Original Research

Open Access

Belitung Nursing Journal
Volume 9(5), 489-497

https://doi.org/10.33546/bnj.2753

Social determinants of health and glycemic control in persons with type 2 diabetes mellitus attending a tertiary hospital in Nepal: A cross-sectional study

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Abstract

Background: Diabetes mellitus (DM) is an emerging global public health challenge worldwide, including Nepal. Social determinants of health (SDOH) play a major role in glycemic control among persons with type 2 DM (T2DM). However, little is known about the association between SDOH and glycemic control among individuals with T2DM in Nepal.

Objective: This study aimed to identify the level of glycemic control and SDOH associated with glycemic control among Nepalese with T2DM.

Methods: This cross-sectional study was conducted at a tertiary hospital in Kathmandu, Nepal, among 135 Nepalese diagnosed with T2DM who attended follow-up appointments. Convenience sampling and inclusion criteria were utilized for participant selection. Data were collected from April to June 2021 using validated scales. Descriptive statistics, Chi-square test, and binary logistic regression were employed to analyze the data.

Results: The mean age of the participants in this study was 53.84 (SD = 11.78) years, and the average monthly household income was 567.64 (SD = 362.30) USD. The majority of the participants (77.8%) were literate and had no health insurance coverage (73.3%). Approximately 64.4% of the participants showed suboptimal glycemic control indicated by glycated hemoglobin (HbA1c) ≥7%. The significant determinants of good glycemic control included monthly household income of >850 USD (odds ratio [OR] = 12.20, 95% confident interval [CI] = 1.76–84.61, p = 0.011) and 341–600 USD (OR = 7.64, 95% CI 1.35–42.98, p = 0.021), being literate (OR = 6.37, 95% CI = 1.65–24.49, p = 0.007), having health insurance (OR = 5.82, 95% CI = 1.49–22.65, p = 0.011), sufficient health literacy (OR = 3.46, 95% CI = 1.10–10.83, p = 0.03), and high (OR = 16.17, 95% CI = 2.36–110.67, p = 0.005) and moderate (OR = 7.02, 95% CI = 1.26–39.07, p = 0.026) food availability, respectively.

Conclusion: The study revealed suboptimal glycemic control in Nepalese with T2DM. This study presents essential social determinants of glycemic control in this population. Therefore, healthcare providers, particularly nurses, should pay more attention to assessing social determinants and provide targeted interventions to patients with T2DM who have low income, are illiterate, have no health insurance coverage, have insufficient health literacy, and have low resources for food availability.

Keywords

glycemic control; Nepal; social determinants of health; type 2 diabetes mellitus

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Article info:
Received: 6 June 2023
Revised: 3 July 2023
Accepted: 5 September 2023

E-ISSN: 2477-4073 | P-ISSN: 2528-181X

Background

Diabetes mellitus (DM) is a medical condition caused by impaired insulin secretion, action, or both and is clinically manifested by hyperglycemia (American Diabetes Association, 2014). Persistent hyperglycemia in patients with DM results in longstanding damage, dysfunction, or even failure of vital organs (Barrett et al., 2017). Globally, 451 million individuals are diagnosed with T2DM, which is anticipated to increase to approximately 693 million by 2045 (Cho et al., 2018). Therefore, DM poses a significant risk to healthful living and remains a major cause of morbidity, mortality, and health-system costs worldwide.

The clinical effect of T2DM is devastating and rapidly increasing in developing countries. Nepal is one of the developing countries with low socioeconomic status, and T2DM poses a significant challenge to its healthcare system. Compared to neighboring nations such as India, Sri Lanka, and Pakistan, Nepal exhibits a greater incidence of T2DM (Gyawali et al., 2015). Furthermore, >50% of T2DM in Nepal remains undetected (Gyawali et al., 2016), contributing to the current DM management problem in the country.

