ORIGINAL ARTICLE

A Cross-Sectional Study on Knowledge about Diabetic Complications among General Public in Penang State, Malaysia

Sireesha Paruchuri[1*], Reeshitharan Vengaathasamy[2], Saraswathi Simansalam[1] and Ganesh Pandian Balasubramanian[1]

[1]*Unit of Clinical Pharmacy & Pharmacy Practice, Faculty of Pharmacy, AIMST University, Bedong, Malaysia*
[2]*Faculty of Pharmacy, AIMST University, Bedong, Malaysia*

Abstract

Background: The prevalence of diabetes has significantly increased over the past three decades, leading to higher morbidity and mortality primarily due to complications.

Aim: This study aimed to assess public knowledge of diabetic complications and examine their association with socio-demographic factors.

Methodology: A cross-sectional study was conducted in Penang, Malaysia, from January to May 2023. Data was collected through a structured questionnaire from 169 participants. Descriptive statistics and logistic regression were used to analyse the data.

Results: Findings show that most participants (43.2%) were aged 40-65 years, followed by 39.6% aged 21-39 years. Gender distribution was nearly equal, with 50.9% females. Participants demonstrated moderate knowledge, 70.01% according to Bloom's cutoff, about diabetic complications. The most common diabetic complications were leg amputation (94.8%), eye problems (92.9%), poor wound healing (92.3%), diabetic foot ulcers (91.7%), and muscle weakness (91.1%). Hypoglycemia (28.4%) and sexual dysfunction (26.6%) were the least recognized. Family or friends (95.86%) and media (television/social media) (81.07%) were the primary sources of information. Ordinal logistic regression indicated a significant relationship between educational status and overall knowledge of diabetic complications (p=0.037), suggesting that higher education leads to better awareness.

Conclusion: The Majority of participants had moderate knowledge about diabetic complications, and educational status was a significant factor influencing this knowledge. The study emphasizes the need for targeted interventions to improve public awareness, particularly through educational efforts that build on the existing sources of information, like family and media.

Keywords: *Diabetes mellitus, complications, knowledge, prevention, Malaysia.*

INTRODUCTION

In this contemporary age, the prevalence of diabetes mellitus has exponentially risen with a resultant increase in morbidity and mortality, mainly due to its complications.

Diabetes is a metabolic disorder and a serious chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use it [1].

It can be referred to as a silent disease, and it is identified as one of the fastest-growing threats to public health all around the world. Statistical reports indicated that only 30 million people had Diabetes Mellitus (DM) in 1985, which increased to 285 million by 2010 and is projected to increase to 439 million by 2030 [2]. The mortality and morbidity rate of diabetic patients is higher compared to non-diabetic patients, as this condition is associated with the complications of diabetes mellitus. The global prevalence of diabetes was estimated to be 9.3% in 2019, and it is expected to surge to 10% by 2030 and 10.9% by 2045, respectively [3]. Underlying chronic diseases like diabetes and age-related physiological changes drive functional disability [4], which further correlates with poor quality of life, depression, hospitalization, and so on [5]. The estimated number will undoubtedly be achieved without the establishment of effective treatment. The prevalence is more serious in lower-middle-income countries such as India, with about 100 million people living with diabetes. Among the Western Pacific region, Malaysia has become one of the leading countries with the highest rate of diabetes, with the prevalence determined to steep from 11.2% in 2011 to 18.3% in 2019, with a 68.3% increase [3]. National survey report 2019 mentioned 3.6 million adults (18 and above years) had diabetes, 49% (3.7 million) cases were undiagnosed. The increasing trend is significantly associated with a variety of causes, including population expansion, population aging, urbanization, and rising rates of obesity and physical inactivity. Moreover, these complications, which occur over time with improper treatment of diabetes, have become one of the major health issues in all four corners of the world. These complications can be categorized into two: acute and chronic [6, 7]. Therefore, proper consideration should be given to reducing and preventing this issue. Lack of awareness among the public is the major contributor to the development of these complications. Yet, a limited number of studies have been conducted regarding these issues, indicating that the matter has been considered

