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HEALTH LITERACY, KNOWLEDGE OF DISEASE AND RISK FOR DIABETIC FOOT IN ADULTS: CROSS-SECTIONAL STUDY

LETRAMENTO EM SAÚDE, CONHECIMENTO DA DOENÇA E RISCO PARA PÉ DIABÉTICO EM ADULTOS: ESTUDO TRANSVERSAL

ALFABETIZACIÓN EN SALUD, CONOCIMIENTO DE LA ENFERMEDAD Y RIESGO DE PIE DIABÉTICO EN ADULTOS: ESTUDIO TRANSVERSAL

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Objective: to analyze the relationship of health literacy, knowledge of the disease and risk for the development of diabetic foot in adults with Diabetes *Mellitus*, according to sociodemographic and clinical characteristics. Method: cross-sectional, descriptive and analytical study, conducted from January to March 2020. The participants were 33 adults with glycemic alterations registered in a health unit in the Metropolitan Region of Curitiba, Paraná, Brazil. A sociodemographic and clinical questionnaire was applied and the Eight-Item Health Literacy Assessment Tool and Spoken Knowledge in Low Literacy Patients with Diabetes were applied. Results: there was a predominance of satisfactory literacy and adequate knowledge, associated with age (≤59 years), time of schooling (>4 years) and diagnosis (>5 years). When crossing the variables of health literacy and knowledge of the disease with the risk for diabetic foot there was no statistical significance. Conclusion: satisfactory levels of literacy were associated with adequate knowledge, unrelated to the risk for diabetic foot.

Descriptors: Diabetes Mellitus Type 2. Literacy in Health. Adult. Knowledge. Diabetic Foot.

Objetivo: analisar a relação do letramento em saúde, conhecimento da doença e risco para o desenvolvimento do pé diabético em adultos com Diabetes Mellitus, de acordo com as características sociodemográficas e clínicas.

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Método: estudo transversal, descritivo e analítico, realizado de janeiro a março de 2020. Participaram 33 adultos com alterações glicêmicas cadastrados em unidade de saúde da Região Metropolitana de Curitiba, Paraná, Brasil. Aplicou-se questionário sociodemográfico e clínico e os instrumentos Eight-Item Health Literacy Assessment Tool e Spoken Knowledge in Low Literacy Patients with Diabetes. Resultados: houve predominância de letramento satisfatório e conhecimento adequado, associados à idade (≤59 anos), tempo de escolaridade (>4 anos) e diagnóstico (>5 anos). Ao cruzar as variáveis de letramento em saúde e conhecimento da doença com o risco para pé diabético não houve significância estatística. Conclusão: níveis satisfatórios de letramento foram associados ao conhecimento adequado, sem relação com o risco para pé diabético.

Descritores: Diabetes Mellitus Tipo 2. Letramento em Saúde. Adulto. Conhecimento. Pé Diabético.

Objetivo: analizar la relación de alfabetización en salud, conocimiento de la enfermedad y riesgo para el desarrollo del pie diabético en adultos con Diabetes Mellitus, según características sociodemográficas y clínicas. Método: estudio transversal, descriptivo y analítico, realizado de enero a marzo de 2020. Treinta y tres adultos con alteraciones glucémicas registrados en una unidad de salud en la Región Metropolitana de Curitiba, Paraná, Brasil, participaron en el estudio. Un cuestionario sociodemográfico y clínico y los instrumentos Eight-Item Health Literacy Assessment Tool y Spoken Knowledge in Low Literacy Patients with Diabetes. Resultados: predominó la alfabetización satisfactoria y el conocimiento adecuado, asociado a la edad (≤59 años), tiempo de escolaridad (>4 años) y diagnóstico (>5 años). Al cruzar las variables de alfabetización en salud y conocimiento de la enfermedad con el riesgo de pie diabético no hubo significación estadística. Conclusión: los niveles satisfactorios de alfabetización se asociaron con un conocimiento adecuado, no relacionado con el riesgo de pie diabético.

Descriptores: Diabetes Mellitus Tipo 2. Alfabetización en Salud. Adulto. Conocimiento. Pie Diabético.