Glycemic control is considered the most essential factor in preventing DM-associated complications. The clinical management of T2DM typically involves therapeutic control by insulin injection or oral anti-diabetic drugs. Besides therapeutic

approaches, dietary adjustment, lifestyle modifications, and self-monitoring of blood glucose (SMBG) also contribute to DM management (American Diabetes Association, 2016). However, numerous global studies conducted among patients with T2DM, including Nepal, have revealed poor glycemic control even with these therapies and management (Borgharkar & Das, 2019; Pokhrel et al., 2019). Recent evidence suggests that social determinants of health (SDOH), the non-medical determinants, profoundly influence health disparities and glycemic control (World Health Organization, 2021). SDOH includes physical and social situations such as income, educational attainment, employment security, and living conditions that affect well-being at the individual and population levels. The current study applied the Healthy People 2020 social determinants of health framework as a conceptual framework of the study (Office of Disease Prevention and Health Promotion, n.d.). This framework is divided into five key domains of social determinants, namely, (i) economic stability, (ii) education, (iii) health and healthcare, (iv) neighborhood and built environment, and (v) social and community context. The differences in socioeconomic conditions, culture, environment, and healthcare system can influence health outcomes, including glycemic control in DM.

Patients with T2DM with low socioeconomic status and resource constraints may encounter difficulties understanding disease information and treatment recommendations. They may face challenges in assessing healthcare services, medications, healthy food, recreational facilities, and exercise options. These can lead to non-adherence to treatment plans and poor DM management, resulting in poor DM outcomes. Prior studies from different countries have supported the role of economic stability (Rutte et al., 2017), education (Chrvala et al., 2016), health insurance (Liese et al., 2019), health literacy (Marciano et al., 2019), frequency of health care visits (Zhang et al., 2012), and neighborhood and built environment (Gariepy et al., 2013) in glycemic control of T2DM. Therefore, addressing and understanding SDOH leading to better glycemic control has been crucial for improving nursing and healthcare in people with T2DM. Nurses play a critical role in assessing and integrating the SDOH to deliver care and improve health and DM outcomes.

However, knowledge about the SDOH associated with glycemic control in Nepal is limited. Previous studies conducted in Nepalese with T2DM explored demographics (e.g., age, gender, income, education), lifestyle-related factors (e.g., self-care adherence, medication adherence), and clinical factors (e.g., disease duration, cardiovascular factors) associated with glycemic control (Khanal et al., 2022; Pokhrel et al., 2019; Shrestha et al., 2019). To our knowledge, no study explored the association between social determinants and glycemic control among Nepalese with T2DM. Nepal is a resource-constrained country known for its multiethnic and multicultural nation. Living conditions in Nepal, such as housing quality, sanitation and hygiene, education, and access to healthcare, are mainly responsible for the health outcomes of Nepalese citizens (Dahal et al., 2015). Findings of previous studies from other countries with different infrastructure, economic, social, cultural, and healthcare systems may not apply to Nepalese with T2DM. Therefore, more studies are needed to examine the social determinants of good glycemic control in Nepalese with T2DM. Informed by the SDOH from Healthy People 2020, this study aimed to identify the level of glycemic control and SDOH, including household income, level of education, health literacy, frequency of healthcare visits, health insurance, neighborhood resources, and family support associated with glycemic control among Nepalese individuals with T2DM.

Methods

Study Design

A cross-sectional, correlational study using a hospital-based approach recruited patients with T2DM who attended follow-up visits at the medicine and endocrinology outpatient department (OPD) clinics of a tertiary hospital in Kathmandu, Nepal.

Samples/Participants

Based on the selection criteria, the participants were selected using the convenience sampling approach. Participants aged ≥18 years with a confirmed diagnosis of T2DM for a minimum of 1 year, well-oriented to time, place, and person, can communicate in Nepali, and had HbA1c test reports available within the past six months were eligible for this study. Participants who had a documented history of psychiatric disorders such as dementia, schizophrenia, and bipolar disorder, pregnant women, individuals taking medications known to affect glycemic control such as antidepressants, corticosteroids, and beta-blockers, and individuals aged >60 years old, who were recognized to have cognitive impairments with a score <9 in the General Practitioner Assessment of Cognition (GPCOG) were excluded. G-power software 3.1.9.2 (Faul et al., 2009) was utilized to calculate the sample size. The maximum sample estimate calculation was based on a previous study by Saeed et al. (2018). The sample size was determined using logistic regression with two tails, probability H1 = 0.26 and probability H0 = 0.0073, X pam 0.15, α = 0.05, power = 0.90, and R2 other X: 0, X distribution is a binomial distribution calculated according to the result of a previous study. By using these specifications, the sample size was estimated as 135 participants.

