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ORIGINAL ARTICLE

Prevalence of Diabetic Peripheral Neuropathy and Its Association with Health Literacy among Patients with Type 2 Diabetes Mellitus in Kuantan Primary Health Clinics.

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Abstract

Introduction: Diabetic peripheral neuropathy (DPN) is a common microvascular complication of type 2 diabetes mellitus (T2DM), contributing to disability, foot ulceration, and reduced quality of life. Health literacy may influence patients' self-care and early detection of complications, but evidence from Malaysian primary care is limited. This study aimed to determine the prevalence of DPN and its association with health literacy among patients with T2DM in primary health clinics in Kuantan. **Methods:** A cross-sectional study was conducted among 430 adults with T2DM selected using probability proportionate to size sampling across four primary health clinics in Kuantan. Simple random sampling was applied within clinics. DPN was assessed using monofilament and tuning fork tests, and health literacy using an interviewer-administered Health Literacy Short Form Instrument (HLS-SF12) questionnaire. Multiple logistic regression identified associated factors. **Results:** The prevalence of DPN was 23.3% (n = 100; 95% CI: 19.3–27.5). Increasing age (AOR 1.04, 95% CI: 1.02–1.07, p = 0.003) and HbA1c (AOR 1.20, 95% CI: 1.06–1.35, p = 0.003) were independently associated with higher odds of DPN. Participants with adequate health literacy had significantly lower odds of DPN compared to those with limited health literacy (AOR 0.48, 95% CI: 0.28–0.82, p = 0.008). Other sociodemographic and clinical factors were not significantly associated with DPN. **Conclusion:** Nearly one in four adults with T2DM attending primary care clinics in Kuantan had DPN. Adequate health literacy was independently associated with lower odds of DPN, highlighting the importance of routine screening and health literacy–focused interventions in primary care to reduce neuropathic complications.

Keywords: *Diabetic peripheral neuropathies; health literacy, type 2 diabetes mellitus.*

Introduction

Diabetes mellitus is a rising global health challenge. The International Diabetes Federation projects a 17% increase in prevalence by 2050, particularly in low- and middle-income countries [1]Click or tap here to enter text.. Malaysia has seen a rise in adult diabetes prevalence from 14.9% in 2006 to 19% in 2021, with most patients having type 2 diabetes mellitus (T2DM) [2].

Diabetic peripheral neuropathy (DPN) is one of the most common and debilitating microvascular complications of T2DM. It can contribute to pain, sensory loss, gait imbalance, ulceration, and lower-limb amputation. These issues significantly impair quality of life and increase healthcare costs. Globally, up to half of individuals with diabetes develop DPN during their lifetime [3]. Despite its clinical importance, DPN often remains underdiagnosed due to unrecognised symptoms and inconsistent screening practices [4].

In Malaysia, studies have reported wide-ranging DPN prevalence: 26.5% in a Selangor community survey, 58.4% in Melaka primary care, and up to 79.1% in tertiary hospitals [5-7]. These variations stem from differences in methodology and patient populations, but consistently emphasise the substantial burden in primary care, where most diabetes management occurs.

Health literacy (HL) is the ability to obtain, process, and understand basic health information. It is crucial for effective diabetes management, but often under-recognised. Improving HL can empower patients, leading to better self-care, earlier complication recognition and improved glycaemic control, ultimately reducing the risk of DPN [8,9]. However, evidence from Malaysian primary care on the direct relationship between HL and DPN remains limited.
Therefore, this study aimed to determine the prevalence of DPN and its association with HL among adults with type 2 diabetes mellitus (T2DM) attending government primary health clinics in Kuantan, Pahang. The findings of this study are expected to provide insights into the magnitude of the problem and clarify whether HL may be an important contributing factor in reducing the burden of DPN.

Materials and methods

A cross-sectional study was conducted from June to December 2024 at four government health clinics in Kuantan, Pahang. The clinics were Klinik Kesihatan Bandar Kuantan, Indera Mahkota, Kurnia, and Jaya Gading. These sites were chosen because they have the highest volume of diabetes patients in Kuantan, reliable record systems, and availability of diabetes services. These clinics also represent both urban and suburban populations. Ethical approval was obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (NMRR ID: NMRR -23-03684-PRR [IIR]), as well as the Kuantan District Health Office and the Pahang State Health Department.

The study included adult Malaysian patients aged 18 years or older with a confirmed diagnosis of type 2 diabetes mellitus (T2DM) for at least 1 year, who had attended at least 2 follow-up appointments per year at participating clinics. Patients were excluded if they had a psychiatric illness or intellectual disability that could interfere with questionnaire completion.

