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Peru Knowledge, attitudes, and practices regarding prevention of peripheral vascular complications in patients with type 2 diabetes mellitus

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ABSTRACT

Background: Type 2 diabetes mellitus may lead to peripheral complications that compromise lower-limb integrity and require active patient involvement in prevention. Knowledge, attitudes, and self-care practices are relevant components for identifying preventive behaviors and potential educational needs. **Objective:** To determine knowledge, attitudes, and practices related to the prevention of peripheral vascular complications among patients with type 2 diabetes mellitus treated at a hospital in Trujillo, Peru, during 2025. **Methods:** An observational, descriptive, cross-sectional study was conducted among 44 adults with type 2 diabetes mellitus (T2DM) included through census sampling. Information was collected using three structured questionnaires assessing knowledge, attitudes, and preventive practices. Results were summarized using absolute frequencies and percentages. **Results:** Intermediate knowledge predominated in 68.2% (n = 30) of participants, while 22.7% (n = 10) had high knowledge and 9.1% (n = 4) had low knowledge. Attitudes were favorable in 59.1% (n = 26), somewhat favorable in 31.8% (n = 14), and unfavorable in 9.1% (n = 4). Regarding preventive practices, 61.4% (n = 27) showed good practices, 29.5% (n = 13) regular practices, and 9.1% (n = 4) inefficient practices. **Conclusions:** Intermediate knowledge, favorable attitudes, and good preventive practices predominated. Nevertheless, the presence of patients with insufficient knowledge and less favorable preventive behaviors identifies areas that may benefit from strengthened education and self-care follow-up.

Keywords: Diabetes Mellitus, Type 2; Diabetic Foot; Health Knowledge, Attitudes, Practice; Self Care; Disease Prevention.

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Introduction

Diabetes mellitus continues to impose a growing burden on healthcare systems. The most recent estimates indicate that approximately 589 million adults aged 20–79 years were living with diabetes in 2024, with this number projected to reach 853 million by 2050 [1]. Beyond glycemic control, a substantial part of its impact is related to complications affecting the lower extremities. Neuropathy, peripheral artery disease, and diabetes-related foot abnormalities may contribute to injury, ulceration, and infection and, at advanced stages, may lead to amputation. Diabetes-related foot disease therefore represents an important clinical problem, particularly in settings where early detection and access to specialized care remain limited [2,3].

Preventing these complications does not depend solely on interventions delivered during clinical consultations. Current recommendations include periodic risk assessment, foot inspection, early recognition of lesions, appropriate footwear, and self-care behaviors tailored to individual patient characteristics [2,4]. For these measures to become part of everyday care, patients need to understand what should be prevented, maintain a favorable attitude toward prevention, and translate that information into concrete actions. Available evidence nevertheless shows considerable variability in foot-care knowledge and practices among people living with diabetes [5]. Knowledge, skills, and attitudes are also recognized as components that may influence adherence to self-care behaviors, which has encouraged the development of specific instruments for their assessment [6].

Evidence from Peru also demonstrates peripheral vascular involvement among people with type 2 diabetes mellitus. A Peruvian case-control study demonstrated an independent association between poor metabolic control and peripheral artery disease, reinforcing the importance of recognizing and addressing components related to vascular risk [7]. Nevertheless, evidence jointly examining patients' knowledge, attitudes, and preventive practices remains more limited, particularly among individuals receiving hospital care in northern Peru. This information is relevant because knowing a preventive recommendation does not necessarily imply having a favorable attitude toward it or consistently incorporating it into self-care.

Assessing these three dimensions may help identify educational needs that are not readily apparent during routine clinical care. Foot-care education has shown

favorable effects mainly on knowledge and self-care behaviors and, in some studies, on outcomes such as ulceration and amputation, although the magnitude of these effects varies across interventions [8]. Evidence obtained directly from healthcare settings may therefore support educational strategies that more closely address patients' needs and strengthen preventive actions before more severe lesions develop. In this context, the objective of this study was to determine knowledge, attitudes, and practices related to the prevention of peripheral vascular complications among patients with type 2 diabetes mellitus treated at a hospital in Trujillo, Peru, during 2025.

