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Comparing the knowledge and awareness of diabetes mellitus among pre-clinical and clinical medical students

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ABSTRACT

Introduction: Diabetes mellitus (DM) is a collection of metabolic illnesses characterised by hyperglycaemia caused by abnormalities in insulin production, insulin action, or both. It has become an epidemic, and in 2021 about 536.6 million people are living with DM. Aims: The objective of this study is to assess knowledge among preclinical and clinical year medical students in a private medical institution in Malaysia regarding DM. **Methods:** A cross-sectional survey of medical students was conducted on a designated questionnaire. Students were divided into two groups (pre-clinical and clinical groups) for analysis. **Results:** A total of 72 students participated, with 33.3% (24 students) from the preclinical group and 66.7% (48 students) from the clinical group. Over 87.5% of students correctly identified diabetes as a metabolic disorder, 90.6% knew the pancreas produces insulin, and 84.4% recognized the main insulin target+ organ. Common symptoms recognized included polyuria (79.2%), polydipsia (71.9%), polyphagia (61.5%), and delayed wound healing (75%), while pruritis vulvae was less frequently identified (11.5%). Both pre-clinical (100%) and clinical groups (95.8%) were aware of diabetes risk factors ($p<0.001$), and knew it is preventable (pre-clinical: 95.8%, clinical: 91.7%, $p<0.001$). Knowledge of diabetes screening was reported by 50% of pre-clinical and 43.8% of clinical students ($p<0.001$). Only 46.9% of students knew the World Health Organization (WHO) diagnostic criteria for diabetes ($p<0.001$), and 5% believed diabetes does not always require medication ($p<0.001$). **Conclusion:** The findings underscore the importance of continuous curriculum development and clinical immersion to optimize medical education outcomes related to diabetes care.

Keywords:

diabetes mellitus, knowledge, medical students, pre-clinical students, clinical students.

INTRODUCTION

Diabetes mellitus (DM) is a collection of metabolic illnesses marked by an increase in blood glucose levels. It is defined as a collection of metabolic illnesses characterised by hyperglycaemia caused by abnormalities in insulin production, insulin action, or both (Kharono et al. 2017). DM is divided into two types: type 1 and type 2. Type 2 DM is a type of diabetes caused by a combination of insulin resistance and insufficient compensatory insulin secretory response. Although type 2 diabetes is typically thought to be a disease that affects adults, it is increasingly being diagnosed more commonly in children and teenagers (Kharono et al. 2017).

DM has become an epidemic, and it was estimated that in 2021 there are 536.6 million people are living with diabetes and it was expected to increase to 783.2 million by 2045 worldwide (Sun et al. 2022). In Malaysia, recent data reported about 3.9 million people aged 18 years and above have DM (Health). Moreover, the WHO has estimated that in 2030, Malaysia will have a total number of 2.48 million diabetics compared to 0.94 million in 2000. DM is strongly associated with obesity (Leitner et al. 2017, Al-Goblan et al. 2014). Obesity is a family history of the illness, and a sedentary lifestyle are all established risk factors for the development of Type 2 diabetes (Bhowmik et al. 2012). Family history is a significant non-modifiable risk factor for the development of diabetes. It represents not just an inherited genetic predisposition, but also shared environmental influences such as cultural beliefs and behaviours, such as dietary preferences and exercise routines (Bhowmik et al. 2012).

Knowledge is the greatest weapon in the fight against DM. The previous study reported that the knowledge of students at Ziauddin University, Karachi about DM was more in the clinical group as compared to the preclinical group (Mumtaz et al. 2009). A local study also has been conducted about the knowledge among medical students and non-medical students in the Faculty of Medicine, UniSZA, Kuala Terengganu and they reported that medical students had significantly more knowledge than non-medical students in this matter (Rao et al. 2018). These previous data show that the level of education is found to be a predominant factor in knowledge of DM. Also, there is no data on the level of knowledge of DM among preclinical and clinical year medical students. Hence, in this study, we aimed to assess knowledge among preclinical and clinical year medical students in a private medical institution in Malaysia towards DM. The knowledge of DM was assessed using a designated questionnaire from Mumtaz et al. (2009).