Instruments

Data were collected using a personal information form, Diabetes Family Behavior Checklist- II (DFBC-II), Europe-Asia-Health Literacy Survey Questionnaire (HLS-EU–ASIA-Q), Neighborhood Scale, and GPCOG. Permission was granted to use all scales in this study.

The researchers developed a personal information form to collect demographic and clinical characteristics. The participants provided the demographic characteristics, and clinical characteristics were collected from the participants' medical records by the principal investigator (PI).

The DFBC-II was developed by Glasgow and Toobert (1988) and was used to measure family support in this study. The DFBC-II originally consisted of 17 items with nine positive or supportive items, seven negative or non-supportive items, and one open-ended item. The nine supportive items for assessing perceived emotional and informational support were used to examine participants' family support. These supportive items were also used in Thai women with T2DM, and a Cronbach's alpha of 0.79 was found (Siripitayakunkit et

al., 2008). The nine supportive items were rated on a 5-point Likert scale varying from 1 (never) to 5 (at least once daily). Possible scores range from 9 to 45. A total score of 9-21 was considered low, 22-35 moderate, and 36-45 high family support. In this study, the Cronbach's alpha coefficient of the DFBC-II scale was 0.915.

In this study, the HLS-EU–ASIA-Q Nepali version by Shrestha et al. (2018) was used to assess health literacy. This validated scale is already used in Nepalese patients with chronic diseases, including T2DM. Translation into the local Nepali language and linguistic validity test were performed using the back translation method (Shrestha et al., 2018). This 16-item scale is a short form of the HLS-EU–Q47 designed to measure the ability of individuals to access, understand, appraise, and apply health information to make decisions about their health (Pelikan et al., 2014). Response options ranged from 1 (very difficult) to 4 (very easy). The score was transformed into an index ranging from 0 to 50 (Sørensen et al., 2015). The indices were interpreted into four levels to represent the following levels of health literacy: inadequate (0-25), problematic (26-33), sufficient (34-42), and excellent (43-50). In the present study, it was further categorized into insufficient (inadequate and problematic; 0-33) and sufficient (sufficient and excellent; 34-50) health literacy. In this study, the Cronbach's alpha coefficient of HLS-EU–ASIA-Q was 0.917.

The Neighborhood Scale with two subscales (suitability of the environment for physical activity and availability of healthy foods subscales) was used to measure the neighborhood resources. This scale was developed by Echeverria et al. (2004) to measure neighborhood characteristics in six subscales. Later, Auchincloss et al. (2009) used the two-subscale form to measure neighborhood resources in persons with T2DM. With a total of nine items, the environment for physical activity subscale included six items, and the availability of healthy foods subscale had three items. This is a 5-point Likert scale varying from 1 (strongly disagree) to 5 (strongly agree). Possible scores for the environment for physical activity subscale ranged from 6 to 30. The score could be summarized as low (6–14), moderate (15–23), and high (24–30) suitability of the environment for physical activity. In the availability of healthy foods subscale, possible scores ranged from 5 to 15. The score could be interpreted as low (3–7), moderate (8–11), and high (12–15) availability of healthy foods. In this study, the Cronbach's alpha coefficient of the 9-item Neighborhood Scale was 0.936.

To use the DFBC-II and Neighborhood Scale with two subscales in Nepalese with T2DM, the scales were translated into Nepali by bilingual experts in English and Nepali using the back-translation method (Brislin, 1970). This was initiated with a forward translation of the original English version of both scales into Nepali language by a highly experienced lecturer in Nepali language. Next, back translation to the English version was done by a PhD graduate from the United States who has been living there for more than ten years. The meaning equivalence of the original language and backward translated versions were evaluated, and discrepancies were discussed. The translation process was repeated until the maximum equivalence between the two versions was reached.