The required sample size was determined using the single-proportion formula, based on a previously reported prevalence of 49.4% for diabetic peripheral neuropathy (DPN)[10]. At a 95% confidence level with a 5% margin of error, the minimum sample size was 384. Accounting for a 10% non-response rate, the final sample size was set at 430 participants.

A stratified random sampling method was used. The four clinics with the highest number of active T2DM patients (total $N \approx 10{,}500$) were treated as four strata. Using probability-proportionate-to-size (PPS) allocation, the total sample of 430 was distributed among the clinics according to the number of active patients in each clinic.

Within each clinic, simple random sampling was conducted using an alphabetical registry of active T2DM patients. The =RAND() function in Microsoft Excel was used to generate random numbers and reorder the list. Patients were then approached in sequence from the randomised list and screened against the study's inclusion and exclusion criteria until the required sample size for each clinic was achieved. All participants provided written informed consent before participation.

Patient demographic data were collected through a structured, self-administered questionnaire. The questionnaire captured sociodemographic characteristics and lifestyle factors, including smoking status, proper footwear use, and daily foot inspection practices. Proper footwear was defined according to the Malaysian Clinical Practice Guidelines on Diabetic Foot (2018), including well-fitting, closed-toe footwear with adequate support and protection. Each participant's diabetes record was reviewed to obtain clinical data such as duration of diabetes, HbA1c level, body mass index (BMI), and history of dyslipidaemia, hypertension and ischaemic heart disease.

Screening for DPN was performed on all eligible participants using two validated tools: the Semmes–Weinstein monofilament examination (SWME) and the 128 Hz tuning fork test.
For SWME, a 10-g monofilament was used to assess protective sensation by being applied perpendicularly to 10 non-callused plantar sites on each foot, as per standard screening protocol. With eyes closed, participants verbally indicated when they perceived a sensation. Failure to detect the monofilament at more than 3 out of 10 sites indicated loss of protective sensation. Compared with nerve conduction studies (NCS), the SWME has demonstrated sensitivity ranging from 57% to 93% and specificity from 75% to 100%. A meta-analysis of 19 diagnostic studies reported pooled sensitivity and specificity of 0.53 and 0.88, respectively [11].

A 128 Hz tuning fork was used to assess vibration sense at the dorsum of the hallux and medial malleolus. Participants indicated when the vibration sensation ceased. When compared with vibration perception threshold testing, this assessment has shown a sensitivity of 97% and a specificity of 42% [11].

Participants were classified as having DPN if they met either of the following criteria:
1. loss of protective sensation at more than 3 out of 10 sites on SWME, or
2. Inability to perceive vibration using the 128 Hz tuning fork.

Using both tests in combination increases the overall sensitivity for detecting DPN to approximately 87%, thereby improving screening effectiveness[11]. Both tests were performed by a well-trained postgraduate doctor in Family Medicine to ensure validity and consistency.

Health literacy (HL) was assessed using the Health Literacy Short Form Instrument (HL-SF12), a 12-item questionnaire developed from the European Health Literacy Survey (HLS-EU-Q47). HL-SF12 has been validated as a reliable tool for assessing general health literacy in several Asian populations, including Malaysia, and demonstrates strong psychometric properties, with Cronbach's alpha of 0.85, good criterion-related validity, moderate to high item–scale convergent validity, no floor or ceiling effects, and good model fit [12]. The questionnaire was available in English, Malay, and Mandarin, and permission to use was obtained from the instrument developers [12].

Each item in the questionnaire was rated on a four-point Likert scale: 1 (very difficult), 2 (fairly difficult), 3 (fairly easy), or 4 (very easy). An overall HL index score, ranging from 0 to 50, was calculated using the formula (Index = (Mean-1) x

50/3), where *Mean* represents the average score calculated by summing all answered items for each participant and dividing by the total number of items answered [12]. The HL index was then categorised as: Inadequate: 0–25, Problematic: >25–33, Sufficient: >33–42 or Excellent: >42–50. For analysis, "inadequate" and "problematic" were merged into a single limited HL category (0–33), while "sufficient" and "excellent" were combined as adequate HL (>33–50). Thus, the analytic categories provided a clear dichotomy for subsequent evaluation [12].