**Corresponding author: Sireesha Paruchuri, Department of Clinical Pharmacy & Pharmacy Practice, Faculty of Pharmacy, AIMST University, Bedong - 08100, Malaysia, E-mail: siree.paruchuri@gmail.com*
Received: January 27, 2025; Revised: June 14, 2025; Accepted: July 24, 2025
DOI: https://doi.org/10.37184/lnjpc.2707-3521.7.79

  ISSN: 2708-9134 (Online) Liaquat National Journal of Primary Care 2025; 7(4): 360-365

less significantly in society. The truth is that information on the prevalence of Type 2 Diabetes Mellitus (T2DM) related complications is paramount for the establishment of policies and practices in diabetic care management to gain better control of T2DM. The alarming prevalence of diabetes and its complications in Malaysia prompted this study, aimed at assessing the knowledge on diabetic complications among the general public, in addition to finding an association between knowledge of diabetic complications and their social demographics.

METHODOLOGY

This is a cross-sectional study conducted among residents living in the State of Penang, Malaysia. The study was conducted from January 2023 to May 2023. Ethical approval for this study was granted by the institutional ethical committee (AUHEC/FOP/21/09/03/2023). Any individual who lives in the Taman Tasek Indah residential area during the study period is included in the study, and those who provide full consent for participating in the study and those who were not living in that area were excluded from the study.

Sample size was calculated using Raosoft sample size calculator, and the minimum recommended sample size was found to be 142 with a population size of 224 (95% Confidence interval, 5% margin of error, and 50% mean response distribution). A total of 169 data points were collected for this study.

Data was collected by sending an online questionnaire to the participants through social media platforms. Participants were asked to fill out an online consent form before their participation.

A self-administered questionnaire was developed and validated (face validity by the general public and content validation by an expert). After the modifications, a pilot study was conducted among 20 participants. The responses collected in the pilot study were analysed for reliability, and the Cronbach's alpha was found to be 0.7. The questionnaire has three sections with closed-ended questions, which include Section 1: socio-demographics of participants, Section 2 includes health information of participants, and Section 3 focuses on knowledge of diabetic complications and preventive measures. Each question in the questionnaire was given a score, and the final score was categorized based on Bloom's cutoff points (80-100% shows high knowledge, 60-79% shows moderate, and less than 60% shows low level of knowledge [8]. Scoring was given for all the questions on knowledge of diabetic complications as 1 for yes, 0 for no, and don't know. All the scores were added to get the total score. The study questionnaire is attached as a supplementary file.

The collected data were compiled and analyzed using the Statistical Package for the Social Sciences (ver 25 SPSS). The results obtained throughout the study were described by using descriptive statistics. Binary logistic regression were done to determine if there is any association between categorical variables and knowledge. P-values less than or equal to 0.05 were considered significant.

RESULTS

A total of 169 respondents from the residential area who met the inclusion criteria took part in this study. Socio-demographic variables of respondents were summarized in Table **1**. It was found that there was almost equal participation of both males and females, with a total number of 83 and 86, respectively. Among them, the major population group participating in this study was between 41 and 65 years of age. The participants were multiethnic, with the majority being of Indian descent. The assessment of marital and educational status shows that most of the participants are married and have obtained an adequate level of education. Moreover, the 169 respondents comprised only 30.8% diabetic patients, while the remaining 69.2% are healthy people based on the health information obtained. Even though there is a smaller number of diabetes patients within the subject group, it was identified from the study that around 72.2% percentages of participants' relatives were suffering from diabetes.

Table 1: Socio-demographic characteristics of study participants.