Materials and methods

Study design and setting

An observational, descriptive, cross-sectional study with a quantitative approach was conducted among adults with type 2 diabetes mellitus (T2DM) treated at a level III-2 public hospital in Trujillo, Peru. Data were collected during 2025. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for cross-sectional observational studies [9].

Population, sample, and sampling

The target population consisted of adults diagnosed with T2DM. The accessible population comprised 44 patients with T2DM registered at the healthcare facility during the study period. Because a census approach of all accessible patients was adopted ($N = 44$), a formal sample-size calculation was not required.

Eligibility criteria

Male and female patients aged 18 years or older with a diagnosis of T2DM who voluntarily agreed to participate and provided written informed consent were included. Patients with neurological disorders or cognitive impairment that could interfere with understanding or completing the questionnaires were excluded.

Study variables

The main variables were knowledge, attitudes, and practices related to the prevention of peripheral vascular complications among patients with T2DM.

Knowledge was assessed using 13 questions and classified according to the total score as low (0–5 points), intermediate (6–9 points), or high (10–13 points).

Preventive attitudes were assessed using 24 items with three response options: never, 1 point; sometimes, 2 points; and always, 3 points. Total scores were classified as unfavorable (25–36 points), somewhat favorable (37–54 points), or favorable (55–72 points).

Preventive self-care practices were assessed using 27 items with the same three ordinal response options. Total scores were classified as inefficient (27–45 points), regular (46–63 points), or good (64–81 points).

Sociodemographic variables included sex, age, and educational level. Sex was recorded as male or female; age was recorded in years and subsequently grouped according to the categories established in the study; and educational level was classified as complete or incomplete primary education, complete or incomplete secondary education, technical education, or university education.

Data collection instruments

Data were collected using three structured questionnaires administered face-to-face. The first instrument consisted of 13 multiple-choice questions assessing knowledge related to glycemic control, peripheral circulation, foot hygiene and inspection, nail care, footwear, skin hydration, and actions to be taken when lesions were identified.

The second questionnaire consisted of 24 items assessing attitudes toward preventive measures related to foot hygiene and inspection, footwear and socks, nail and callus care, medical follow-up, treatment adherence, glycemic monitoring, and selected health-related behaviors.

The third instrument consisted of 27 items assessing self-care practices related to diet, physical activity, weight control, foot hygiene and inspection, nail care, injury prevention, and appropriate footwear and socks. Scores were categorized according to the previously established cutoff points for each instrument.

Procedure

After the corresponding ethical and institutional authorizations were obtained, patients meeting the eligibility criteria were identified. Participants were

approached in person and informed about the purpose of the study, the procedures involved, the voluntary nature of participation, and the confidential handling of their information.

Participants who agreed to take part provided written informed consent before questionnaire administration. The three questionnaires were administered face-to-face, and responses were recorded using codes that did not contain direct personal identifiers. Data were subsequently organized in an electronic database and reviewed before statistical analysis.

Statistical Analysis

Data were initially organized using Microsoft Excel and subsequently analyzed using IBM SPSS Statistics, version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized using absolute frequencies and percentages. Distributions of knowledge, attitudes, and preventive practices were calculated for the total sample. Differences in the distribution of knowledge, attitudes, and practices according to sex, age group, and educational level were assessed using Pearson's chi-square test. Statistical significance was set at $p < 0.05$. Analyses were bivariate, and no multivariable models or adjusted measures of association were estimated.

Ethical considerations

The study was authorized by the Research Ethics Committee of the Regional Teaching Hospital of Trujillo under document No. 135, dated July 30, 2025. All participants provided written informed consent before questionnaire administration. Participation was voluntary, and confidentiality was protected through coded data that did not directly identify participants.