Permission was obtained from the person in charge at each participating clinic, and clinic staff were subsequently asked to assemble selected patients before the investigator's weekly visits. Over the six-month data collection period, the principal investigator, who is a trained postgraduate doctor, visited each clinic weekly to provide a brief explanation of the study and invite eligible patients to participate. Written informed consent was then obtained from all participants.

After consent, face-to-face interviews were conducted to complete the questionnaire and HL-SF12. The SWME and tuning fork tests for DPN were then performed, and relevant clinical data were extracted from diabetes records. All data were stored in an electronic database.

Data were analysed using IBM SPSS Statistics version 29. Descriptive statistics were used to summarise sociodemographic and clinical characteristics. Normality of continuous variables was assessed using the Shapiro–Wilk test. As the data were not normally distributed, continuous variables were presented as median and interquartile range (IQR), while categorical variables were expressed as frequencies and percentages.

For bivariate analysis, the Mann–Whitney U test was used for continuous variables and the Pearson χ^2 test for categorical variables. Variables with $p < 0.25$ in the bivariate analysis were included in a multivariable binary logistic regression model to identify independent predictors of diabetic peripheral neuropathy (DPN). Results were reported as adjusted odds ratios (AOR) with 95% confidence intervals (CI), and a p-value < 0.05 was considered statistically significant.

Multivariable binary logistic regression was performed using the backward stepwise method. Multicollinearity among independent variables was assessed using the variance inflation factor (VIF), and no significant multicollinearity was detected.

Results

A total of 430 patients with T2DM were included in the study. The median age was 62 years (interquartile range [IQR] 53–68), with ages ranging from 31 to 89 years. The majority of the participants were female (n = 259, 60.2%), Malay (n = 372, 86.5%), had secondary education (n = 230, 53.4%), and were in the B40 group (n = 385, 89.5%). Just over half of the participants (n = 222, 51.6%) had limited health literacy (Table 1).

Nearly two-thirds of participants had been diagnosed with diabetes for ≥5 years (n = 278, 64.7%), while more than half were obese (n = 233, 54.1%). Hypertension was present in 327 participants (76.0%), dyslipidaemia in 345 (80.2%) and ischaemic heart disease in 24 (5.6%). The median HbA1c level was 7.2% (IQR 6.3–8.8), with values ranging from 4.6% to 13.6%. Current smoking was reported by 47 participants (10.9%), and 7 (1.6%) reported alcohol consumption. In terms of foot care, less than half reported wearing proper footwear; 193 (44.9%) and 202 (47.0%) performed daily foot inspection (Table 2).

Among the study population, the prevalence of diabetic peripheral neuropathy (DPN) was 23.3% (n = 100), with a 95% confidence interval (CI) of 19.3% to 27.5%. This reflects a moderate burden of DPN among adults with T2DM attending primary health clinics in Kuantan.

Health literacy, age, HbA1c level and education level were significantly associated with DPN ($p < 0.05$). Participants with limited health literacy had a higher prevalence of DPN (32.4%) compared to those with adequate health literacy (13.5%), $\chi^2(1, N = 430) = 21.65$, $p < 0.001$. Participants with DPN were also older (median 66 years, IQR 59–73) than those without DPN (median 61 years, IQR 53–68), U = 12,149.50, $p < 0.001$. The median HbA1c level was also significantly higher among participants with DPN (7.5%, IQR 6.4–9.6) than among those without DPN (7.05%, IQR 5.9–8.2), U = 14,193.50, $p = 0.034$. Education level was significantly associated with DPN, with a higher prevalence among those with lower educational attainment, $\chi^2(3, N = 430) = 12.70$, $p = 0.005$.

Variables with $p < 0.25$ in bivariate analyses, namely health literacy, age, HbA1c, BMI, education level, household income, and footwear, were entered into the multiple logistic regression model. Other variables, including gender, race, smoking, alcohol consumption, duration of diabetes, hypertension, dyslipidaemia, ischaemic heart disease, and daily foot inspection, were not significantly associated with DPN (all $p > 0.25$) and were excluded from multivariable analysis.

In the multivariable logistic regression model, two factors (age and HbA1c) remained significantly associated with higher odds of DPN, while health literacy was independently associated with lower odds of DPN. Increasing age was independently associated with DPN; each additional year of age increased the odds of having DPN by 4% (adjusted odds ratio [AOR] 1.04, 95% CI 1.02–1.07, $p = 0.003$). Higher HbA1c was also significantly associated with DPN, with each 1% increase in HbA1c corresponding to a 20% increase in the odds of DPN (AOR 1.20, 95% CI 1.06–1.35, $p = 0.003$).