Socio-demographic Variables	Groups	Frequency (%)
Gender	Male	83 (49.1)
	Female	86 (50.9)
Age	18-21 years	7 (4.1)
	21-40 years	67 (39.6)
	41-65 years	73 (43.2)
	Above 65 years	22 (13)
Ethnicity	Malay	49 (29)
	Chinese	38 (22.5)
	Indian	81 (47.9)
	Others	1 (0.6)
Religion	Islam	49 (29)
	Buddhist	36 (21.3)
	Hindu	78 (46.2)
	Others	6 (3.6)
Marital Status	Married	112 (66.3)
	Single	57 (33.7)
Educational Status	higher	139 (82.2)
	Lower	30 (17.8)

The computed frequency of overall knowledge was found to be 70.01% considered a moderate level according to Bloom's cutoff shown in Table **2**. Out of this, around 44.38% (n=75) possessed a moderate level of knowledge, followed by poor knowledge (28.40%, n=48) and high knowledge (27.22%, n=46) respectively.

Table 2: Respondents' knowledge level on diabetic complications.

Knowledge items	Frequency	Percentage
Will it cause cardiac failure?	105	62.13
Diabetic foot ulcer can occur	155	91.71

Knowledge items	Frequency	Percentage
Muscle weakness and pain	154	91.12
It can cause heart disease.	117	69.23
It increases blood cholesterol	118	69.82
It increases blood pressure	48	28.40
It reduces blood glucose level in body	137	81.06
It can cause sexual dysfunction	45	26.62
Infections (UTI/ Respiratory/ Skin)	155	91.71
It led to heart attack	115	68.04
Nerve damages are observed	90	53.25
Poor wound healing	156	92.30
Kidney disease	131	77.51
It affects eyes	157	92.89
Stroke	93	55.02
Death at early age	88	52.07
It led to leg amputation	159	94.08
Do you know factors that reduce development of diabetic complications	135	79.88
Ever visited a doctor because of diabetic complication?	68	40.23
Regular blood sugar testing	109	64.49
Regular inspection of feet	165	97.63
Losing excess weight	103	60.94

Based on Fig. **(1)**, it was found that the primary source of information for the participants was family and friends (95.86%). This was followed by television or social media (81.07%) and newspapers (76.92%) as the second line of information for the study subjects. Knowledge acquired on regular foot inspection methods was mainly through books (62.13%), conference/ workshop (42.60%). Meanwhile, family/ friends and newspapers/ magazines serve as the source for people on regular blood glucose testing. Knowledge on weight loss as a prevention method was mainly obtained *via* books, conferences, newspapers, and social media, indicating this method is less practiced among the public.

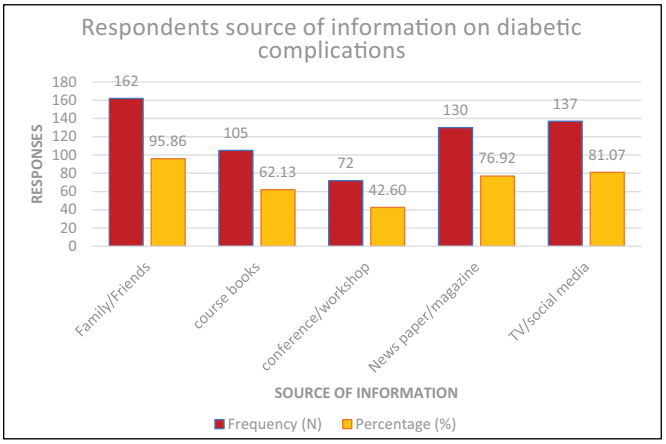

Fig. (1): Respondents sources of information on diabetic complications knowledge.

Fig. **(2)** shows that knowledge on preventive measures was found to be 68.63%. Complications of diabetes commonly known by the respondents were leg amputation 94.8%), eye problems 92.9%, poor wound healing 92.3%, infection and diabetic foot ulcer 91.7%

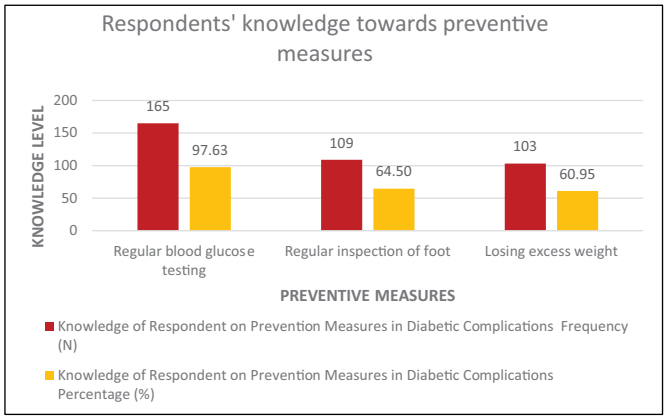

Fig. (2): Knowledge of respondent in diabetic complications prevention measures.