The study was conducted in accordance with the ethical principles of the World Medical Association Declaration of Helsinki [10].

Results

A total of 44 patients with type 2 diabetes mellitus were analyzed. Of these, 23 (52.3%) were men and 21 (47.7%) were women. The most represented age groups were 40–49 years (36.4%; $n = 16$) and 50–59 years (34.1%; $n = 15$). Complete secondary education was the most prevalent educational attainment (45.5%; $n = 20$), followed by university and complete primary education (15.9%; $n = 7$ each).

Regarding the prevention of peripheral vascular complications, 68.2% ($n = 30$) of participants had an intermediate level of knowledge, 22.7% ($n = 10$) had a high level, and 9.1% ($n = 4$) had a low level. Favorable attitudes were observed in 59.1% ($n = 26$), while 31.8% ($n = 14$) showed somewhat favorable attitudes and 9.1% ($n = 4$) unfavorable attitudes. Good preventive practices predominated in 61.4% ($n = 27$), followed by regular practices in 29.5% ($n = 13$) and inefficient practices in 9.1% ($n = 4$) (Table 1).

Table 1. Knowledge, attitudes, and practices regarding prevention of peripheral vascular complications among patients with type 2 diabetes mellitus

Variable	Category	n	%
Knowledge	Low	4	9.1
	Intermediate	30	68.2
	High	10	22.7
Attitudes	Unfavorable	4	9.1
	Somewhat favorable	14	31.8
	Favorable	26	59.1
Practices	Inefficient	4	9.1
	Regular	13	29.5
	Good	27	61.4

Note: n, absolute frequency.

Knowledge levels did not show statistically significant differences according to sex ($p = 0.891$) or age group ($p = 0.598$). In contrast, a statistically significant difference was observed according to educational level ($p = 0.001$) (Table 2).

Preventive attitudes showed no statistically significant differences according to sex ($p = 0.271$) or age group ($p = 0.389$). A statistically significant difference was identified according to educational level ($p = 0.003$) (Table 3).

Preventive practices did not differ significantly according to sex ($p = 0.147$) or age group ($p = 0.408$). Differences were statistically significant according to educational level ($p = 0.001$) (Table 4).

Discussion

The main finding of this study was that intermediate knowledge predominated among patients with type 2 diabetes mellitus, whereas favorable attitudes and good

preventive practices were observed in more than half of the participants. Educational level was the only sociodemographic characteristic showing statistically significant differences in the distribution of knowledge, attitudes, and practices. In contrast, no significant differences were observed according to sex or age. These findings suggest that the three components of preventive behavior do not necessarily develop to the same degree and that educational background may be relevant when planning strategies for the prevention of peripheral vascular and diabetes-related foot complications.

The predominance of intermediate knowledge is consistent with the heterogeneous levels reported in populations with diabetes. Alshahrani et al. found moderate knowledge in a large hospital-based KAP study, while Alharbi and Sulaiman reported good diabetic-foot knowledge in 56.5% of their participants [11,12]. In contrast, Omotosho et al. found poor foot self-care knowledge in 52.5% of patients attending diabetic clinics in The Gambia [13]. This variability has also been identified in reviews of diabetic-foot self-care, where knowledge ranged from markedly insufficient to adequate depending on the population, instruments, healthcare setting, and previous exposure to diabetes education [5,14]. Consequently, the intermediate level observed in the present study should not be interpreted as complete preparation for prevention; rather, it indicates that a considerable proportion of patients had acquired preventive information without consistently reaching the highest category of knowledge.