Health literacy was found to be an independent protective factor. Participants with adequate health literacy had 52% lower odds of having DPN compared to those with limited health literacy (AOR 0.48, 95% CI 0.28–0.82, $p = 0.008$). Other variables in the model, including education level, BMI category, household income and footwear, were not significantly associated with DPN (all $p > 0.05$).

Discussion

This study found that nearly one in four adults with T2DM attending primary health clinics in Kuantan had DPN. This prevalence lies at the lower end of global estimates, which have reported a pooled worldwide prevalence of around one-third in a large meta-analysis [13]. Variations in population characteristics, clinical setting and diagnostic tools largely explain prevalence differences across studies. This study used the 10 g monofilament and 128 Hz tuning fork, tools recommended for primary care screening but less sensitive than nerve conduction studies (NCS)[11]. To address concerns about early detection, it is important to recognise that these tools may not identify subclinical neuropathy, potentially underestimating true prevalence and highlighting the need for more sensitive diagnostic options where feasible.

Comparable prevalence has been reported in community-based studies in Asia using similar screening tools, including Vietnam and India [14,15]. In contrast, tertiary hospital studies often report higher prevalence due to more severe disease and the use of more sensitive diagnostic methods, such as NCS or neuropathy scoring systems [16-18].

Malaysian studies have shown a higher prevalence of DPN in urban clinics and tertiary centres, often exceeding 50%, reflecting both more advanced disease and the greater sensitivity of diagnostic tools used. In urban clinic settings, this may partly reflect the use of symptom-based screening tools such as the Neuropathy Symptom Score, while tertiary centres often utilise more sensitive diagnostic methods [6,10,19]. Despite the lower prevalence observed in this study, DPN remains a significant concern due to its association with foot ulceration, amputation and impaired quality of life, underscoring the need for routine screening in primary care.

Adequate HL emerged as an independent protective factor against DPN. Participants with adequate HL had significantly lower odds of neuropathy, consistent with international evidence that HL influences diabetes self-management and complications[8]. HL was measured using the validated HL-SF12 tool, which has been shown to perform well in Asian populations [12]. Local studies have similarly reported a high proportion of T2DM patients with limited HL [20]. International evidence strongly aligns with these findings. Studies from Iran, Turkey and Australia have shown that inadequate HL is linked to higher complication rates, poorer glycaemic control and greater neuropathy risk [9,21-23]. Patients with better HL are more likely to understand treatment plans, adhere to medications and engage in preventive behaviours such as daily foot inspection and proper footwear use. This study contributes novel Malaysian primary care evidence by demonstrating HL as a modifiable factor associated with DPN. Enhancing HL through structured patient education and culturally tailored communication strategies may therefore represent a cost-effective means of reducing neuropathy burden.

Advancing age was significantly linked to DPN, aligned with international and Malaysian studies showing higher neuropathy rates in older adults with diabetes. Age-related changes such as reduced nerve regeneration, increased oxidative stress, and microvascular dysfunction increase neuropathy risk with chronic hyperglycaemia. Older patients also typically have longer diabetes duration and more comorbidities, raising cumulative risk [10,14,24-26]. The clinical implication is clear: primary care teams must make it a priority to routinely screen older adults with diabetes for neuropathy, provide comprehensive foot-care education, and initiate early preventive measures to mitigate long-term complications.

Higher HbA1c levels were independently associated with DPN, aligning with strong global evidence linking chronic hyperglycaemia to microvascular complications. Long-term studies, including landmark trials, show that improved HbA1c lowers neuropathy risk [14,26]. Chronic hyperglycaemia injures metabolism and blood vessels, endothelial dysfunction, and impairs nerve repair [24]. Regional and local studies support HbA1c as a key DPN predictor [10,14]. Therefore, clinicians should prioritise targeted interventions and regular monitoring to maintain appropriate HbA1c levels and reduce the risk of neuropathy. Notably, while the difference in median HbA1c between participants with and without DPN was modest (7.05% vs. 7.5%, respectively) and achieved statistical significance only due to the large sample size ($p = 0.034$), the adjusted odds ratio from the multivariable model (AOR 1.20 per 1% HbA1c increase) reflects a clinically meaningful gradient of risk across the broader range of HbA1c values observed in this population.