Data Collection

The PI collected data from April to June 2021. Initially, intern doctors screened patients with T2DM attending the medicine and endocrinology OPD clinics to identify patients who met the inclusion criteria. Once permission was obtained, the PI informed potential participants with detailed information regarding the research objectives, protocol, potential benefits, associated risks, privacy considerations, and confidentiality measures. In addition, to identify any exclusion criteria, the PI sought permission from potential participants to assess their medical records. Participants aged >60 years were evaluated for cognitive impairment using the GPCOG scale. Subsequently, the participants were requested to answer the questionnaires. They had the right to withdraw from the study until data collection was completed. Data collection took approximately 20-25 min for each participant. After the participants completed all sets of questionnaires, clinical data were collected from their medical records with their consent. The data collection procedures mentioned above were repeated until the researchers obtained the required sample size of 135 participants.

Data Analysis

Data analysis was performed using Statistical Package for the Social Science version 18.0, licensed by Mahidol University**.** A significance level of *p*-value of <0.05 was used to determine statistical significance. Participant characteristics were described using descriptive statistics. Categorical data were generated using frequencies and percentages. The mean, percentage, standard deviation (SD), and range were used to analyze continuous data. The Chi-square test assessed the association between each determinant and glycemic control. Binary logistic regression was applied to examine the association of the SDOH with good glycemic control. HbA1c level of <7% was considered controlled, whereas ≥7% was considered uncontrolled (American Diabetes Association, 2020).

Ethical Consideration

Ethical committee approval was obtained from the Faculty of Nursing, Mahidol University (COA No.IRB-NS2021/601.1502). Before data collection, the PI provided the participants with detailed information about the study. They voluntarily signed the informed consent form after their questions and concerns were addressed, indicating their willingness to participate.

Results

Participants' Demographic and Clinical Characteristics

The total number of participants enrolled (*N*) was 135. The age of the participants ranged from 25 to 81 years, with a mean age of 53.84 ± 11.78 years. Most participants were middle-aged adults (40-60 years), accounting for 63.7% of the sample. The proportion of male participants was slightly greater than that of female participants (54.8% vs. 45.2% respectively). The mean monthly household income was 567.64 ± 362.30 USD, calculated using an exchange rate of 117 NPR for USD. Approximately one-third (30.4%) of participants had received education only up to the primary school level, whereas 22.2% were illiterate. There were more participants from rural (63%) than urban areas (37%). The vast

majority of participants (94.0%) were married, and the majority (66.7%) lived in extended or joint family setups. A significant proportion (73.3%) had no health insurance coverage to support their healthcare expenses. The demographic characteristics of the participants are shown in **Table 1**.

Table 1 Demographic characteristics of participants (*N* = 135)

Demographic Characteristics	*n*	%
Age (Years)		
21-39 (Young adult)	13	9.6
40-60 (Middle-aged adult)	86	63.7
>60 (Older adult)	36	26.7
(Mean ± SD: 53.84 ± 11.78; Range: 25-81)		
Gender		
Male	74	54.8
Female	61	45.2
Monthly Household Income (USD)		
85-340	52	38.5
341-600	40	29.6
601-850	27	20.0
>850	16	11.9
(Mean ± SD: 567.64 ± 362.30; Range: 85-1710)		
Level of Education		
Illiterate	30	22.2
Primary school	41	30.4
Secondary school	34	25.2
High school	12	8.9
Diploma/certificate	3	2.2
Bachelors	12	8.9
Postgraduate	3	2.2
Residence		
Rural[1]	85	63.0
Urban[2]	50	37.0
Marital Status		
Married	127	94.0
Unmarried	4	3.0
Widow/Widower/Divorced/ Separated	4	3.0
Family Type		
Nuclear	45	33.3
Extended/Joint	90	66.7
Occupation		
Government service	29	21.5
Business	46	34.1
Labor	14	10.4
Housewife	37	27.4
Farmer	8	5.9
Others (Teacher)	1	0.7
Health Insurance Coverage		
Yes	36	26.7
No	99	73.3