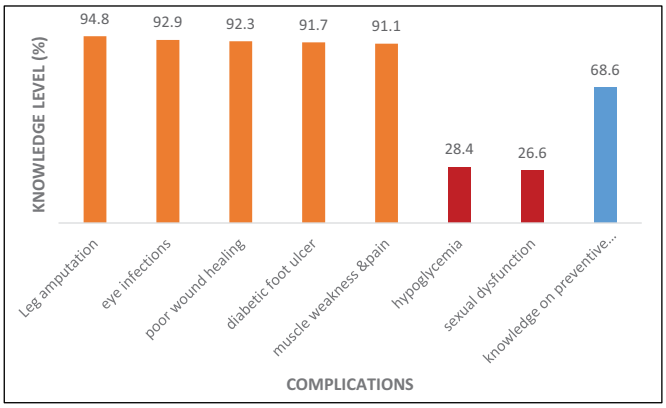

Fig. (3): Percentage of knowledge on each complication.

and muscle weakness and pain 91.1%. Meanwhile, hypoglycemia and sexual dysfunction were the two least known complications among participants, with a proportion of 28.4% and 26.6% respectively, as shown in Fig. **(3)**.

Table **3** shows the results of logistic regression to see the association of respondents' demographics with overall knowledge. It was found that there was a significant association between ethnicity ($p<0.001$), religion ($p<0.05$), and education ($p=0.037$) with overall knowledge.

Table 3: Association of respondents' demographic profile with overall knowledge of diabetic complications.

Variables	OR (95% CI)	p-value
Age		
18-20 years	0.821 (0.25-2.68)	0.942
21-40 years	1.29 (0.69-2.48)	0.434
41-65 years	1.74(0.91-3.34)	0.912
Above 65 years	Reference category	
Gender		
Male	1.07(0.72-1.59)	0.720
Female	Reference category	
Ethnicity		
Maly	2.2(1.38-3.61)	*<0.001
Chinese	1.8(1.06-3.06)	*<0.001
Indian	2.8(2.82-2.82)	*<0.001

Variables	OR (95% CI)	p-value
Other	Reference category	
Education		
Low	0.35(0.19-0.65)	*0.037
Higher	Reference category	
Marital Status		
Single	1.09(0.72-1.65)	0.676
Married	Reference category	
Religion		
Islam	0.23(0.67-0.82)	*0.002
Buddhist	0.18(0.52-0.69)	*0.001
Hindu	0.28(0.84-0.96)	*0.044
Others	Reference category	

CI: Confidence interval, OR: Odds Ratio, *Significant at p<0.05

DISCUSSION

The findings of this study on the source of information indicated family and friends as the major source of information. In contrast, Sanz-Nogués *et al.* indicated that magazines serve as a better source compared to family and friends [9]. Their study specifically focused on healthcare professionals as the sources of information, which was lacking in the questionnaire. Meanwhile, similar to the findings, Bukhsh *et al.* mentioned family and friends as the major source of information [10].