Introduction

Diabetes *Mellitus* (DM) is a chronic non-communicable disease that represents a global public health problem, due to high morbidity and mortality rates and consequent micro and macro vascular alterations that compromise various organs and systems, resulting in complications, especially diabetic foot[1].

This is a condition defined as ulceration, infection or destruction of soft tissues, associated with peripheral arterial disease and neurological alterations[2]. Its impact is significant on quality of life, mobility and physical functionality, especially when there is no healing, culminating in indication of body segment amputation[3].

Among the risk factors for the development of diabetic foot is Diabetes *Mellitus* type 2 (DM2), systemic arterial hypertension (SAH), obesity, tobacco consumption, increased levels of cholesterol, triglycerides and blood glucose, which contribute to the formation of atheroma plaques, resulting in decreased blood flow to the lower limbs[4-5].

It is estimated that, worldwide, the incidence of diabetic foot varies between 5% and 6.3%, with a prevalence of 4% to 10%, on a larger scale in developing countries[1]. In Brazil, a hypothetical analysis for 7.12 million people with DM2 estimated that more than 480,000 would develop ulcers, 169,000 would receive hospitalization, about 81,000 would require amputation, of which more than 21,000 would result in death[1].

Diabetic foot precedes about 85% of non-traumatic amputations, but it can be prevented[1]. For this, the person with DM should obtain adequate knowledge about the disease and satisfactory levels of health literacy (HL), for active participation in treatment with medication and lifestyle changes. Knowledge and HL are the bases for the development of self-care skills[6].

HL or health literacy refers to the skills of the person and/or collectivity in the search, interpretation and decision-making, through access to the information and services available. Low levels of HL can influence the knowledge of the disease, treatment adherence and, consequently, glycemic uncontrol, increased risk factors and complications[7-8].

The measurement of HL and knowledge of the disease provides support for the direction of health education actions, optimizing access to information, development of skills and autonomy of the person for self-care, with a

view to minimizing or postponing complications associated with DM. In view of the above, the aim of this study was to analyze the relationship of health literacy, knowledge of the disease and risk for the development of diabetic foot in adults with DM, according to sociodemographic and clinical characteristics.

Method

This is a cross-sectional, descriptive and analytical study that followed the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[9]. Data collection occurred from January to March 2020 in a *Estratégia Saúde da Família* (ESF) unit located in the Metropolitan Region of Curitiba, Paraná, Brazil, which was indicated by the *Coordenação de Saúde do Município* because it has the highest number of registered users (n=10,141) and diagnosed with DM (n=516).

The sample consisted of 33 adults with DM who were part of the coverage area and were registered in the ESF where data collection was performed. Inclusion criteria were: being between 18 and 65 years old; present record in the medical records of fasting glycaemia ≥126mg/dL and/or glycated hemoglobin (HbA1c) >7% in the years 2019 and 2020. Exclusion criteria were: presenting comorbidities and/or complications that prevented communication.

The selection of participants was performed through a list of the names and registration numbers of users who were part of the *Programa de HAS* and *DM* (Hiperdia) of the ESF, and an active search was performed in medical records and verified whether they met the eligibility criteria. Of the 516 users with DM, 78 were selected, to whom telephone contact was made to invite participation in the study. It was not possible to contact 27 users, due to the lack of phone number or mistake, 6 did not accept to participate and 5 did not answer any of the 3 phone calls made on different days and times.

The 40 volunteers were offered a meeting at home or in the ESF to clarify the study. At that time, one volunteer refused to participate, five presented the last test result in printed form with fasting glucose and/or HbA1c below the criteria established for this study and one presented difficulty in communication due to the diagnosis of Alzheimer's, resulting in a final sample of 33 users.

For those who agreed to participate in the study, the Informed Consent Form (ICF) was read. After signing, the nursing consultation was initiated, conducted by a single researcher, who applied the sociodemographic and clinical questionnaire and the Eight-Item Health Literacy Assessment Tool (HLAT-8) and Spoken Knowledge in Low Literacy Patients with Diabetes (SKILLD), to evaluate the HL and knowledge about DM. The consultation lasted an average of 90 minutes, of which 31 were performed at home and 2 in the ESF office, using a single protocol and standardized equipment.