Note: [1]Rural: Villages and towns other than metropolitan cities; [2]Urban: Metropolitan cities

The glycemic control of the participants was assessed based on their most recent HbA1c test results, reported within the last three months. The mean HbA1c was 8.34 ± 2.18, ranging from 5.6 to 14.1. As **Table 2**, only 35.6% of the 135 participants achieved good glycemic control (HbA1c level <7%). Hypertension was found in 69.6% of the participants; 10.4% had dyslipidemia, and 20% had a history of other comorbidities. The mean DM duration was 6.07 ± 5.03 years. The majority of the participants (68.9%) had been living with DM for 1–5 years, whereas only 4.4% had DM for >20 years. Most participants (74.8%) had a family history of DM. Regarding anti-diabetic treatment, most of the participants (71.8%) were taking oral anti-diabetic medications, some (17.8%) were using insulin, and only a minority (10.4%) were being treated with both oral drugs and insulin.

Nearly half of the participants (48.9%) reported measuring their blood glucose levels at home when necessary or when suspicious of symptoms, with very few (0.7%) measuring more than once a month. Many participants had complications of micro (53.4%) or macrovascular (48.1%). Among those experiencing complications, the majority had retinopathy (36.3%) as a microvascular complication and ischemic heart disease (30.4%) as a macrovascular complication. The participants had regular visits for the management of their DM.

Table 2 Clinical characteristics of participants (*N* = 135)

Clinical Characteristics	*n*	%
Glycemic Control (HbA1c)		
Controlled (HbA1c <7%)	48	35.6
Uncontrolled (HbA1c ≥7%)	87	64.4
(Mean ± SD: 8.34 ± 2.18**:** Range: 5.6-14.1)		
Comorbidities		
Hypertension	94	69.6
Dyslipidemia	14	10.4
Others (Chronic lung or liver disease)	27	20.0
Duration of DM (Years)		
1-5	93	68.9
6-10	24	17.8
11-20	12	8.9
>20	6	4.4
(Mean ± SD: 6.07 ± 5.03; Range: 1-28)		
Family History of DM		
Yes	101	74.8
No	23	17.1
Unknown	11	8.1
Anti-Diabetic Medication		
Oral anti-diabetic	97	71.8
Insulin	24	17.8
Both oral and insulin	14	10.4
Self-Monitoring of Blood Glucose at Home		
Never/Don't have a device	58	43.0
When necessary/Suspicious of symptoms	66	48.9
Once every 2-3 months	3	2.2
At least once every month	2	1.5
More than once a month	1	0.7
At least once a week	5	3.7
Micro-Vascular Complications		
Retinopathy	49	36.3
Neuropathy	9	6.7
Nephropathy	14	10.4
None	63	46.6
Macro-Vascular Complications		
Ischemic heart disease	41	30.4
Cerebrovascular disease	4	3.0
Peripheral artery disease	20	14.7
None	70	51.9
Healthcare Visit (time/year)		
1-4	30	22.2
5-8	54	40.0
9-12	51	37.8
(Mean ± SD: 6.17 ± 2.88, Range: 2-12)		

Association between the Study Variables and Glycemic Control

This study used the Chi-square test to examine the association between household income, education level, health literacy, frequency of healthcare visits, health insurance, neighborhood resources, and family support with glycemic control (**Table 3**). The results indicated that household income (χ^2 = 14.99, *p* =

0.002), education level (χ^2 = 4.07, p = 0.044), health literacy (χ^2 = 8.88, p = 0.003), suitability of the environment for physical activity (χ^2 = 10.21, p = 0.006), availability of healthy foods (χ^2 = 23.12, p <0.001), and family support (χ^2 = 15.29, p <0.001) were significantly associated with glycemic control. Only two variables, namely, frequency of healthcare visits (χ^2 = 2.38, p = 0.303) and health insurance (χ^2 = 2.38, p = 0.122), were not significantly associated with glycemic control in Nepalese with T2DM.