METHODS

A cross-sectional survey of medical students from the first year to the final year was conducted using a designated questionnaire by Mumtaz et al. 2009.

Sample Size

The sample size for this study was calculated by using Epi info software. It is estimated that 89% have an awareness of diabetes as a metabolic disorder (Mumtaz et al. (2009), with a 7% margin of error and 95% confidence level, a minimum of 70 participants were required for this study.

The questionnaire was distributed using Google form and all the students were informed about the study. The participants were recruited by convenience sampling methods. The questionnaire included three sections altogether related to demographic characteristics, physiology, and pathology presentation along with risk factors, prevention, screening, diagnosis, management, and complications of diabetes.

The data entry and analysis were performed using SPSS (Version 27.0). Students were divided into preclinical and clinical years for analysis. The chi-square test and test of proportion were used to

compare knowledge between preclinical and clinical students. The statistically significant level was set at 0.05.

Ethical consideration

Ethical approval (RP006_2022) to conduct this study was granted by the Research Ethics Committee, Manipal University College Malaysia.

RESULTS

The results of this study are significant in understanding the level of knowledge and awareness of diabetes mellitus among medical students in a private medical institution in Malaysia. A total of 72 students participated in this study.

The study revealed that the ratio of male and female students was almost equal, with 48.6% male and 51.4% female. The ethnic distribution also showed that the student body was rather diverse, with the majority of Indian (55.6 %) and Chinese (25.0 %) students, with a small percentage of Malay (6.9 %) students. Most of the respondents were in the clinical phase (66.7 %) while a smaller number were in the pre-clinical phase (33.3 %). Most of the students were from the Medicine program (86.1 %) in comparison to the Dentistry program (13.9 %) (Table 1).

Table 1: Demographic Characteristics of Participants (n=72)

Variable		n (%)
Gender	Male	35 (48.6)
	Female	37 (51.4)
Ethnicity	Malay	5 (6.9)
	Chinese	18 (25.0)
	Indian	40 (55.6)
	Punjabi	3 (4.2)
	Sikh	6 (8.3)
Phase	Pre-clinical	24 (33.3)
	Clinical	48 (66.7)
Programme (discipline)	Medicine	62 (86.1)
	Dentistry	10 (13.9)

The results of the survey showed that 83.3 % of preclinical and 91.7 % of clinical students knew that diabetes mellitus is a metabolic disorder ($P < 0.001$). It was also noted that the participants had different levels of awareness of the sites where insulin is produced. Clinical students (85.4 %) gave the correct answer more than preclinical students (95.8 %) on the question regarding the site of insulin production ($P < 0.001$).

Concerning the knowledge of the main target organs of insulin action, clinical students were more knowledgeable than preclinical students. Preclinical students identified liver, muscle, and adipocytes as insulin targets less frequently (79. 2 %) than clinical students (89.6 %). On the other hand, preclinical students mentioned stomach, liver, and pancreas (20.8 %) more frequently ($P < 0.001$).

Preliminary findings indicate that both preclinical and clinical students knew symptoms related to diabetes mellitus. However, clinical students consistently demonstrated a more nuanced understanding across all symptoms assessed: Some of the common symptoms include polyuria, polydipsia,

polyphagia, delayed wound healing, unexplained ill health, weight loss, big-size baby (macrosomia), pruritus vulvae, and erectile dysfunction (P < 0.001 for all symptoms) (Table 2).

