, adherence to diabetes medication, and factors associated with these two variables in Kerala, the most advanced Indian state in epidemiological transition with the highest literacy level in India.

Materials and Methods

Study Design and Population

We conducted this cross-sectional study in the Thiruvananthapuram district of Kerala state, a fairly representative district of Kerala. The literacy rate of the district was 93.02% very close to the 94% for the entire state and the human development index for the district was 0.733 same as for the entire state.^{9,14} This community-based survey of self-reported diabetes patients was conducted among urban residents of the district from March to April 2022. The sample size was estimated based on an anticipated diabetes knowledge level of 49%¹⁵ 95% confidence level, half-width of the confidence interval (CI) as 8%, a design effect of 1.5 to account for the cluster sampling design, and a nonresponse rate of 20%. The sample size of 270 thus obtained was rounded off to 280. Sample selection was done using a multistage

cluster sampling technique. Thiruvananthapuram district consists of five urban areas—one corporation (Thiruvananthapuram) and four municipalities (Attingal, Nedumangad, Neyyattinkara, and Varkala). Of these urban areas, Thiruvananthapuram Corporation was selected as the only corporation in the district and Neyyattinkara municipality was selected randomly from the four municipalities. In the second stage, 10 wards each from these two urban areas were selected using the lottery method (Flowchart 1). In the third stage, from each of these selected wards (each ward was considered a cluster) 14 diabetes patients were identified and recruited for the study ($14 \times 20 = 80$). With the assistance of a local person, the center of each ward was located, and the first household was identified using the cluster sampling technique suggested by the World Health Organization.¹⁶ Beginning with the first household, the subsequent households were visited until 14 diabetes patients were recruited for that particular cluster. Inclusion criteria were—(1) age 18 years or above (both men and women) and (2) had diabetes for >6 months. Self-reported diabetes patient was those who were told by a healthcare provider that she/he had diabetes. Patients with cognitive impairment and those who were not willing to give written informed consent were excluded from the study. This process was repeated in all the 20 wards (clusters) and 280 diabetes patients were recruited for the study. Out of the 290 participants approached 10 (3.4%) refused to participate in the study.

Data Collection Tool and Technique

Information on sociodemographic variables was collected using a semi-structured interview schedule that included age, sex, religion, marital status, education status, occupation, monthly household expenditure, number of household members, internet usage, newspaper reading, health magazine reading, family history of diabetes, and living arrangements of the participants. Diabetic health literacy was assessed using the revised Michigan Diabetes Knowledge test including the correct answers for each question, which is freely available. This 20 items test has a maximum score of 20.¹⁷ The correct answer was given one point and the wrong and don't know answers were given zero points. This test originally developed by Fitzgerald was modified and validated by Collins et al.^{18,19} This scale was validated in a previous study in Hyderabad, India.²⁰ Medication adherence for diabetes was measured using the Hill-Bone medication adherence subscale.^{21,22} This scale has nine items and each of the items has a score ranging from 1 to 4. If a patient has perfect adherence she/he will get a total score of 36. The score for imperfect adherence will range from 9 to 35. Hill bone scale is recommended for assessing adherence to medication for chronic conditions such as hypertension, diabetes, and others. This scale was validated in India for hypertension.²³ All the questionnaires were translated to the local language Malayalam and back-translated to English till there was an agreement between the original version and the back-translated version. The data collection was done by the first author (Mohammed Parisa A Arshad) by visiting the homes of the patients.

Statistical Analysis

Univariate analysis was done to assess the diabetic health literacy rate using the median score obtained from the revised Michigan Diabetes Knowledge test. The median score of nine was used to dichotomize the variable into good and poor diabetes health literacy. Medication adherence was categorized into perfect and imperfect adherence using the

maximum score of 36 indicating perfect adherence. Binary logistic regression analysis was used to find out the factors associated with diabetes health literacy and medication adherence. All statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) Windows version (IBM SPSS 26.0). A “*p*” value of <0.05 was used to denote statistical significance.