Table 3 Association between the study variables and glycemic control

SDOH	All	Controlled DM (HbA1c <7) (n = 48)	Uncontrolled DM (HbA1c ≥7) (n = 87)	χ^2	p-value
	N (%)	*n* (%)	*n* (%)		
Household Income (USD)				14.99	0.002
85-340	52 (38.5)	14 (26.9)	38 (73.1)		
341-600	40 (29.6)	16 (40.0)	24 (60.0)		
601-850	27 (20.0)	6 (22.2)	21 (77.8)		
>850	16 (11.9)	12 (75.0)	4 (25.0)		
Level of Education				4.07	0.044
Illiterate	30 (22.2)	6 (20.0)	24 (80.0)		
Literate	105 (77.8)	42 (40.0)	63 (60.0)		
Health Insurance				2.38	0.122
Yes	36 (26.7)	9 (25.0)	27 (75.0)		
No	99 (73.3)	39 (39.4)	60 (60.6)		
Health Literacy				8.88	0.003
Insufficient	87 (64.4)	23 (26.4)	64 (73.6)		
Sufficient	48 (35.6)	25 (52.1)	23 (47.9)		
Healthcare Visits (time/year)				2.38	0.303
1-4	30 (22.2)	12 (40.0)	18 (60.0)		
5-8	54 (40.0)	15 (27.8)	39 (72.2)		
9-12	51 (37.8)	21 (41.2)	30 (58.8)		
Neighborhood Resources					
Suitability for physical activity				10.21	0.006
High	50 (37.0)	12 (24.0)	38 (76.0)		
Moderate	43 (31.9)	13 (30.2)	30 (69.8)		
Low	42 (31.1)	23 (54.7)	19 (45.3)		
Food availability				23.12	<0.001
High	61 (45.2)	13 (21.3)	48 (78.7)		
Moderate	37 (27.4)	10 (27.1)	27 (72.9)		
Low	37 (27.4)	25 (67.6)	12 (32.4)		
Family Support				15.29	<0.001
High	68 (50.4)	34 (50.0)	34 (50.0)		
Moderate	30 (22.2)	3 (10.0)	27 (90.0)		
Low	37 (27.4)	11 (29.7)	26 (70.3)		

SDOH Associated with Glycemic Control

Binary logistic regression analysis indicated that the significant determinants of good glycemic control were having household income >850 USD per month (OR = 12.20, 95% CI 1.76–84.61, p = 0.011), 341–600 USD (OR = 7.64, 95% CI = 1.35–42.98, p = 0.021), being literate (OR = 6.37, 95% CI = 1.65–24.49, p = 0.007), having health insurance (OR = 5.82, 95% CI =1.49–22.65, p = 0.011), sufficient health literacy (OR= 3.46, 95% CI = 1.10–10.83, p = 0.03), and high (OR = 16.17, 95% CI = 2.36–110.67, p = 0.005) and moderate (OR = 7.02, 95% CI = 1.26–39.07, p = 0.026) food availability respectively. Details are shown in **Table 4**.

Discussion

The study findings provide valuable insight into the glycemic control status among Nepalese individuals with T2DM. Overall, the controlled HbA1c observed in this study was suboptimal, aligning with previous studies in Nepal (Pokhrel et al., 2019) and China (Chen et al., 2015). However, this controlled DM rate (35.6%) was relatively better than those of the studies conducted in China (Dong et al., 2019) and India (Borgharkar & Das, 2019), which reported controlled DM prevalence of 19.5% and 23.4%, respectively. The discrepancies in patient recruitment, study setting, and method of glycemic control measurement might have contributed to the varying HbA1c levels among studies. In the present study, poor glycemic control might be related to several causes. First, the majority of the participants were middle-aged (63.7%) and young (9.6%) adults, in whom achieving glycemic targets are challenging (Mohebi et al., 2018).

Furthermore, the majority of the participants had comorbidities such as hypertension and/or dyslipidemia, which are associated with poor glycemic control (Al-Amin et al., 2021). Thus, the presence of these comorbidities may complicate DM management and contribute to poorer glycemic control outcomes. In addition, the majority of the participants were from rural Nepal. This may have led to difficulties in comprehending and implementing glycemic control strategies, resulting in poor adherence to treatment regimens. Moreover, regular SMBG is not wisely used in Nepal. Most participants had never or rarely monitored their blood glucose levels at home. This may hinder controlling their

DM. Our finding suggests that DM education should emphasize the importance of SMBG, and nurses should find effective strategies to increase SMBG in Nepalese with T2DM.