In this study, the proportion of complications of diabetes was well known among the respondents. The moderate level of knowledge among respondents on these diabetes complications can be related to their occurrence. Most diabetic patients will experience these complications in the long term, and they can be identified by visiting healthcare facilities for treatment. Meanwhile, hypoglycemia and sexual dysfunction were the two least known complications among participants. This may be because these complications seldom occur in diabetic patients, leading to less awareness among the public. These findings were supported by other studies, which produced almost similar results for the commonly known complications [1, 2, 11, 12]. The slight difference in the proportion may be associated with the level of educational status and also differences in the study population. A study from Nigeria supported our findings specifically for the awareness of the public on retinopathy-related complications (56.9%) [13]. Assumptions can be made that increased response of patients' knowledge on several complications can be associated with their high prevalence or experience among diabetic patients. Besides, the participants' knowledge was also affected by their relatives' health condition, as the study indicated that around 70% of respondents are related to diabetic family members. Thus, it affected the individuals' exposure to diabetes knowledge. Hence, it was verified that around 70.45% of the public possesses knowledge of these diabetic complications, while the remaining 29.55% lack this. This is consistent with another study in which 85.5% of its respondents had good knowledge about complications of diabetes (such as loss of vision, heart failure, kidney failure, foot ulcer) and they knew that diabetes could cause certain complications if it remained uncontrolled, in contrast to a recent study from India which exhibited low level of knowledge on these complications among study subjects [14, 15]. Similar to this study, a Saudi Arabian study identified that almost 41.8% participants had good awareness of neuronal complications [16]. In addition to that, the conducted study measured the knowledge in the whole population; thus, a precise comparison of the knowledge results with others might be difficult because most of the studies measured knowledge in diabetic patients (a different targeted population).

Apart from that, the association between the socio-demographic variables and the respondents' diabetic knowledge level on diabetic complications was assessed. There was a statistically significant association between the age factor and the knowledge level of some complications. The complications showing significant levels include diabetic foot ulcer, hyperlipidemia, hypoglycemia, hypertension, sexual dysfunction, infection, and heart attack. These complications are collectively referred to as age-related complications, which develop with increasing age. This is consistent with a study conducted by Ullah *et al.* [2].

Furthermore, the determination of the association between the participants' knowledge of diabetic complications and races demonstrated that the races did affect the knowledge among the public. Diabetic foot ulcer, muscle weakness, hypoglycemia, hypertension, sexual dysfunction, infection, poor wound healing, eye problems, and leg amputation were identified as the complications with a high significance level. Studies found the prevalence of these complications is usually higher among Indians [17]. As the majority of respondents are Indians, it slightly influenced the people's knowledge level in this study.

On the other hand, awareness of most of the complications demonstrated no relationship for three of the variables (gender, religion, and marital status). This can be justified by the generalized sample population. Determination of a clear association cannot be achieved as the sample population is not only diabetes patients but also common citizens (including healthy personnel). In contrast, studies from Nigeria [13] and Ethiopia [1] conducted in other countries demonstrated a significant association for these factors.

Meanwhile, evaluation of the association between the participants' knowledge of diabetic complications and educational status demonstrated statistically significant levels. This clearly explains that an individual's educational status will drastically influence the degree of wisdom they possess. Hence, the higher the education level, the better their knowledge level on a particular issue. As most of the respondents have access to formal education, it has affected their knowledge level on the

above complications. Findings of the study by two other authors supported similar findings, as it stated the meta-analysis of 61 studies of 18,905 adults with T1DM or T2DM to determine associations of health literacy with several diabetes outcomes and found that higher levels of health literacy were significantly associated with better diabetes knowledge [18, 19]. The result was also consistent with findings of a study conducted in Ghana and South-Western Saudi Arabia, which showed diabetic patients with higher levels of education had greater knowledge of diabetic complications [16]. Another study conducted in Bangladesh also supports that a higher education level was significantly associated with greater knowledge of diabetic symptoms, risk factors, complications, and presentation. The significant association between education, especially tertiary education, and knowledge of diabetic complications is expected because patients who have completed tertiary education might have attended workshops, conferences, seminars, and health talks on health-related issues.

Lastly, the assessment on the prevention measures indicated that blood glucose testing was agreed upon as the most common and effective method in controlling this disorder, with a prevalence of 165 compared to other measures. This is consistent with a study by Ahmad *et al.* in which 60.3% respondents were engaged in regular monitoring of blood glucose after their diagnosis of diabetes mellitus [11]. In addition, another study in Saudi Arabia found the glucose meter ownership of 86.8% among the diabetes patients [16]. A study by Yasir *et al.* confirmed the good knowledge, attitude, and practice about diabetes among diabetic patients in Malaysia [20], whereas this study's finding shows that the general public's knowledge of diabetic complications is moderate. Rahaman *et al.* found educational status had a significant association with good knowledge [21], which is consistent with the current study. This could be a result of participants who are more educated being able to read the required information more readily than those who are not.