Results

Study sample characteristics are given in Table 1. Good diabetes health literacy was reported by 35.7% (95% CI: 30.1–41.6) of the patients and the remaining had poor diabetes health literacy. Perfect adherence to diabetes medication was reported by 33.2% (CI: 27.7–39.1) of patients without any gender difference and the remaining patients reported imperfect adherence. There was no difference in the diabetes literacy level between male and female patients. Factors associated with diabetes health literacy based on binary logistic regression analysis are given in Table 2. Those who reported internet usage were two times [adjusted odds ratio (AOR) 2.03; 95% CI: 1.02–4.05] and those who reported regular newspaper reading were three times (AOR 2.75; CI: 1.40–5.40) more likely to report good diabetes health literacy compared to their counterparts. Factors associated with medication adherence based on binary logistic regression analysis are given in Table 3. Those who reported the habit of health magazine reading were three times (AOR 2.76; CI: 1.01–7.60) more likely to report perfect medication adherence compared to those who did not.

Discussion

In our community-based study among 280 diabetes patients, good diabetes health literacy based on the Michigan Knowledge test was reported by 35.7% without any gender difference. Perfect medication adherence to diabetes was reported by 33.2% of patients without any gender difference. Major factors associated with good diabetes health literacy were internet use, regular newspaper reading, and insulin use. The major factor associated with perfect drug adherence was health magazine reading. Good diabetes health literacy was not associated with perfect medication adherence.

In a Singapore study, those who had good functional health literacy were able to identify symptoms of diabetes correctly in 83.5% indicating a strong correlation between health literacy and diabetes knowledge.²⁴ In spite of having a very high general literacy of 94% in Kerala, India, among our study population of diabetes patients, good diabetes health literacy was reported by only 35.7%. An Ethiopian study among 402 diabetes patients reported low, moderate, and high diabetes health literacy of 41.8, 27.9, and 30.3%, respectively.²⁵ Although the grouping of patients was different in this study compared to our study the diabetes health literacy was almost similar. Health literacy intervention as suggested by a recent systematic review is likely to improve diabetes health literacy and diabetes care in a state like Kerala which has a high general literacy level of 94%.²⁶

Internet use was one of the factors associated with diabetes health literacy in our study. It has been reported that e-health interventions were useful in improving chronic disease control including diabetes.²⁷ In Kerala several e-health interventions are being done as part of the

prevention and control of noncommunicable diseases including diabetic retinopathy care.²⁸ This could be one of the reasons for better diabetes health literacy among those who were using the internet.

Those who reported regular newspaper reading were more likely to report good diabetes health literacy in our study. A content analysis of mass media including newspapers in Kerala reported high coverage of health messages.²⁹ However, a recent study from Malaysia reported that there was much room for improvement in the language such as using simple sentence structures in newspapers.³⁰ All media including newspapers have a very good role in improving diabetes health literacy. Other than newspaper reading, internet use, and glucose monitoring, we did not capture information on other diabetes self-care practices which are reported to be effective in improving diabetes control rates.³¹ Diabetes-related distress has also been reported to be high in resource-constrained rural settings affecting the self-care practices of diabetes patients.³² Living in a joint family and the availability of other social support systems are likely to help these patients to improve self-care practices. Those who used insulin were 2.6 times more likely to have a good level of diabetes health literacy compared to their counterparts similar to the findings from a recent study from Saudi Arabia that reported a positive association between the duration of insulin therapy and diabetes knowledge.³³

Adherence to diabetes medication is usually measured by different scales. One of the commonest is the Morisky medication adherence scale. In Kerala, one study reported 25% adherence using the Morisky scale and the remaining 75% reported inadequate adherence. Another community-based study from Kerala reported 60% good adherence in the state using a different scale indicating large variations in the adherence rates based on the scale used. A recent study among 257 diabetes patients from Uganda reported a good adherence level of 62% using the Hill-Bone scale, which was almost double that of our study.³⁴ A recent systematic review reported a medication adherence level of 51.2 and 47.7% were persistent with the diabetes medications.³⁵

The only factor that was found associated with perfect medication adherence in our study was reading health magazines. This could be due to the effects of some specific articles published in health magazines related to diabetes and other chronic diseases. Arney et al. reported that direct-to-consumer advertising could be used as an opportunity by physicians to understand patients' perspectives on illness and medication adherence in order to improve adherence.³⁶

Perfect medication adherence in our study was reported only by a third of the diabetes patients. This low level of medication adherence could be the reason for the low level of 15.3% control rate of diabetes (fasting blood sugar <126 mg/dL) reported in the latest study from a representative sample of the Kerala population.¹ This controlled rate was similar to the control rate of 15.7% reported by a nationally representative study in India.² An earlier study from Thiruvananthapuram district reported a control rate of 21.5% higher than the control rate for the entire state reported recently.³⁷ Diabetes control rates were similar in Punjab (14.2%) and Haryana (13.8%) states of India.³⁸ Kerala health indicators are one of the best in India and the Kerala model of low-cost health care is well-known

internationally.³⁹ Why the diabetes control rate in Kerala is the same as the national average is a question that needs to be investigated. While all other health indicators in Kerala are much better than the national average and comparable to the Western countries, this low level of diabetes control needs the attention of policymakers. Improving diabetes health literacy and medication adherence for diabetes is likely to improve control rates of diabetes in this highly literate state.