Table 2: Knowledge about Physiology, Pathology and Presentation of Diabetes mellitus among participants (n=72)

Variables	Preclinical n=24 (%)	Clinical n=48 (%)	P value*
Diabetes mellitus is a metabolic disorder	20 (83.3)	44 (91.7)	<0.001
Site of production of insulin			
Liver	0 (0.0)	7 (14.6)	
Pancreas	23 (95.8)	41 (85.4)	<0.001
Stomach	1 (4.2)	0 (0.0)	
Main target organ of insulin			
Liver, muscle, adipocyte	19 (79.2)	43 (89.6)	<0.001
Stomach, liver, pancreas	5 (20.8)	5 (10.4)	
Main target organ of insulin			
Polyuria	19 (79.2)	38 (79.2)	<0.001
Polydipsia	18 (75.0)	33 (68.8)	<0.001
Polyphagia	13 (54.2)	33 (68.8)	<0.001
Delayed wound healing	17 (70.8)	38 (79.2)	<0.001
Unexplained ill health	2 (8.3)	14 (29.2)	<0.001
Weight loss	7 (29.2)	17 (35.4)	<0.001
Big size baby	3 (12.5)	15 (31.3)	<0.001
Pruritis vulvae	1 (4.2)	9 (18.8)	<0.001
Erectile dysfunction	5 (20.8)	8 (16.7)	<0.001

*Chi-square test

All the preclinical students identified diabetes as a condition with modifiable risk factors (100%) while slightly fewer clinical students did so (95.8 %). Likewise, both groups agreed that diabetes was a preventable disease, with preclinical students being more inclined to this notion than their clinical counterparts (95.8 % and 91.7 % respectively). These results reveal that students had a good knowledge base about risk factors and preventive measures in diabetes management (P < 0.001). The results showed that the majority of preclinical (91.7 %) and clinical (97.9 %) students agreed with the statement that exercise has a role in the prevention of diabetes (P < 0.001).

Preclinical students had a diverse perception of the frequency of screening for individuals with diabetes risk factors, 58. 3% choose to get screened once a year 29.2 % for biannual screenings, while 12.5 % were unsure. Clinical students, however, were more organized, with 47.9 % opting for annual examinations, 25.0 % biannual screenings, and 27.1 % unsure (P < 0.001).

The preclinical and clinical students were able to identify the diagnostic criteria for diabetes based on WHO recommendations; however, the clinical students were more accurate. Preclinical students described signs, Fasting Blood Glucose (FBG) of 7.0 mmol/L and Random Blood Glucose (RBG) of 11.1 mmol/L as criteria, while clinical students were more accurate in identifying symptoms, with FBG of 5.6 mmol/L, and RBG of 8.9 mmol/L (P < 0.001).

The findings also revealed that clinical students possessed better knowledge of diabetes treatment options and their consequences than preclinical students. Clinical students used drug therapy, insulin, healthy diet, regular exercise, weight control, and smoking cessation more often as treatment methods than preclinical students (P < 0.001 for all treatment modalities).

All preclinical and clinical students identified the main diabetic mellitus comorbidities, such as cardiovascular disease, neuropathy, retinopathy, stroke, foot issues, and mortality ($P < 0.001$) for all complications) (Table 3).

Table 3: Knowledge about Risk Factors, Prevention, and Management of Type 2 Diabetes among participants (n=72)