Newer studies could include the risk factors associated with diabetic complications in larger populations. The information obtained in this study can be used to improve diabetic education programs, specifically on the prevention of hypoglycemia and neuropathy.

CONCLUSION

Based on Bloom's cutoff, 70.01% of residents in Penang's residential areas had a moderate degree of knowledge about diabetic complications. Overall knowledge and educational attainment were shown to be significantly correlated. Interventional programs should help raise awareness of the risk factors for complications from diabetes and how to avoid them.

ETHICS APPROVAL

This study was approved by the AIMST University Human Ethics Committee (AUHEC/FOP/21/09/03/2023). All the data were collected following the ethical considerations of the Helsinki Declaration.

CONSENT FOR PUBLICATION

Informed consent was collected from all the participants.

AVAILABILITY OF DATA

All the study data are available with the corresponding author and will be provided upon a valid request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

None.

AUTHORS' CONTRIBUTION

SP: Study Design, Questionnaire development, Data Analysis, Final Approval of Article

RV: Data Collection, Data Analysis, Initial Draft

SS: Review of Draft

GP: Questionnaire development, Data Analysis, Final Approval of Article

SUPPLEMENTARY MATERIAL

Supplementary material is available on the journal's website.

REFERENCES

1. Admasu BG, Yeshitila BB, Dagmawit BK. Knowledge about diabetic complications among patients on diabetic follow up clinic at Jimma University Medical Centre; 2019. J Diabetes Metab Disord 2019; 6(1): 1-6.
   DOI: http://dx.doi.org/10.24966/dmd-201x/100029
2. Ullah F, Afridi AK, Rahim F, Ashfaq M, Khan S, Shabbier G, *et al.* Knowledge of diabetic complications in patients with diabetes mellitus. J Ayub Med Coll Abbottabad 2015; 27(2): 360-3.
3. Akhtar S, Nasir JA, Ali A, Asghar M, Majeed R, Sarwar A. Prevalence of type-2 diabetes and prediabetes in Malaysia: A systematic review and meta-analysis. PLoS One 2022; 17(1): e0263139.
   DOI: http://dx.doi.org/10.1371/journal.pone.0263139
4. Fried LP, Guralnik JM. Disability in older adults: Evidence regarding significance, etiology, and risk. J Am Geriatr Soc 1997; 45(1): 92-100.
   DOI: http://dx.doi.org/10.1111/j.1532-5415.1997.tb00986.x
5. Ganesh PB, Saraswathi S, Sireesha P, Lydia LQY, Jun HC. Functional disability among the older population in Kedah, Malaysia. Clin Epidemiol Glob Health 2024; 29: 101673.
   DOI: https://doi.org/10.1016/j.cegh.2024.101673
6. Complications of diabetes [Internet]. Diabetes UK. 2018 [cited 2023 Jul 7]. Available from: https://www.diabetes.org.uk/guide-to-diabetes/complications