One of the strengths of our study was that we recruited a representative sample of 280 diabetes patients from the urban community from a district that fairly represents the state. One of the limitations of our study was that we did not measure the control rates of diabetes in our patients due to resource limitations. The cross-sectional design of our study has limitations for the associations that we report in this study. Our study did not capture the use of alternative systems of medicine and the duration of diabetes. However, a previous study from Kerala reported exclusive complementary and alternative medicine use of 9%, exclusive modern medicine use of 61%, and combined use of 30%.⁴⁰ Diabetes duration of 5 years were found positively associated (2.05; 95% CI 1.09, 4.19) with diabetes literacy.²⁵

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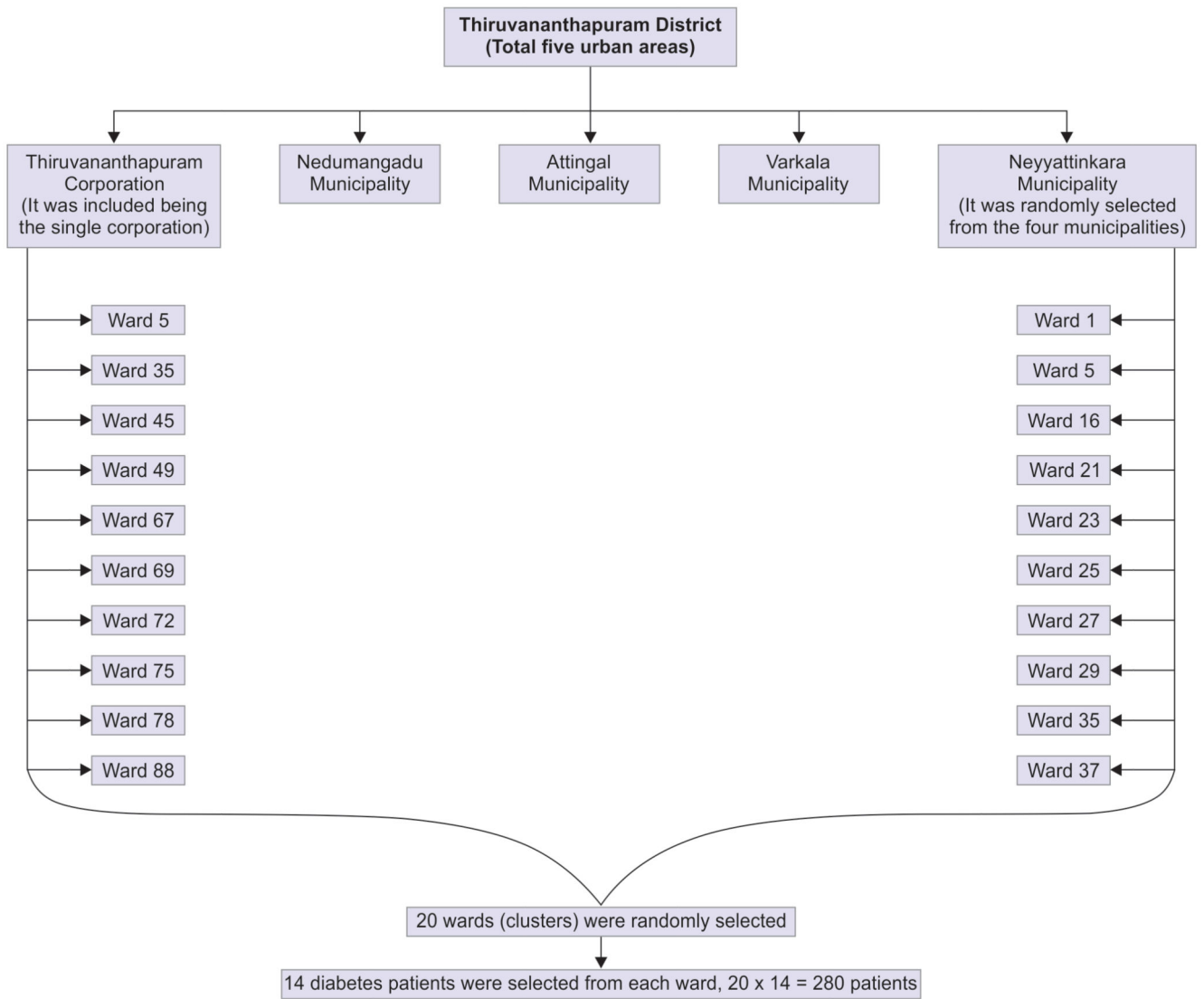
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Flowchart 1. Flowchart showing recruitment of patients