Favorable attitudes were observed in 59.1% of the participants. Similar findings have been reported in other hospital populations, although the magnitude varies. Bekele and Berhanu found a favorable attitude toward diabetic-foot care in approximately two-thirds of patients, whereas Awwad and Abu-khader reported considerable variability across knowledge, attitude, and practice scores and identified educational level as an important characteristic associated with preventive attitudes [15,16]. More recent evidence has likewise shown that favorable attitudes may coexist with incomplete knowledge or inconsistent preventive behaviors [11]. This distinction is relevant because willingness to perform foot care does not necessarily imply that patients have all the information or skills needed to perform each preventive activity correctly. Differences between studies may also reflect the content of the questionnaires, scoring thresholds, previous counseling received, duration of diabetes, and characteristics of the health services in which patients were recruited.

Table 2. Knowledge regarding prevention of peripheral vascular complications according to sociodemographic characteristics

Characteristic	Category	Low, n (%)	Intermediate, n (%)	High, n (%)	χ^2	p
Sex	Male	3 (6.8)	14 (31.8)	6 (13.6)	0.341	0.891
	Female	1 (2.3)	16 (36.4)	4 (9.1)		
Age, years	80–89	0 (0.0)	2 (4.5)	0 (0.0)	3.810	0.598
	70–79	0 (0.0)	5 (11.4)	2 (4.5)		
	50–59	2 (4.5)	11 (25.0)	2 (4.5)		
	40–49	2 (4.5)	9 (20.5)	5 (11.4)		
	30–39	0 (0.0)	2 (4.5)	1 (2.3)		
	18–29	0 (0.0)	1 (2.3)	0 (0.0)		
Educational level	Technical	0 (0.0)	3 (6.8)	1 (2.3)	6.147	0.001
	University	0 (0.0)	6 (13.6)	1 (2.3)		
	Incomplete secondary	1 (2.3)	3 (6.8)	1 (2.3)		
	Complete secondary	2 (4.5)	15 (34.1)	3 (6.8)		
	Incomplete primary	0 (0.0)	0 (0.0)	1 (2.3)		
	Complete primary	1 (2.3)	3 (6.8)	3 (6.8)		
Total		4 (9.1)	30 (68.2)	10 (22.7)		

Note: Values are presented as n (%). Percentages were calculated using the total sample (N = 44) as the denominator. p-values were determined using Pearson's chi-square test or Fisher's exact test, as appropriate for expected cell counts. Statistical significance was set at $p < 0.05$.

Table 3. Attitudes toward prevention of peripheral vascular complications according to sociodemographic characteristics

Characteristic	Category	Unfavorable, n (%)	Somewhat favorable, n (%)	Favorable, n (%)	χ^2	p
Sex	Male	1 (2.3)	8 (18.2)	14 (31.8)	0.238	0.271
	Female	3 (6.8)	6 (13.6)	12 (27.3)		
Age, years	80–89	1 (2.3)	0 (0.0)	1 (2.3)	4.630	0.389
	70–79	0 (0.0)	2 (4.5)	5 (11.4)		
	50–59	2 (4.5)	4 (9.1)	9 (20.5)		
	40–49	1 (2.3)	5 (11.4)	10 (22.7)		
	30–39	0 (0.0)	2 (4.5)	1 (2.3)		
	18–29	0 (0.0)	1 (2.3)	0 (0.0)		
Educational level	Technical	0 (0.0)	1 (2.3)	3 (6.8)	5.786	0.003
	University	0 (0.0)	2 (4.5)	5 (11.4)		
	Incomplete secondary	0 (0.0)	1 (2.3)	4 (9.1)		
	Complete secondary	2 (4.5)	7 (15.9)	11 (25.0)		
	Incomplete primary	0 (0.0)	1 (2.3)	0 (0.0)		
	Complete primary	2 (4.5)	2 (4.5)	3 (6.8)		
Total		4 (9.1)	14 (31.8)	26 (59.1)		

Note: Values are presented as n (%). Percentages were calculated using the total sample (N = 44) as the denominator. p-values were determined using Pearson's chi-square test or Fisher's exact test, as appropriate for expected cell counts. Statistical significance was set at $p < 0.05$.