The sociodemographic and clinical questionnaire was previously tested and validated by the adult and elderly health research group, of which the authors are part, and contained questions related to gender, age, schooling, income, time of diagnosis of DM, number of daily medications, physical activity, body mass index (BMI) and evaluations for diabetic foot screening (bone changes in the feet, ankle-brachial index (ABI) values and plantar and vibratory sensitivity tests).

The risk classification for diabetic foot was performed based on clinical findings by assessing tactile sensitivity using a 10g Semmes-Weistein esthesiometer (Sorri-Bauru®), vibratory sensitivity with 128 Hz (Golgran®) and ABI. It was interpreted as loss of protective sensitivity of the feet when the participant did not feel two of the three applications of the 10g monofilament on the surfaces of the distal phalanges of the first, third and fifth fingers, and in the three metatarsi points of the respective fingers. Vibratory sensitivity was evaluated as abnormal when the participant answered incorrectly two of the three applications of the tuning form in the medial malleolar region and/or in the proximal phalanx of the hallux[10].

The ABI was obtained by checking systolic blood pressure (SBP) in the arm and leg, using a calibrated aneroid sphygmomanometer

(Premium®) and portable vascular Doppler (DV 610B Medmega®). The value was obtained by the ratio between brachial SBP divided by ankle SBP, classified as normal (1.01 to 1.40mmHg), borderline (0.91 to 1.00mmHg) and abnormal (<0.90mmHg)[11].

The risk for the development of diabetic foot was categorized as 0, when there was no loss of sensitivity and normal ABI; risk 1 when there were changes in sensitivity with or without deformities in the feet; risk 2 when ABI <0.90mmHg with or without loss of sensitivity; and risk 3 when a history of amputation or ulceration[10]. For the analysis of these data, the values were re-categorized, being considered low/moderate risk for the development of diabetic foot when indexes 0 and 1 and high risk, when 2 and 3.

HLAT-8 was used to evaluate HL levels. The version translated and validated for the Portuguese is composed of 8 questions, with scores between 0 and 37; the higher the score, the better the evaluation of the corresponding item. This scale allows the measurement of four structural factors: understanding of health information (UHI: questions 1 and 2; from zero to five points); search for health information (SHI: questions 3 and 4; from zero to four points); health interaction (HI: questions 5 and 6; from zero to five points) and critical health knowledge (CHK: questions 7 and 8; with a maximum score of five and four points, respectively)[12]. For this study, the maximum HLAT-8 score of 37 points was considered, adopting as satisfactory HL the total score ≥50% (≥19 points); the lower values were considered as unsatisfactory HL.

SKILLD was used to assess the knowledge of DM; the version translated and validated for the Brazilian Portuguese is composed of 10 questions with scores ranging from 0 to 100%. This instrument accepts verbal responses, and it is not necessary for the participant to have reading skills. In the case of non-understanding of the question, the second statement with the reformulated question is used[13]. For the analysis of the values obtained in SKILLD, the total score of ≥6 (>50%) was considered as adequate knowledge; the lowers were categorized as inadequate knowledge.

The data were entered in Microsoft Excel 365® spreadsheets, with double checking and later exported to the Software Statistical Package for the Social Sciences (SPSS), version 20.0®, which performed the statistical analysis. The results of HLAT-8 were analyzed descriptively by measures of central tendency – mean and standard deviation (SD). SKILLD wrong and correct answers were analyzed by simple (n) and absolute (%) frequencies.

The reliability analysis by Cronbach's alpha was used for HLAT-8 and SKILLD, because these instruments were validated for the Brazilian Portuguese in populations different from that of this study.