Other variables, including education level, income, BMI, footwear use, foot inspection, gender, ethnicity, diabetes duration, smoking, alcohol intake, and cardiometabolic comorbidities, were not significantly associated with DPN in the final model. Interestingly, participants with normal BMI showed higher odds of DPN compared to those who were obese. This finding should be interpreted cautiously, as it may reflect residual confounding, reverse causation, or limitations of BMI in accurately reflecting body composition. This paradoxical finding may partly reflect the limitations of BMI as a measure of adiposity, particularly its inability to distinguish fat mass from lean mass or capture central obesity, which is more metabolically relevant to DPN. Similar inconsistencies have been reported in previous studies. Although these factors were not statistically significant, they remain clinically important in diabetes care. Healthcare providers should address them through routine counselling and risk-reduction strategies to improve patient outcomes.

The identification of HL as a protective factor highlights the need to incorporate HL assessment and improvement into routine diabetes care. Strategies such as simplified educational materials, teach-back methods, and culturally tailored counselling may help reduce the risk of neuropathy.

Other strategies include prioritising screening, foot care education, and prevention for older adults and those with suboptimal glycaemic control and strengthening HL-sensitive diabetes education in primary care and investing in staff training and accessible resources.

Future longitudinal studies must urgently examine causal pathways among HL, glycaemic control, and DPN, and rigorously evaluate HL-focused interventions in Malaysian populations to inform effective healthcare strategies.

Strengths and limitations

This study's strengths include its real-world primary care setting, probability-proportionate sampling across four clinics, and use of validated DPN and HL assessment tools. Notably, it is among the first Malaysian studies to examine the association between HL and DPN in primary care. Limitations include a cross-sectional design precluding causal inference, a predominantly Malay sample limiting generalisability, and monofilament and tuning fork tests possibly missing subclinical neuropathy compared to NCS. Some residual confounding may also exist.

Conclusion

This study found a DPN prevalence of 23.3% among adults with T2DM attending primary health clinics in Kuantan, consistent with regional estimates in Southeast Asia. Older age, higher HbA1c levels, and limited health literacy were independently associated with increased DPN risk. These findings highlight the importance of early screening, strict glycaemic control, and strengthening health literacy as key strategies to reduce neuropathy in primary care.

Overall, this study reinforces the need for comprehensive diabetes management programmes that incorporate patient education and targeted preventive measures to reduce the burden of DPN in Malaysia.

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Conflicts of interest

The authors declare no conflicts of interest.

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Authors' contributions

NEEM was responsible for conceptualisation, methodology, data collection, formal analysis, and drafting of the original manuscript. AHS provided research supervision, validation, statistical oversight, and contributed to reviewing and editing the manuscript. MAZA contributed to methodology, resources, data curation, and reviewed and edited the manuscript. All authors read and approved the final version of the manuscript.

Data sharing statement

The datasets generated and analysed during the current study are not publicly available due to patient confidentiality, but are available from the corresponding author upon reasonable request. De-identified data may be shared for academic and research purposes with approval from IIUM and the Ministry of Health Malaysia.

Table 1. Sociodemographic characteristics of respondents (N = 430)

Variables	Characteristics	n	%	Median (IQR) Range
Age (years)		-	-	62.0 (15) 31–89
Gender	Male	171	39.8	
	Female	259	60.2	
Race	Malay	372	86.5	
	Chinese	31	7.2	
	Indian	22	5.1	
	Others	5	1.2	
Education Level	No formal education	24	5.6	
	Primary school	82	19.1	
	Secondary school	230	53.4	
	Tertiary	94	21.9	
Household Income	B40 <RM 3900	385	89.5	
	M40 RM 3900-RM 7599	33	7.7	
	T20 > RM 7600	12	2.8	
Health Literacy	Limited	222	51.6	
	Adequate	208	48.4	

Table 2. Clinical characteristics of respondents (N = 430)

Variables	Characteristics	n	%	Median (IQR) Range
Duration of Diabetes	< 5 years	152	35.3	
	≥ 5 years	278	64.7	
BMI (kg/m²)	Underweight	3	0.7	
	Normal	51	11.9	
	Overweight	143	33.3	
	Obese	233	54.1	
HbA1c		-	-	7.2 (2.5) 4.6–13.6
Smoker (Yes)		47	10.9	
Proper Footwear (Yes)		193	44.9	
Daily Foot Inspection (Yes)		202	47.0	
Hypertension (Yes)		327	76.0	
Dyslipidaemia (Yes)		345	80.2	
Ischemic Heart Disease (Yes)		24	5.6	

Table 3. Bivariate analysis of factors associated with diabetic peripheral neuropathy (N = 430)