The findings illustrate that the availability of healthy foods in the neighborhood was the strongest contributor to good glycemic control in T2DM. This result corresponds with those of previous studies conducted on the diabetic population (Berkowitz et al., 2018; Sadiya & Mnla, 2019). In the present study, the majority of the participants resided in rural areas with better access to healthy foods. This finding might benefit future studies assessing glycemic control in persons with DM living in rural communities. Household income was the second strongest determinant associated with glycemic control, which aligns with the findings of a study conducted in China (Zhang et al., 2013). The cost of DM treatment and follow-ups can burden patients financially, leading to poor adherence to treatment plans. The education level was another factor significantly associated with glycemic control. This result is consistent with the findings of an earlier study (Al-Rasheedi, 2014). Literate individuals have better access to health information and are more capable of understanding disease management strategies.

Table 4 Binary logistic regression analysis of the study variables and glycemic control

Variables	B	SE	Wald	95% CI	OR	*p*-value
Household income (USD)						
85-340	Ref	-	7.29	-	-	0.063
341-600	2.03	0.88	5.32	1.35-42.98	7.64	0.021
601-850	1.51	0.88	2.93	0.80-25.58	4.53	0.087
>850	2.50	0.98	6.41	1.76-84.61	12.20	0.011
Level of Education						
Illiterate	Ref	-	-	-	-	-
Literate	1.85	0.68	7.27	1.65-24.49	6.37	0.007
Health Insurance						
No	Ref	-	-	-	-	-
Yes	1.76	0.69	6.46	1.49-22.65	5.82	0.011
Health Literacy						
Insufficient	Ref	-		-	-	
Sufficient	1.24	0.58	4.57	1.10 - 10.83	3.46	0.03
Healthcare Visit (time/year)						
1-4	Ref	-	2.99	-	-	0.223
5-8	0.35	0.65	0.29	0.39-5.21	1.43	0.586
9-12	1.05	0.60	2.98	0.86-9.43	2.86	0.084
Neighborhood Resources						
Suitability for physical activity						
Low	Ref	-	1.15	-	-	0.562
Moderate	-0.52	0.95	0.29	0.91-3.88	0.59	0.587
High	-0.88	0.85	1.08	0.77-2.19	0.41	0.298
Food availability						
Low	Ref	-	8.12	-	-	0.46
Moderate	1.94	0.87	4.95	1.26-39.07	7.02	0.026
High	2.78	0.98	8.05	2.36-110.67	16.17	0.005
Family Support						
Low	Ref	-	6.86	-	-	0.03
Moderate	-0.95	0.59	2.58	0.12-1.23	0.38	0.10
High	1.00	0.87	1.31	0.49 -15.36	2.74	0.25

Note: Hosmer-Lemeshow test; χ^2 =0.955, df= 8, *p*-value= 0.999, Cox & Snell R^2 = 0.38, Nagelkerke R^2= 0.52, Overall percentage of predictive correct = 80.7%

Moreover, coverage of health insurance was related to glycemic control. Patients with health insurance coverage are more likely to afford the necessary treatments, leading to improved DM outcomes. Although the government of Nepal initiated a health insurance program in 2016, enrollment rates have remained relatively low (Acharya et al., 2019). Finally, sufficient health literacy was strongly correlated with glycemic control. This finding is congruent with the results of previous studies (Olesen et al., 2017; Tefera et al., 2020). Effective DM management requires abilities to comprehend DM recommendations such as medications, diet modification, and physical activity and makes appropriate decisions to manage health and prevent complications (Gomes et al., 2020). They also require proficiency in using medical devices such as glucometers and insulin injections.