Table 1
Study sample characteristics (N = 280)

<i>Variables</i>	<i>Total n (%)</i>
Age in years (mean \pm standard deviation)	61.65 \pm 9.5 years
Sex	
Male	118 (42.1)
Female	162 (57.9)
Religion	
Hindu	173 (61.8)
Muslim	47 (16.8)
Christian	60 (21.4)
Marital status	
Married	221 (78.9)
Others *	059 (21.1)
Years of schooling	
<10 years	110 (39.3)
10 years	170 (60.7)
Occupation	
Employed	100 (35.7)
Unemployed	180 (64.3)
Monthly household expenditure (Indian rupee)	
5,000	146 (52.1)
>5,000	134 (47.9)
Household members	
One to four members	188 (67.1)
Five or more members	92 (32.9)
Living arrangement	
Alone	18 (06.4)
With family members	262 (93.6)
Internet usage	
Yes	84 (30.0)
No	196 (70.0)
Regular newspaper reading	
Yes	171 (61.1)
No	109 (38.9)
Health magazines reading	
Yes	19 (6.8)
No	261 (93.2)
Family history of diabetes	
Yes	147 (52.5)
No	133 (47.5)
Diabetes monitoring interval	

<i>Variables</i>	<i>Total n (%)</i>
Every 2 months	135 (48.2)
Others [†]	145 (51.8)
Glucose monitoring facility at home	
Yes	106 (37.9)
No	174 (62.1)
Medication adherence	
Complete adherence	93 (33.2)
Incomplete adherence	187 (66.8)

* other marital status categories include never married, widowed, and separated/divorced

[†] other diabetes monitoring intervals include once every 6 months, once in 1 year, and never monitoring

Table 2
Factors associated with a good level of diabetes health literacy: results of binary logistic regression analysis (N = 280)

<i>Variables</i>	<i>Good level of diabetic health literacy (%)</i>	<i>Unadjusted odds ratio (95% CI)</i>	<i>Adjusted odds ratio (95% CI)</i>
Age			
>60 years	26.0	1.00	1.00
60 years	46.9	2.52 (1.52–4.16) *	1.48 (0.75–2.93)
Sex			
Male	34.7	1.00	1.00
Female	36.4	1.08 (0.66–1.77)	1.45 (0.69–3.05)
Religion			
Christian	31.7	1.00	1.00
Hindu	36.4	1.24 (0.66–2.31)	1.24 (0.60–2.55)
Muslim	38.3	1.34 (0.60–2.98)	1.17 (0.45–3.02)
Marital status			
Others [‡]	22.0	1.00	1.00
Currently Married	39.4	2.3 (1.17–4.50) †	1.28 (0.52–3.16)
Years of schooling			
<10 years	19.1	1.00	1.00
10 years	46.5	3.68 (2.10–6.46) *	1.47 (0.70–3.08)
Occupation			
Employed	34.0	1.00	1.00
Unemployed	36.7	1.12 (0.67–1.88)	1.16 (0.55–2.47)
Monthly household expenditure (Indian rupee)			
5,000	26.0	1.00	1.00
>5,000	46.3	2.45 (1.48–4.04) *	1.43 (0.774–2.63)
Household members			
Five or more members	34.8	1.00	1.00
One to four members	36.2	1.06 (0.63–1.79)	1.02 (0.54–1.95)
Internet usage			
No	25.0	1.00	1.00
Yes	60.7	4.64 (2.69–7.99) *	2.03 (1.02–4.05) †
Regular newspaper reading			
No	17.4	1.00	1.00
Yes	47.4	4.26 (2.39–7.61) *	2.75 (1.40–5.40) *
Health magazine reading			
No	35.2	1.00	1.00
Yes	42.1	1.34 (0.52–3.44)	0.87 (0.31–2.49)
Family history of diabetes			
No	30.1	1.00	1.00