Variable	DPN		Test Statistic	*P*-Value
	No (%)	Yes (%)		
Health Literacy			21.654[a]	<0.001
Limited	150 (67.6)	72 (32.4)		
Adequate	180 (86.5)	28 (13.5)		
Gender			0.975[a]	0.324
Male	127 (74.3)	44 (25.7)		
Female	203 (78.4)	56 (21.6)		
Age (Years (IQR))	61 (53–68)	66 (59–73)	12,149.5[b]	<0.001
Hba1c (%)	7.05 (5.9–8.2)	7.5 (6.4–9.6)	14,193.5[b]	0.034
BMI (kg/m^2)				0.071
Underweight	2 (66.7)	1 (33.3)	7.015[a]	
Normal	32 (62.7%)	19 (37.3%)		
Overweight	110 (76.9%)	33 (23.1%)		
Obese	186 (79.8%)	47 (20.2%)		
Race				0.626
Malay	289 (77.7)	83 (22.3)	1.750[a]	
Chinese	22 (71.0)	9 (29.0)		
India	16 (72.7)	6 (27.3)		
Others	3 (60.0)	2 (40.0)		
Education				0.005
No formal education	16 (66.7)	8 (33.3)	12.70[a]	
Primary school	55 (67.1)	27 (32.9)		
Secondary school	176 (76.5)	54 (23.5)		
Tertiary	83 (88.3)	11 (11.7)		
Income				0.216
B40	293 (76.1)	92 (23.9)	3.064[a]	
M40	29 (87.9)	4 (12.1)		
T20	8 (66.7)	4 (33.3)		
Duration Of Diabetes			0.639[a]	0.424
< 5 Years	120 (78.9)	32 (21.1)		
≥ 5 Years	210 (75.5)	68 (24.5)		
Hyperlipidemia			0.048[a]	0.826
No	66 (77.6)	19 (22.4)		
Yes	264 (76.5)	81 (23.5)		
Ischemic Heart Disease			0.498[a]	0.481
No	313 (77.1)	93 (22.9)		
Yes	17 (70.8)	7 (29.2)		
Smoking			1.261[a]	0.261
No	297 (77.5)	86 (22.5)		
Yes	33 (70.2)	14 (29.8)		
Alcohol			1.532[a]	0.216
No	326 (77.1)	97 (22.9)		
Yes	4 (57.1)	3 (42.9)		
Footwear			2.496[a]	0.114
Improper Footwear	175 (73.8)	62 (26.2)		

Proper Footwear	155 (80.3)	38 (19.7)		
Daily Foot Inspection			0.478[a]	0.489
No	178 (78.1)	50 (21.9)		
Yes	152 (75.2)	50 (24.8)		

[a] chi-square; [b] Mann-Whitney *U;* * *p* value <0.05 statistically significant; variables with P < 0.25 were included in the multiple logistic regression model.

Table 4. Multiple logistic regression analysis of factors associated with diabetic peripheral neuropathy (N = 430)

Variable	B	Wald	AOR	95% CI	*p*
Age (years)	**0.04**	**9.47**	**1.04**	**[1.02 – 1.07]**	**0.003***
Education Level		2.08			0.556
No Education (ref)					
Primary School	0.12	0.06	1.13	[0.42 – 3.08]	0.811
Secondary School	0.22	0.19	1.25	[0.47 – 3.34]	0.662
Tertiary Level	−0.31	0.27	0.74	[0.23 – 2.36]	0.605
Income		3.73			0.155
B40 < RM 3900 (ref)					
M40 RM 3900–7599	0.36	0.32	1.43	[0.41 – 4.95]	0.572
T20 ≥ RM 7600	1.50	3.69	4.49	[0.97 – 20.75]	0.055
BMI (kg/m²)		6.54			0.089
Obese (ref)					
Underweight	0.68	0.31	1.98	[0.18 – 22.29]	0.581
Normal	0.70	6.09	2.02	[1.16 – 3.51]	0.014
Overweight	0.09	0.10	1.09	[0.63 – 1.90]	0.756
HbA1c (%)	**0.18**	**8.74**	**1.20**	[1.06 – 1.35]	**0.003***
Health Literacy					
Limited (ref)					
Adequate	**−0.74**	**7.14**	**0.48**	[0.28 – 0.82]	**0.008***
Footwear					
Improper (ref)					
Proper Footwear	−0.19	0.57	0.83	[0.51 – 1.35]	0.452

AOR = Adjusted Odds Ratio. CI = Confidence Interval.

**p value <0.05, statistically significant.*

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