Table 4. Preventive practices regarding peripheral vascular complications according to sociodemographic characteristics

Characteristic	Category	Inefficient, n (%)	Regular, n (%)	Good, n (%)	χ^2	p
Sex	Male	3 (6.8)	11 (25.0)	9 (20.5)	0.380	0.147
	Female	1 (2.3)	2 (4.5)	18 (40.9)		
Age, years	80–89	0 (0.0)	0 (0.0)	2 (4.5)	4.892	0.408
	70–79	1 (2.3)	2 (4.5)	4 (9.1)		
	50–59	0 (0.0)	4 (9.1)	11 (25.0)		
	40–49	2 (4.5)	6 (13.6)	8 (18.2)		
	30–39	1 (2.3)	1 (2.3)	1 (2.3)		
	18–29	0 (0.0)	0 (0.0)	1 (2.3)		
Educational level	Technical	1 (2.3)	1 (2.3)	2 (4.5)	6.586	0.001
	University	0 (0.0)	2 (4.5)	5 (11.4)		
	Incomplete secondary	1 (2.3)	2 (4.5)	2 (4.5)		
	Complete secondary	1 (2.3)	5 (11.4)	14 (31.8)		
	Incomplete primary	1 (2.3)	0 (0.0)	0 (0.0)		
	Complete primary	0 (0.0)	3 (6.8)	4 (9.1)		
Total		4 (9.1)	13 (29.5)	27 (61.4)		

Note: Values are presented as n (%). Percentages were calculated using the total sample (N = 44) as the denominator. p-values were determined using Pearson's chi-square test or Fisher's exact test, as appropriate for expected cell counts. Statistical significance was set at $p < 0.05$.

Good preventive practices were present in 61.4% of the sample. This proportion is close to that reported by Alharbi and Sulaiman, who identified good practices in 56.9% of patients, and to the 63.6% with satisfactory practices reported by Dhandapani et al. in South India [12,17,18]. Other settings have shown less favorable results. Letta et al. reported good foot-care practices in only 20.2% of patients with T2DM, while Omotosho et al. found poor practices in 68.7% [13,14].

These differences reinforce that self-care behavior is strongly context dependent. Access to information, previous contact with healthcare personnel, duration of the disease, cultural habits, available resources, and the way preventive education is delivered may influence whether recommendations are incorporated into everyday routines.

An interesting aspect of the present findings was the coexistence of predominantly intermediate knowledge with predominantly favorable attitudes and good practices. Although knowledge and health behaviors are related, they represent distinct constructs that do not always align linearly.

Letta et al. found that adequate diabetes knowledge was associated with better foot-care practices, while other studies have shown that patients may perform some recommended activities despite incomplete conceptual knowledge [14,17]. This could occur when behaviors have been incorporated through repeated medical advice, personal experience, family support, or routine disease management rather than through comprehensive understanding of the mechanisms underlying prevention. Accordingly, the present findings should not be interpreted as evidence that intermediate knowledge is sufficient; instead, they highlight the value of assessing knowledge, attitudes, and practices separately when identifying educational needs.

Educational level was significantly related to all three outcomes evaluated in this study. This finding is particularly relevant because previous research has repeatedly identified education as an important determinant of diabetic-foot knowledge and self-care. Alrashed et al. emphasized differences in diabetic-foot knowledge and practices across educational levels in a study of 534 patients [19]. Omotosho et al. also identified educational level as significantly associated with foot-care knowledge [13], while Letta et al. found that secondary or higher education was associated with

greater odds of adequate diabetes knowledge [14]. Similar associations have been reported for preventive attitudes and practices by Awwad and Abu-khader [16], and for specific foot-care behaviors in a Brazilian population by Lima et al. [17]. In addition, Bekele et al. identified higher educational status as a predictor of better diabetic-foot self-care practices [20]. Taken together, these studies support the relevance of educational background, although the distributions observed in the present sample were not strictly linear across every educational category. Therefore, the result should be interpreted as a difference according to educational level rather than as evidence that each successive level of formal education necessarily produces proportionally better preventive behavior.