The variables were categorized and re-categorized by parameters established by the researchers based on the literature, being: age (≤59 and >59 years), classified as adults and the elderly; time of diagnosis (up to 5 and >5 years), due to the experiences resulting from the disease; education (up to 4 and >4years), considering elementary school (low schooling). Data from 32 participants were used for this analysis); income (≤1,045.00 BRL and >1,045.00 BRL), based on the Brazilian minimum wage in force during the study period; gender (male and female); level of HL (satisfactory and unsatisfactory) and knowledge (adequate and inadequate), based on the scores established in the validation of the instruments[12-13]; and risk for diabetic foot, according to the risk classification, according to the definition of the literature (risk 0 and 1 (low/moderate) and 2 and 3 (high))[10]. To analyze the relationship of the variables, the chi-square test with Yates correction was applied, and when they presented distribution in one of the cells below five participants, the Fisher's Exact test was used. A value of p≤0.005 was adopted as significant.

The study was approved by the Research Ethics Committee (REC) of the *Universidade Federal do Paraná* (UFPR), under Opinion n. 3.752.041 and *Certificado de Apresentação de Apreciação Ética* (CAAE) 20244119.3.0000.0102. All ethical guidelines specified in Resolution n. 466 of December 12, 2012 of the *Conselho Nacional de Saúde* for research involving human beings were respected.

Results

The participants had a minimum age of 34 years and a maximum of 65 (57.0±8.08). Regarding age, 84.8% (n=28) were >59 years; 78.8% (n=26) had schooling time >4 years, 69.7% (n=23) were female and 69.7% (n=23) had *per capita* income less than or equal to a national minimum wage (1,045.00 BRL).

Regarding clinical variables, 91.0% (n=30) did not practice physical activity regularly, 75.7% (n=25) had DM for >5 years, 57.6% (n=19) had high risk for the development of diabetic foot, 54.5% (n=18) used five or fewer medications continuously and 51.5% (n=17) had BMI ≤29.9 kg/m^2.

Regarding the measurement of HL, the mean HLAT-8 score was 20.7±5.4, with a minimum of 9 and a maximum of 32, with 57.6% (n=19) obtaining satisfactory levels of HL. The average scores of HLAT-8 questions and structural factors are detailed in Table 1.

Table 1 – Assessment of health literacy in adults with Diabetes Mellitus. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33)

Variables	Mean	Standard deviation
Questions of the Eight-Item Health Literacy Assessment Tool		
Q1 – How much do you understand about the instructions on the medication inserts?	1.6	1.7
Q2 – How much do you understand about health information in leaflets/ booklets?	2.2	1.8
Q3 – When I have questions about illnesses or complaints, I know where I can find this information.	2.7	0.7
Q4 – When I want to do something for my health without being sick, I know where I can find this information.	2.2	1.1
Q5 – How often were you able to help your family or a friend if they had questions about health problems?	3.7	1.6
Q6 – When you had questions about health problems and issues, how many times were you able to receive advice and information from other people (family and friends)?	3.3	1.8
Q7 – How do you believe you know how to choose the advice and recommendations that are best for your health?	3.6	0.8
Q8 – Regarding health information on the Internet, I am able to determine which sources are of high or low quality.	1.5	1.5
Structural factors of the Eight-Item Health Literacy Assessment Tool		
Understanding health information	3.8	2.9
Search for health information	4.9	1.2
Health interaction	7.0	2.5
Critical health knowledge	5.1	1.8

Source: Created by the authors.

Regarding the application of SKILLD, 54.4% (n=18) presented adequate knowledge about DM, and the score ranged from 0 to 100%, with an average of 5.2±2.6. The percentage of wrong and right answers of the instrument is shown in Table 2.

Table 2 – Percentage of correct answers among adults with Diabetes Mellitus in the Spoken Knowledge instrument in Low Literacy Patients with Diabetes. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33)

(continued)

Questions of the Spoken Knowledge in Low Literacy Patients with Diabetes	n		%	
	Wrong	Right	Wrong	Right
Q1 – What are the signs and symptoms of high blood glucose?	28	5	84.8	15.2
Q2 – What are the signs and symptoms of low blood glucose?	22	11	66.7	33.3

Table 2 – Percentage of correct answers among adults with Diabetes Mellitus in the Spoken Knowledge instrument in Low Literacy Patients with Diabetes. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33)