Variables	Preclinical n=24 (%)	Clinical n=48 (%	P value*
Is there any risk factor for diabetes?	24 (100)	46 (95.8)	<0.001
Is Diabetes preventable?	23 (95.8)	44 (91.7)	<0.001
Regular exercise helps in prevention?	22 (91.7)	47 (97.9)	<0.001
How frequently people with risk factors be screened?			
Annually	14 (58.3)	23 (47.9)	<0.001
Biannually	7 (29.2)	12 (25.0)	
Don't know	3 (12.5)	13 (27.1)	
Diagnostic criteria for diabetes according to WHO			
Symptoms, FBG† 7.0, RBG‡ 11.1	12 (50.0)	21 (43.8)	<0.001
Symptoms, FBG† 5.6, RBG‡ 8.9	5 (20.8)	12 (25.0)	
Symptoms, FBG† 6.7, RBG‡ 11.1	5 (20.8)	13 (27.1)	
Every diabetic should be treated with drugs	5 (20.8)	5 (10.4)	<0.001
What are the methods of treatment			
Drugs	4 (16.7)	12 (25.0)	<0.001
Insulin	11 (45.8)	27 (56.3)	<0.001
Healthy diet	20 (83.3)	44 (91.7)	<0.001
Regular exercise	20 (83.3)	46 (95.8)	<0.001
Weight control	18 (75.0)	42 (87.5)	<0.001
Quit smoking	13 (54.2)	26 (54.2)	<0.001
Others	3 (12.5)	0 (0.0)	<0.001
The common complications resulting from diabetes mellitus			
Cardiovascular disease	21 (87.5)	33 (68.8)	<0.001
Neuropathy	14 (58.3)	32 (66.7)	<0.001
Retinopathy	9 (37.5)	35 (72.9)	<0.001
Stroke	14 (58.3)	32 (66.7)	<0.001
Foot problems	19 (79.2)	38 (79.2)	<0.001
Death	10 (41.7)	16 (33.3)	<0.001

*Chi-square test

†FBG: Fasting Blood Glucose

‡RBG: Random Blood Glucose

DISCUSSION

The study indicates that clinical exposure is a critical factor in increasing medical students' knowledge and awareness of diabetes mellitus. Although both preclinical and clinical students have a general idea of what diabetes is, a clinical year enhances their knowledge of disease processes, insulin function, and clinical presentation. Clinical experience seems to reinforce theoretical learning from preclinical courses, especially in the identification of insulin production sites and target organs, which were more accurate among clinical students. This progression also highlights the need to incorporate clinical experiences in the early years of medical education to close these gaps between theory and practice

(Mann 2011, Kaufman 2018, Holmboe et al. 2011). Furthermore, the differential recognition of diabetes symptoms also highlights the importance of clinical exposure in improving diagnostic skills and patient care. The fact that clinical students were able to recognize more symptoms of diabetes, indicates that exposure to real-life patients enhances understanding of the presentation and management of the disease (Edelbring et al. 2011, DeSipio et al. 2018, Eklics et al. 2024).

Clinical exposure is a critical factor in the development of medical students' knowledge about diabetes mellitus beyond the preclinical curriculum (Myers et al. 2021, Mohsen et al. 2021). This transition from classroom learning to clinical practice enhances the understanding of students by applying the information from the textbooks to actual patient cases (Stokes and Kost 2013). By interacting with patients, clinical students learn about the various signs and symptoms of diabetes and its various complications (Nam et al. 2011). This form of learning not only sharpens their diagnostic skills but also increases their understanding of diabetes as a diverse and intricate disease process (Quirk 2006). Furthermore, clinical education enhances the student's critical thinking skills which are vital in the management of diabetes (Zarifsanaiey et al. 2016). Students are trained on how to perform detailed patient assessments, apply diagnostic criteria correctly, and develop appropriate treatment plans (Daniel et al. 2019). The understanding of the pathophysiology of diabetes in combination with clinical reasoning helps students to focus on the patient's needs and provide more individualized and patient-centred care (Mitchell et al. 2014, Stewart et al. 2024).

In addition, clinical exposure also focuses on the application of preventive medicine concepts in practice. Lifestyle changes such as dietary optimization, exercise, and smoking cessation are taught to medical students as the first-line interventions in diabetes prevention and management (Malatskey et al. 2019). Through the promotion of preventive health measures, clinical education prepares future healthcare professionals to reduce modifiable risk factors and enhance the overall health of those at risk of developing diabetes (Association 2019). Besides preventive measures, clinical education also helps students to develop knowledge about pharmacological and non-pharmacological management of diabetes mellitus (Wang et al. 2008). Clinical sites offer students the chance to practice insulin administration, medication administration, and therapeutic decision-making based on patient's clinical characteristics and personal preferences (Hsu et al. 2016). This practical exposure not only enhances glycaemic management but also tackles the multifactorial aspects of diabetes complications, which in turn enhances patient's quality of life and clinical outcomes (Chan et al. 2014). Furthermore, clinical education enables the acquisition of knowledge about diabetes mellitus as a chronic disease affecting the whole body (Irby 2014). Students are taught how to identify and prevent diabetes complications like cardiovascular disease, neuropathy, retinopathy, and diabetic foot issues by early diagnosis and effective treatment with the help of other healthcare professionals. This approach emphasizes the need for integrated care in the management of diabetes to reduce complications and improve the quality of life of patients (Grohmann et al. 2017).