No statistically significant differences were observed according to sex or age. The absence of differences by sex is consistent with the Brazilian study by Lima et al., in which foot self-care activities were not significantly associated with sex [17]. However, findings concerning age have been less consistent. Some studies have identified age as a factor associated with knowledge or preventive behaviors [12,14,15], whereas others have not found a clear relationship with all dimensions of self-care. Differences in sample size, age distribution, duration of diabetes, educational background, and clinical history may explain these discrepancies. In the present study, the small number of participants within several age categories also limits the precision with which age-related patterns can be characterized.

From a clinical and educational perspective, the findings support preventive education that goes beyond providing information alone. Patients may benefit from strategies adapted to their educational and health-literacy characteristics, using clear language, demonstrations of foot inspection and hygiene, guidance on footwear and nail care, and periodic reinforcement during follow-up. Current international recommendations emphasize structured education as part of diabetes-related foot-disease prevention [2,4]. Moreover, the systematic review and meta-analysis by Drovandi et al. found that educational interventions generally improved knowledge and self-care behaviors, although variation among interventions and methodological quality requires cautious interpretation [8]. Educational strategies should therefore be practical, repeated, and adapted to the patient's ability to understand and apply preventive recommendations rather than relying exclusively on one-time verbal counseling.

Among the strengths of this study were the simultaneous assessment of three complementary components of preventive care knowledge, attitudes, and practices and the inclusion of the entire accessible population meeting the eligibility criteria during the study period. The face-to-face administration of structured questionnaires also allowed the same data-collection procedure to be applied to all participants. In addition, examining the three outcomes according to sociodemographic characteristics provided information that may be useful for identifying groups requiring differentiated educational approaches.

Several limitations should nevertheless be considered. The study was conducted in a single hospital and included 44 participants, which limits the generalizability and precision of the findings, particularly within educational and age subgroups containing few individuals. Its cross-sectional design does not allow temporal or causal relationships to be established. Knowledge, attitudes, and practices were assessed using self-reported responses and may therefore have been influenced by recall or social-desirability bias. The analyses were bivariate and did not adjust for potential confounding factors such as duration of diabetes, previous diabetes education, glycemic control, history of foot ulceration, neuropathy, or other clinical characteristics that have been associated with preventive knowledge and behavior in previous studies [11–15,19,20]. Thus, the observed differences according to educational level should be interpreted as associations within this sample rather than independent effects.

Future research should include larger multicenter populations and, where feasible, probability-based sampling. Studies incorporating standardized measures of health literacy, duration of diabetes, previous educational exposure, glycemic control, peripheral neuropathy, peripheral artery disease, and history of foot complications would allow more comprehensive multivariable analyses. Prospective or interventional designs would also be useful for determining whether educational programs tailored to patients' baseline knowledge and educational characteristics produce sustained improvements in attitudes, self-care practices, and clinically relevant foot outcomes.

Conclusions

Among patients with type 2 diabetes mellitus, intermediate knowledge regarding the prevention of peripheral vascular complications predominated, while most participants showed favorable attitudes and good

preventive practices. Statistically significant differences in knowledge, attitudes, and practices were identified according to educational level, whereas no significant differences were observed according to sex or age. These findings highlight the importance of considering patients' educational characteristics when planning preventive education and self-care strategies.

Author Contributions Statement (CRediT)

MAI: Conceptualization, Methodology, Investigation, Formal Analysis, Data Curation, Visualization, Writing – Original Draft, Writing – Review & Editing, and Project Administration

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Conflict of Interest

The author declares that he has no financial, institutional, professional, or personal conflicts of interest that could have influenced the conduct or publication of this study.

Data Availability

The data supporting the findings of this study are not publicly available because of ethical and confidentiality considerations related to participant information. Data may be requested from the corresponding author upon reasonable request and will be subject to the appropriate institutional authorization.

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