(conclusion)

Questions of the Spoken Knowledge in Low Literacy Patients with Diabetes	n		%	
	Wrong	Right	Wrong	Right
Q3 – How should low blood glucose be treated?	8	25	24.2	75.8
Q4 – How often should a person with diabetes have their feet checked?	21	12	63.6	36.4
Q5 – Why is foot examination important for a person who has diabetes?	13	20	39.4	60.6
Q6 – How often should a person with diabetes see the optician and why is this important?	9	24	27.3	72.7
Q7 – What is normal fasting blood glucose?	8	25	24.2	75.8
Q8 – What is the normal value of glycated hemoglobin?	21	12	63.6	36.4
Q9 – How many times a week should a person with diabetes exercise and for how long?	15	18	45.5	54.5
Q10 – What are the long-term complications of uncontrolled diabetes?	17	16	51.5	48.5

Source: Created by the authors.

When evaluating the reliability of HLAT-8 and SKILLD instruments, Cronbach's alpha value of 0.511 and 0.756, respectively, was obtained. By correlating sociodemographic and clinical variables with levels of knowledge of the disease, HL and risk for diabetic foot, an association of HL with knowledge of the disease was identified (p= 0.015), and people with adequate HL level also had satisfactory knowledge (n=14; 77.8%). However, there was no statistical significance between the level of knowledge and HL with the risk for diabetic foot (Table 3).

Table 3 – Relationship between sociodemographic and clinical variables with knowledge of Diabetes Mellitus, level of health literacy and risk for diabetic foot. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33)

(continued)

Variables	Knowledge of Diabetes Mellitus (Spoken Knowledge in Low Literacy Patients with Diabetes)			Level of Health Literacy (Eight-Item Health Literacy Assessment Tool)		
	Adequate n (%)	Inadequate n (%)	p-value	Satisfactory n (%)	Unsatisfactory n (%)	p-value
Sex			1.00 (1)			0.335 (1)
Female	13 (56.5)	10 (43.5)		15 (65.2)	8 (34.8)	
Male	5 (50.0)	5 (50.0)		4 (40.0)	6 (60.0)	
Age group (years)			0.238 (1)			0.421 (1)
≤59	12 (66.7)	6 (33.3)		12 (66.7)	6 (33.3)	
>59	6 (40.0)	9 (60.0)		7 (46.7)	8 (53.3)	
Education (years)			0.365 (2)			0.194 (2)
≤4	2 (33.3)	4 (66.7)		2 (33.3)	4 (66.7)	
>4	16 (61.5)	10 (38.5)		17 (65.4)	9 (34.6)	
***Per capita* income (BRL) (3)**			0.070 (2)			0.707 (2)
≤1,045.00	10 (43.5)	13 (56.5)		14 (60.9)	9 (39.1)	
>1,045.00	8 (80.0)	2 (20.0)		5 (50.0)	5 (50.0)	
Time of diagnosis (years)			0.101 (2)			0.238 (2)
≤5	2 (25.0)	6 (75.0)		3 (37.5)	5 (62.5)	
>5	16 (64.0)	9 (36.0)		16 (64.0)	9 (36.0)	

Table 3 – Relationship between sociodemographic and clinical variables with knowledge of Diabetes Mellitus, level of health literacy and risk for diabetic foot. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33)

(conclusion)

