Prevalence of Diabetes Mellitus and Risk Factors in Kota Bharu, Eastern Malaysia: A Cross-Sectional Study

Nor Hidayah Mustafa[1,*], Nurul Azmir Amir Hashim[1], Fazna Saleem[1], Ghazali Hasni Mohd Hassan[1], Nur Adnie Raihana Mohamed Samud[1], Afiq Iqwan Azharuddin[1], Ahmad Hazman Hisham[1], Muhammad Imtiyaz S Roslan[1], Rama Al Basti[1], Kwabla Chris-David Selassie[1]

[1]School of Medicine, Lincoln University College, Selangor, Malaysia

Corresponding Author's E-mail: dr.nor@lincoln.edu.my

Abstract
A cross-sectional survey was conducted to investigate diabetes mellitus, a major public health concern in Malaysia that contributes substantially to morbidity, mortality, and healthcare costs. Although lifestyle factors such as high carbohydrate intake, physical inactivity, and obesity are well-established contributors, localized evidence from Kota Bharu remains limited. This study aimed to determine the prevalence of diabetes mellitus and identify its key risk factors among residents of Kota Bharu. A cross-sectional study was conducted involving 568 participants recruited from Billion Mall, Kota Bharu. The mean age of participants was 41.6 years. Data on sociodemographic characteristics and lifestyle habits were collected using questionnaires. Statistical analyses were performed to estimate the prevalence and examine associations between potential risk factors and diabetes mellitus. The prevalence of diabetes mellitus in the study population was 17.6%, indicating a relatively high burden within this community. Significant risk factors included older age, comorbid conditions such as hypercholesterolemia and hypertension, a positive family history of diabetes mellitus, a sedentary lifestyle, and lack of physical exercise. Multiple logistic regression analysis revealed that age was a significant predictor of diabetes risk perception (AOR = 16.96; 95% CI: 1.86–154.35), indicating that older individuals were markedly more likely to perceive themselves at risk compared to those aged 18–28 years. Similarly, respondents engaging in less than 150 minutes of physical activity per week demonstrated higher odds of risk perception (AOR = 4.54; 95% CI: 1.81–11.37). These findings underscore the urgent need for targeted preventive measures and community-based interventions to mitigate the growing burden of diabetes mellitus in this population.

Keywords: Cross-Sectional Study; Diabetes; Hypercholesterolemia; Hypertension; Physical Activity.

1.0 Introduction
Diabetes mellitus is a chronic metabolic disorder and a growing public health concern in Malaysia, characterized by elevated blood glucose levels and long-term complications. Globally, its

prevalence is rising at an alarming rate, with projections indicating that the number of cases may double in the coming years (Singh *et al.* 2025; Mustafa *et al.* 2025). Although the prevalence of diabetes mellitus in Malaysia has been extensively documented, region-specific data remain limited (Amsah *et al.* 2023; Mohd Rawi *et al.* 2023; Mohd Nor *et al.* 2024). National statistics provide valuable overall estimates; however, they may not adequately capture the distinctive socioeconomic, dietary, and lifestyle characteristics of local populations. The paucity of localized data poses challenges in designing public health interventions that are appropriately tailored to the community's specific risk profiles and healthcare needs. The burden of diabetes mellitus is particularly concerning, largely driven by lifestyle factors such as unhealthy dietary patterns, sedentary behavior, and underlying genetic susceptibility. Additionally, the economic burden of diabetes on Malaysia's healthcare system and productivity loss is substantial, making early and effective intervention a national priority.

Early detection and preventive measures are essential to reduce the risk of long-term complications associated with diabetes mellitus, including cardiovascular disease, renal failure, and lower-limb amputations. Understanding the prevalence of diabetes mellitus and identifying its associated risk factors within specific populations is therefore critical (Dal Canto *et al.* 2019). Comparing local data with national and regional trends can also help to contextualize the magnitude of the problem and reveal unique patterns in specific communities. Such evidence can inform the design of more effective screening programs, health education campaigns, and lifestyle interventions targeted to local contexts.