By contrast, the frequency of healthcare visits was not significantly associated with glycemic control. This result is consistent with the findings of an earlier study (Herndon et al., 2020). However, our findings did not agree with the research conducted in the USA (Zhang et al., 2012). Poor glycemic control among the participants is one of the reasons for the high frequency of healthcare visits in the present study. If any patient with DM had uncontrolled blood glucose levels during follow-up, the doctors scheduled more frequent visits for close monitoring.

Moreover, family support did not show a significant association with glycemic control, which is congruent with the finding of a previous study (AlHaidar et al., 2020). Most participants were living with extended families and married, and most received moderate to high family support; however, the association was not strong enough to consider it a significant determinant of good glycemic control. Similarly, the suitability of the neighborhood environment for physical activity was not associated with good glycemic control. Studies have found that physical activity is positively correlated with glycemic control in T2DM (Alhariri et al., 2017; Bohn et al.,

2015; Pai et al., 2016). However, the suitability of the environment may not directly contribute to performing physical activity. Other factors not examined in this study, such as motivation, role and responsibility, partner accompanying during exercise, social acceptability, and physical conditions may affect physical activity performance and lead to good glycemic control. This may result in the lack of significance of this determinant in this study.

Limitations of the Study

There were several limitations of this study. As this was a cross-sectional study and convenience sampling was employed, cause-and-effect relationships could not be established among the study variables. In addition, this study was conducted in a tertiary hospital in Kathmandu, Nepal, limiting the generalizability of the findings to only Nepalese who have characteristics similar to those of the participants. Finally, other SDOH factors affecting glycemic control, such as occupation, violence, social discrimination, housing quality, and cultural beliefs and practices, were not evaluated. Accordingly, longitudinal studies should be conducted to explore cause-and-effect relationships. Thus, more studies conducted in other settings with different levels of care are needed to increase generalizability. Future studies should include some determinants not examined in this study.

Implications for Nursing Practice

This study provides evidence that optimal glycemic control remains challenging in Nepal. The findings also highlight the effect of the SDOH on achieving glycemic control. To optimize glycemic control, nurses should deliver more holistic care by assessing social determinants of glycemic control and integrating them into nursing care. SDOH assessment involves asking questions about patients' neighborhood resources, availability of healthy foods, financial constraints, healthcare access, and health literacy levels. This can help nurses develop targeted strategies that address specific barriers that patients face. Our findings suggest that nurses should work collaboratively with other professionals, such as social workers, community health workers, and community organizations, to address SDOH and enhance the support and resources available, leading to better glycemic control. Furthermore, nurses should pay special attention to patients with low education levels, insufficient health literacy, and low income and provide understandable and accessible education to ensure they understand the provided DM information. In addition, health education regarding the importance of self-monitoring practices, including regular home blood glucose monitoring and health coverage by government programs or other agencies, should be emphasized.

Conclusion

In this study, the majority of the study participants had poor glycemic control. The results highlighted the influence of various social determinants on glycemic control in patients with T2DM. In addition, social determinants, including the availability of healthy foods, household income, education level, health insurance, and health literacy, could contribute to the disruption of glycemic control in Nepalese with T2DM. Therefore, healthcare providers, particularly nurses, should pay closer attention and provide efficient interventions to support this population.

Declaration of Conflicting Interest

The authors have no conflict of interest to disclose.

Funding

None.

Acknowledgment

The authors acknowledged the support of the Faculty of Nursing, Mahidol University, Thailand.

Authors' Contributions

PA initiated the study, coordinated data collection, performed statistical analysis, and prepared the manuscript. AS contributed to the design of the study. AS and WP reviewed the data and contributed to the manuscript revision. All authors were accountable for the study processes and approved the final version of the manuscript.

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Data Availability

The data presented in this study are available from the corresponding author upon reasonable request.

Declaration of Use of AI in Scientific Writing

Nothing to declare.

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Cite this article as: Adhikari, P., Sriyuktasuth, A., & Phligbua, W. (2023). Social determinants of health and glycemic control in persons with type 2 diabetes mellitus attending a tertiary hospital in Nepal: A cross-sectional study. *Belitung Nursing Journal, 9*(5), 489-497. https://doi.org/10.335 46/bnj.2753