7. Yen PN, Ramadan A, Guat SO, Chia YL, Ganesh PB, Cheng HY. The rate of progression of type 2 diabetes mellitus to end stage renal disease - A single centered retrospective study from Malaysia. Diabetes Metabol Syndr: Clin Res Rev 2018; 12: 1025-30. DOI: http://dx.doi.org/10.1016/j.dsx.2018.06.018
8. Manar MA, Abdullah AA, Somayah AA, Renad KA. Knowledge and attitude of dentists towards obstructive sleep apnoea. Int Dent J 2021; 72(3): 315-21. DOI: http://dx.doi.org/10.1016/j.identj.2021.05.004
9. Sanz-Nogués C, Mustafa M, Burke H, O'Brien T, Coleman CM. Knowledge, perceptions and concerns of diabetes-associated complications among individuals living with type 1 and type 2 diabetes mellitus. Healthcare 2020; 8(1): 25. DOI: http://dx.doi.org/10.3390/healthcare8010025
10. Bukhsh A, Goh B-H, Zimbudzi E, Lo C, Zoungas S, Chan K, *et al.* Type 2 diabetes patients' perspectives, experiences, and barriers toward diabetes-related self-care: A qualitative study from Pakistan. Front Endocrinol 2020; 11: 534873. DOI: http://dx.doi.org/10.3389/fendo.2020.534873
11. Ahmed IB, Mohammed SB, Talal MA, Raes AA, Basamad MA, Alqurashi AE, *et al.* Level of diabetic patients' knowledge of diabetes mellitus, its complications and management. Arch Pharma Pract 2019; 10(4): 80-6.
12. Ng YP, Ganesh PB, Heng YP. Renin angiotensin-aldosterone system (RAAS) blockers usage among type II diabetes mellitus patients—A retrospective study. Diabetes Metabol Syndr: Clin Res Rev 2018; 12: 305-8. DOI: https://doi.org/10.1016/j.dsx.2017.12.005
13. Nathaniel GI, Adio O. Awareness and attitude of diabetic patients on diabetic eye complications in Port Harcourt, Nigeria. Niger J Med 2015; 24(3): 252-5.
14. Fawwad A, Waris N, Butt A, Askari S, Basit A. Diabetes and its complications; knowledge, attitude, and practices (KAP) and their determinants in Pakistani people with type 2 diabetes. J Diabetol 2021; 12(3): 293-8. DOI: http://dx.doi.org/10.4103/jod.jod_79_20
15. Gulabani M, John M, Isaac R. Knowledge of diabetes, its treatment and complications amongst diabetic patients in a tertiary care hospital. Indian J Community Med 2008; 33(3): 204-6. DOI: http://dx.doi.org/10.4103/0970-0218.42068
16. Al Bshabshe A, Ahmad MT, Assiri OAA, Abeer AA, Ghaida AA, Sameera AAA, *et al.* Diabetes-care practices and related awareness amongst type-2 diabetes patients attending diabetes OPD at a tertiary care hospital in southwestern Saudi Arabia. J Family Med Prim Care 2020; 9(4): 2085-91. DOI: http://dx.doi.org/10.4103/jfmpc.jfmpc_1120_19
17. Swathy G, Ponnaian SD, Sridevi SKS. Prevalence and complications of diabetes mellitus in India - A systematic review. Ind J Pharm Edu Res 2023: 57(2s): s213-25. DOI: http://dx.doi.org/10.5530/ijper.57.2s.25
18. Felicia H, Nancy EA, Seth AB, Chin MH, Gary-Webb TL, Navas-Acien A, *et al.* Social determinants of health and diabetes: A scientific review. Diabetes Care 2021; 44(1): 258-79. DOI: http://dx.doi.org/10.2337/dci20-0053
19. Marciano L, Camerini A-L, Schulz PJ. The role of health literacy in diabetes knowledge, self-care, and glycemic control: A meta-analysis. J Gen Intern Med 2019; 34(6): 1007-17. DOI: http://dx.doi.org/10.1007/s11606-019-04832-y
20. Yasir FA, Ooi GA, Ng YP, Ganesh PB, Yap CH, Sireesha P. Diabetes Knowledge, attitude, and practice among type 2 diabetes mellitus patients in Kula Muda District, Malaysia - A cross-sectional study. Diabetes Metabol Syndr: Clin Res Rev 2018; 12: 1057-63. DOI: http://dx.doi.org/10.1016/j.dsx.2018.06.025
21. Rahaman KS, Majdzadeh R, Naieni KH, Raza O. Knowledge, Attitude and Practices (KAP) regarding chronic complications of diabetes among patients with type 2 diabetes in Dhaka. Int J Endocrinol Metab 2017; 15(3): e12555. DOI: http://dx.doi.org/10.5812/ijem.12555