To our knowledge, few studies have focused specifically on the Kelantan population, despite its distinct cultural and socioeconomic characteristics (Remali *et al.* 2019; Awang & Ja'afar, 2020). To address this gap, the present study examines the prevalence of diabetes mellitus and its associated risk factors among adults in Kota Bharu, the capital of Kelantan. The findings are expected to provide valuable insights for healthcare professionals and policymakers in developing targeted strategies for diabetes prevention and management in this region.

2.0 Methods

2.1 Research Design, Setting, and Participants

A cross-sectional study was conducted in Kota Bharu, Kelantan, Malaysia, using a Questionnaire adapted with slight modifications from Hu *et al.* (2019), among 568 Malaysian adults aged 18–59 years. Descriptive statistics were used to analyse the socio-demographic characteristics and health status. Participants were recruited using a convenience sampling approach at Billion Mall, Kota Bharu, over five days. The target population comprised adults residing in Kota Bharu. A total of 568 individuals consented to take part. However, the use of a convenience sampling method may limit the generalizability of the findings to the broader Kota Bharu population, as the sample may not fully represent all demographic groups. The sample size was determined using a standard sample size calculation formula:

$$n = \frac{Z^2 \times p \times (1 - p)}{E^2}$$

where n is the required sample size, Z is the standard normal deviate corresponding to the desired confidence level (typically 1.96 for 95% confidence), p is the estimated proportion of the population with the characteristic of interest, and E is the margin of error (commonly set at 0.05).

2.2 Data Collection Tools and Procedures

Data collection methods included validated questionnaires administered through face-to-face interviews and self-administered questionnaires. Data were collected using a structured bilingual (Malay and English) questionnaire and basic clinical measurements. The questionnaire covered four domains: (i) demographics (age, gender, ethnicity, education, and occupation); (ii) medical history (diabetes diagnosis, treatment, family history, comorbidities, and body mass index; and (iii) lifestyle factors (dietary habits, physical activity, and smoking). Diabetes mellitus status was based on self-reported diagnosis by a healthcare professional.

2.3 Data Analysis

Statistical analyses were conducted using SPSS software. Descriptive statistics were used to summarize participant characteristics, with categorical variables presented as frequencies and percentages, and continuous variables as means and standard deviations. The prevalence of diabetes mellitus was estimated, with subgroup analyses conducted by age, gender, and ethnicity. Associations between diabetes mellitus and risk factors were tested using chi-square tests for categorical variables and independent t-tests or Mann–Whitney U tests for continuous variables, depending on distribution. Logistic regression analysis was performed to identify independent risk factors, and results were reported as adjusted odds ratios (OR) with 95% confidence intervals (CI).

2.4 Ethical Considerations

The study received ethical approval from the relevant institutional ethics committee. All participants provided written informed consent prior to participation (Supplementary material). For illiterate participants, the consent form was read aloud, and thumbprints were obtained in the presence of an independent witness. Confidentiality and anonymity were maintained by removing personal identifiers from the dataset, which was stored in password-protected files accessible only to the research team. Participation was voluntary, and respondents were informed of their right to withdraw at any time without consequence. Data collection was carried out with cultural sensitivity, ensuring respect for local norms and practices in Kota Bharu.

3.0 Results

3.1. Demographic Characteristics

The majority of the respondents were men (n = 568, 53%), with Malays comprising the predominant ethnic group (84.7%) (Table 1). The largest proportion of respondents was aged 18–28 years (53.7% men and 46.3% women). In terms of socioeconomic status, 34.5% reported a monthly income of up to MYR 2,999. Most respondents were employed (65.5%), while 13.7% were students, 11.1% were retirees, and 9.7% were unemployed. For diabetes-related characteristics, 84.3% respondents were not receiving any treatment, while 11.3% and 4.4% were on oral medication and insulin, respectively. Overall, 69.7% reported no comorbidities, whereas 57% had a family history of hyperglycemia.