<i>Variables</i>	<i>Good level of diabetic health literacy (%)</i>	<i>Unadjusted odds ratio (95% CI)</i>	<i>Adjusted odds ratio (95% CI)</i>
Yes	40.8	1.60 (0.97–2.63)	1.46 (0.82–2.61)
Diabetes monitoring interval			
Others [§]	30.3	1.00	1.00
Every 2 months	41.5	1.63 (0.99–2.67)	1.32 (0.75–2.33)
Glucose monitoring facility at home			
No	27.6	1.00	1.00
Yes	49.1	2.53 (1.53–4.19) *	1.76 (0.99–3.12)

* $p < 0.01$,

† $p < 0.05$;

‡ other marital status categories include never married, widowed, and separated/divorced;

§ other diabetes monitoring interval includes never monitoring, once in 1 year or once 1 month

Table 3
Factors associated with perfect adherence to the diabetes medication: results of binary logistic regression analysis results

<i>Variables</i>	<i>Perfect adherence (%)</i>	<i>Unadjusted odds ratio (95% CI)</i>	<i>Adjusted odds ratio (95% CI)</i>
Age			
>60 years	38.7	1.00	1.00
60 years	26.9	0.584 (0.352–0.971) [†]	0.725 (0.375–1.405)
Sex			
Male	27.1	1.00	1.00
Female	37.7	1.623 (0.969–2.718)	1.053 (0.506–2.191)
Religion			
Christian	25.0	1.00	1.00
Hindu	37.0	1.761 (0.910–3.411)	1.637 (0.812–3.298)
Muslim	29.8	1.273 (0.541–2.995)	1.065 (0.423–2.685)
Marital status			
Others [‡]	44.1	1.00	1.00
Currently Married	30.3	0.552 (0.307–0.995) [†]	0.590 (0.269–1.295)
Years of schooling			
<10 years	36.4	1.00	1.00
10 years	31.2	0.793 (0.478–1.315)	0.756 (0.374–1.527)
Occupation			
Employed	22.0	1.00	1.00
Unemployed	39.4	2.309 (1.320–4.042) [*]	1.978 (0.950–4.119)
Monthly household expenditure (Indian rupee)			
5,000	30.1	1.00	1.00
>5,000	36.6	1.336 (0.812–2.200)	1.442 (0.797–2.608)
Household members			
Five or more members	39.1	1.00	1.00
One to four members	30.3	0.677 (0.402–1.140)	0.761 (0.421–1.373)
Internet usage			
No	34.2	1.00	1.00
Yes	31.0	0.863 (0.499–1.494)	1.050 (0.503–2.192)
Regular newspaper reading			
No	32.1	1.00	1.00
Yes	33.9	1.085 (0.651–1.810)	1.157 (0.607–2.205)
Health magazine reading			
No	31.8	1.00	1.00
Yes	52.6	2.383 (0.933–6.085)	2.764 (1.005–7.602) [†]
Family history of diabetes			
No	33.1	1.00	1.00
Yes	33.3	1.011 (0.615–1.664)	1.330 (0.768–2.305)

<i>Variables</i>	<i>Perfect adherence (%)</i>	<i>Unadjusted odds ratio (95% CI)</i>	<i>Adjusted odds ratio (95% CI)</i>
Diabetes monitoring interval			
Others [§]	29.0	1.00	1.00
Every 2 months	37.8	1.489 (0.903–2.454)	1.556 (0.900–2.693)
Glucose monitoring facility at home			
No	30.5	1.00	1.00
Yes	37.7	1.384 (0.832–2.300)	1.391 (0.789–2.455)
Diabetes health literacy level			
Poor	34.4	1.00	1.00
Good	31.0	0.855 (0.507–1.443)	0.756 (0.408–1.400)

* $p < 0.01$;

[†] $p < 0.05$;

[‡] other marital status categories include never married, widowed, and separated/divorced;

[§] other diabetes monitoring interval includes never monitoring, once in 1 year or once in 6 months