Finally, the outcomes reflect that the provided clinical exposure leads to positive changes in attitudes, behaviours, and perceptions of medical students as future professionals, preparing them to tackle problems related to diabetes mellitus. The approach of medical institutions allows for creating conditions for developing and strengthening clinical competence, the motivation to learn throughout a medical career, and dedication to the process of quality improvement, the future professionals will be able to take an active role in the prevention of diabetes, the definition of the most appropriate diagnostic methods, the provision of effective therapeutic interventions, and the management of the disease throughout patients' lifetimes. Progressive advancements in medical education and development for

incorporation of a multidimensional framework are crucial to ensure medical students are trained to address healthcare challenges as they progress along their medical education, personal growth, and professional development to provide competent and comprehensive patient-centred healthcare services (Tokuç and Varol 2023). Drawing awareness and developing a culture of excellence and innovation in the management of DM, medical education programs stand a chance to make a great impact towards the well-being of people living with diabetes mellitus and the global health (Sugandh et al. 2023).

The findings of this study will help in understanding the current level of knowledge and awareness of diabetes mellitus among preclinical and clinical medical students. The study further underscores the importance of clinical exposure in influencing the perception of students of diabetes as an intricate metabolic condition. Clinical students had a better understanding of the disease process, diagnostic criteria, therapeutic options and management of complications of diabetes compared to preclinical students. This goes to show that clinical practice is a critical component of the medical program as it brings out the differences between theory and practice (Ten Cate and Scheele 2007). The study also highlights the need to incorporate preventive medicine principles in the training of medical students. All preclinical and clinical students acknowledged the possibility of preventing diabetes and the significance of implementing regular exercise and proper diet in avoiding the disease. Nevertheless, it seemed that clinical experience provided a better reinforcement of these concepts, highlighting the application of the preventive measures in the clinical context. Additionally, the present research highlights the need for specific educational approaches with preclinical students' knowledge of diabetes diagnosis and management. Medical education programs need to ensure that students acquire strong foundational knowledge in the early stages of their training and provide them with well-structured clinical experiences (Cunningham et al. 2015) that will help them prepare for the challenges of managing diabetes and other chronic diseases in different populations.

Consequently, this study support the introduction of early clinical exposure (ECE) in medical education to improve students' comprehension and approaches to complicated diseases such as diabetes mellitus (Singh et al. 2020). The comparison of preclinical and clinical students' knowledge and their practical skills demonstrates the changes that ECE has brought (Tayade and Latti 2021). Clinical students showed an improved understanding of diabetes pathophysiology, diagnostic criteria and management implying that ECE fills the gap between the theoretical and practical (Holstein et al. 2000). Furthermore, students with early clinical exposure were more capable of applying preventive measures inclusive of lifestyle changes thus supporting the use of ECE in enhancing students' practice of disease prevention. The research also reveals the level of preclinical students' knowledge, suggesting that implementing ECE could help improve the students' knowledge base and provide a smoother transition to more specialized clinical education. Thus, the incorporation of ECE into medical curricula is highly crucial to equip the learner to address chronic diseases such as diabetes, thus improving the quality of patient care and health status.

CONCLUSION

The study emphasizes the need for curriculum improvement and clinical practice experience to enhance medical education results for diabetes management. In this way, by providing future healthcare professionals with strong knowledge, skills, and attitudes, medical institutions can improve patients' outcomes and support the global fight against the burden of diabetes mellitus more effectively.

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