Table 1

Descriptive distribution of respondents' Sociodemographic characteristics (n = 568)

Demographic Profile		N (%)
Gender	Male	53.7
	Female	46.3
Age	18 to 28 yearsold	23.4
	29 to 38 years old	21.8
	39 to 48 years old	19.7
	49 to 58 years old	19.9
	59 years old and above	15. 1
Ethnic group	Malay	84.7
	Chinese	8.3
	Indian	4.0
	Others	3.0
Employment status	Employed	65.5
	Unemployed	9.7
	Student	13.7
	Retiree	11. 1
Monthly household income	< MYR 1,000/month	20.2
	MYR 1,000-2,999/month	34.5
	MYR 3,000-4,999/month	23.1
	> MYR 5,000/month	22.2
Diabetic relevant information Currently on diabetes treatment	Oral medication	11. 3
	Insulin	4.4
Comorbidities	No	84.3
	High cholesterol	9.0

	Hypertension	9.0
Family history of hyperglycaemia	Both	12.3
	None	69.7
	Yes	57.0
	No	43.0

3.2. Health Behaviors

Bivariate analysis indicated that dietary carbohydrate, sugar, and body mass index did not differ significantly between diabetic and non-diabetic groups ($p > 0.05$); however, physical activity levels differed significantly ($p < 0.05$) (Table 2).

Table 2

Mean rank of population lifestyle patterns

Variable	Diabetes group (n = 100)	Non-diabetes group (n = 468)
High dietary carbohydrate intake	260.84	289.56
High dietary sugar intake	276.02	286.31
Physical activity levels	240.00*	294.01*
Body mass index	308.86	279.29

* statistically significant ($p < 0.05$)

3.3. Potential Risk Factors

The chi-square test results showed statistically significant differences in the distributions of comorbid conditions, particularly the coexistence of high cholesterol and hypertension, in relation to diabetes ($p < 0.001$). A significant association was also observed between diabetes and a family history of diabetes ($p < 0.001$). However, no statistically significant differences were found for smoking status, ethnicity and gender between the two groups ($p > 0.05$) (Table 3).

Table 3

Bivariate analysis of the interrelationship of risk factors within the study population

Variable	Diabetes group (%) (n = 100)	Non-diabetes group (%) (n = 468)
Existence of comorbid conditions		
High cholesterol	31.4	68.6
Hypertension	29.4**	70.6
High cholesterol and hypertension	62.9**	37.1

None	6.3	93.7
Smoking status		
Smoke	21.1	78.9
Smoke and vape	6.7	93.3
Vape	15.2	84.8
None	17.7	82.3
Ethnic group		
Malay	17.6	82.5
Chinese	25.5	74.5
Indian	13.0	87.0
Others	5.9	94.1
Family history of diabetes		
No	8.2**	91.8
Yes	24.7**	75.3
Gender		
Male	20.9	79.1
Female	14.8	85.2

** statistically significant (p < 0.001)

3.4. Predictors Associated with Diabetes Mellitus Risk Perception

Multiple logistic regression analysis was performed to identify factors associated with respondents' perception of their future risk of developing diabetes mellitus (Table 4). Both demographic variables and health behaviors served as the predictor variables. Age was found to be the predictor of future risk perception in diabetes using multiple logistic regression: age (AOR, 16.96: 95% CI 1.86, 154.35; P value = 0.012), showing markedly higher odds of perceiving themselves at risk compared to those aged 18–28 years. Respondents engaging in less than 150 minutes of physical activity per week demonstrated higher odds of risk perception (AOR = 4.54; 95% CI: 1.81–11.37; $p = 0.01$). In contrast, monthly household income, body mass index, sugary drink, carbohydrate and processed food intake were not significantly associated with diabetes risk perception ($p > 0.05$).

Table 4
Predictors associated with diabetes mellitus risk perception

Factors	Multiple logistic regression Adjusted OR (95% CI)	*P* value
Age		
18 to 28 years old	1	
29 to 38 years old	3.48 (0.35, 34.24)	0.286
39 to 48 years old	10.33 (1.16, 92.11)	0.036*

49 to 58 years old	16.96 (1.86, 154.35)	0.012*
59 years old and above	66.37 (7.53, 585. 11)	<0.001**
Monthly household income		
< 1000 MY / month	1	
1000-2999 MY / month	0.38 (0.11, 1.27)	0.116
3000-4999 MY / month	0.63 (0.28, 1.41)	0.261
> 5000 MY / month	1.06 (0.49, 2.28)	0.886
Body mass index		
18.5-22.9	1	
23.0-27.4	3.25 (0.72, 14.63)	0.125
27.5-32.4	2.22 (0.49, 10.03)	0.300
32.5-37.4	2.60 (0.54, 12.47)	0.231
Sugary drink intake		
Everyday	1	
A few time a week	0.81 (0.33, 1.97)	0.635
Once or twice a week	1.01 (0.41, 2.45)	0.990
Rarely	0.68 (0.27, 1.73)	0.418
Carbohydrate intake		
Everyday	1	
A few times a week	1.17 (0.23, 5.82)	0.851
Once or twice a week	0.37 (0.08, 1.74)	0.207
Rarely	0.24 (0.55, 1.07)	0.061
Processed food		
Everyday	1	

A few times a week	0.70 (0.34, 1.45)	0.331
Once or twice a week	1.49 (0.65, 3.38)	0.353
Rarely	0.49 (0.08, 2.96)	0.434
Physical activity		
> 150 minutes	1	
< 150 minutes	4.54 (1.81, 11.37)	0.01*
No	1.87 (0.84, 4.17)	0.125

AOR = adjusted odds ratio, CI = confidence interval
1 as a reference. Factors with *$P < 0.05$ and **$P < 0.001$ were included in the Multiple Logistic Regression (MLR) analysis

4.0 Discussion

This study identified a diabetes mellitus prevalence of 17.6% among adults in Kota Bharu, Kelantan. In comparison, the National Health and Morbidity Survey (NHMS) 2023 reported a national prevalence of 15.6% (Mat Rifin et al., 2025). The slightly higher prevalence observed may reflect the influence of local dietary and lifestyle patterns characteristic of Kelantan, such as frequent consumption of traditional high-carbohydrate and coconut-based dishes. These findings underscore the need for targeted public health interventions to address the growing diabetes burden in Kota Bharu and emphasize the importance of region-specific data to complement national statistics. Dietary habits played a notable role. Although sugar intake was not significantly associated with diabetes, high carbohydrate consumption showed a borderline association (p = 0.050). This suggests that the type, source, and portion size of carbohydrates, rather than sugar intake alone, may play a greater role in determining diabetes risk in this population. The lack of statistical significance for sugar intake may reflect self-reported dietary adjustments after diagnosis or underestimation of true intake.

The diabetic respondents in this study reported significantly lower levels of physical activity compared to healthy individuals. This finding is consistent with previous evidence that regular physical activity improves insulin sensitivity, reduces adiposity, and lowers cardiometabolic risk (Booth et al., 2012; Garcia et al., 2025). In Kelantan, limited access to recreational facilities, hot weather, and sedentary occupational patterns, particularly among urban adults, may further contribute to low activity levels. Although body mass index was higher among diabetic respondents, the association did not reach statistical significance. This trend aligns with global evidence linking obesity to type 2 diabetes and with national data highlighting the high prevalence of overweight and obesity in Malaysia. Beyond lifestyle influences, the clustering of comorbidities underscores the multifactorial nature of diabetes. Hypertension and hypercholesterolemia were significantly more prevalent among diabetic respondents, with moderate-to-strong effect sizes. This observation is supported by recent evidence from a large Chinese community cohort, where approximately 27.8% of individuals with type 2 diabetes also had both hypertension and hyperlipidaemia, and such clustering was associated with poorer glycaemic control (Zhai et al.,

2023). In the local context, this finding highlights the urgent need for integrated screening programs at the primary care level in Kelantan to simultaneously address diabetes, hypertension, and dyslipidaemia.

Sociodemographic factors further shaped diabetes prevalence. Age showed the strongest association (p < 0.001), with prevalence increasing in older groups, reflecting the progressive decline in insulin sensitivity and beta-cell function with aging. Gender differences were less pronounced, although men demonstrated a slightly higher prevalence than women, consistent with earlier Malaysian findings. Ethnicity was not significantly associated, likely due to the predominantly Malay composition of the study sample. Although household income and body mass index were not significantly associated with diabetes in this study, socioeconomic conditions may still indirectly influence dietary quality and healthcare access in Kota Bharu. Individuals from lower-income households may rely more on inexpensive, carbohydrate-rich foods and have limited access to preventive health services, potentially increasing diabetes risk. These trends, while not statistically significant in the present data, remain relevant in the broader Malaysian context, where socioeconomic disparities have been shown to affect lifestyle and disease outcomes. The association between income and diabetes in Malaysia is complex, as it is shaped by both affluence-related lifestyle risks and disparities in healthcare access (Folayan *et al.*, 2024). Family history emerged as another strong predictor, with 80% of diabetic respondents reporting affected first-degree relatives. This finding aligns with previous studies (Meigs *et al.*, 2000), which highlight the combined influence of genetic predisposition and shared lifestyle patterns in increasing the risk of developing diabetes (Mohd Rawi *et al.*, 2023).

Nevertheless, this study has several limitations. It relied on self-reported information, which may introduce recall or reporting bias, and the sampling was limited to one urban location, thereby limiting the generalizability of the findings to rural populations. Furthermore, the use of a convenience sampling approach may have introduced selection bias, as participants recruited from a shopping mall setting may not fully represent the general adult population of Kota Bharu. In addition, diabetes status was self-reported without biochemical verification (fasting blood glucose or HbA1c), which could lead to misclassification, particularly among individuals who were unaware of their condition or who provided inaccurate information. The questionnaire primarily focused on the most prevalent comorbid conditions and lifestyle factors commonly associated with diabetes mellitus in Malaysia, based on existing national data. Consequently, less common comorbidities or the use of tobacco-related products may not have been adequately captured, which should be addressed in future studies.

Participants aged ≥ 59 years exhibited a markedly higher likelihood of diabetes (AOR = 66.37). This unusually large estimate likely reflects sparse-data bias due to the small number of older participants without diabetes. Although this may indicate some model instability, the direction of association remained consistent with the descriptive trends, supporting the robustness of the observed relationships. The pattern observed is in line with established evidence that advancing age is a strong determinant of diabetes risk, consistent with prior studies reporting exponential increases in diabetes prevalence among older adults (Lin *et al.*, 2025). Comparable findings involving large odds ratios have been reported in studies examining determinants of vaccine efficacy against SARS-CoV-2 infection, suggesting that such strong associations may reflect genuine effects rather than random variation (de Lemos *et al.*, 2022). The consistency of the present results with national and international literature further supports their validity.

Future studies should incorporate clinically verified diagnoses and adopt a more representative sampling strategy encompassing both urban and rural populations to enhance the accuracy and generalizability. These findings also highlight the importance of community-based interventions that promote healthy eating, increased physical activity, and family-oriented diabetes awareness initiatives tailored to the cultural context of Kelantan.

Conclusion
Diabetes prevalence in Kota Bharu reflects national trends, with dietary habits, physical inactivity, body mass index, comorbidities, sociodemographic factors, and family history as key contributors. The clustering of hypertension and hyperlipidemia underscores the need for integrated prevention. Public health strategies must focus on lifestyle modification, targeted screening, and community-based programmes to curb the rising burden of diabetes in this region.

Declaration of conflicting interest
The authors declare that there is no conflict of interest regarding the publication of this article.

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