Variables	**Knowledge of Diabetes Mellitus (**Spoken Knowledge in Low Literacy Patients with Diabetes**)**			**Level of Health Literacy (**Eight-Item Health Literacy Assessment Tool**)**		
	Adequate n (%)	Inadequate n (%)	p-value	Satisfactory n (%)	Unsatisfactory n (%)	p-value
Daily medications			0.187 (1)			0.073 (2)
≤5	8 (42.1)	11 (57.9)		8 (42.1)	11 (57.9)	
>5	10 (71.4)	4 (28.6)		11 (78.6)	3 (21.4)	
Physical activity			0.579 (2)			1.000 (2)
Regular	1 (33.3)	2 (66.7)		2 (66.7)	1 (33.3)	
Sporadic or non-practitioner	17 (56.7)	13 (43.3)		17 (56.7)	13 (43.3)	
Body Mass Index (kg/m²)			0.589 (1)			0.616 (1)
≤29.9	8 (47.1)	9 (52.9)		11 (64.7)	6 (35.3)	
≥30	10 (62.5)	6 (37.5)		8 (50.0)	8 (50.0)	
Risk for diabetic foot			0.421 (1)			0.690 (1)
Low/ moderate	6 (42.9)	8 (57.1)		7 (50.0)	7 (50.0)	
High	12 (63.2)	7 (36.8)		12 (63.2)	7 (36.8)	
Level of Health Literacy (Eight-Item Health Literacy Assessment Tool**)**			0.015 (2)			-
Satisfactory	14 (77.8)	4 (22.2)		-	-	
Unsatisfactory	5 (33.3)	10 (66.7)		-	-	

Source: Created by the authors.

Note: Conventional signal used:
- Numeric data equal to zero not resulting from rounding.

(1) Chi-square test with Yates correction.
(2) Fisher's exact test.
(3) Brazilian minimum wage in January and March 2020 was 1,045.00 BRL.

When analyzing the sociodemographic and clinical variables with the risk for diabetic foot, it was found that the participants at high risk obtained >4 years of schooling (n=17; 65.4%), did not practice physical activity (n=17; 56.7%) and had *per capita* income ≤$1,045.00 BRL (n=17; 65.4%) (Table 4).

Table 4 – Relationship between sociodemographic and clinical variables with the risk for diabetic foot. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33)

(continued)

Variables	**Risk for diabetic foot**		
	Low/moderate n (%)	High risk n (%)	p-value
Sex			0.455 (2)
Female	11 (47.8)	12 (52.2)	
Male	3 (30.0)	7 (70.0)	
Age group (years)			0.923 (1)
≤59	7 (38.9)	11 (61.1)	
>59	7 (46.7)	8 (53.3)	
Education (years)			0.194 (2)
≤4	4 (66.7)	2 (33.3)	
>4	9 (34.6)	17 (65.4)	

Table 4 – Relationship between sociodemographic and clinical variables with the risk for diabetic foot. Metropolitan Region of Curitiba, Paraná, Brazil – 2020. (N=33) (conclusion)

Variables	Risk for diabetic foot		
	Low/moderate n (%)	High risk n (%)	p-value
***Per capita* income (BRL) (3)**			0.257 (2)
≤1,045.00	8 (34.8)	15 (65.2)	
>1,045.00	6 (60.0)	4 (40.0)	
Time of diagnosis (years)			0.695 (2)
≤5	4 (50.0)	4 (50.0)	
>5	10 (40.0)	15 (60.0)	
Daily medications			0.073 (2)
≤5	11 (57.9)	8 (42.1)	
>5	3 (21.4)	11 (78.6)	
Physical activity			1.000 (2)
Regular	1 (33.3)	2 (66.7)	
Sporadic or non-practitioner	13 (43.3)	17 (56.7)	
Body Mass Index (kg/m²)			0.616 (1)
≤29.9	6 (35.3)	11 (64.7)	
≥30	8 (50.0)	8 (50.0)	

Source: Created by the authors.

(1) Chi-square test with Yates correction.
(2) Fisher's exact test.
(3) Brazilian minimum wage in January and March 2020 was 1,045.00 BRL.

Discussion

This study aimed to analyze the relationship of HL, knowledge of the disease and risk for the development of diabetic foot according to the sociodemographic and clinical characteristics of adults with DM. It was identified that participants with adequate knowledge had a higher level of HL (p=0.015), and these results were predominant in people aged ≤59 years, time of schooling >4 years and diagnosis of DM >5 years. However, there was no relationship of these variables with the risk for diabetic foot.

These findings are similar to the cross-sectional research conducted in a DM clinic in the city of Khaf, Southeastern Iran, with 404 participants with DM2, which demonstrated a relationship between SD and knowledge of the disease associated with age and educational level, which were positively correlated with self-care behavior with the feet[6].

Another cross-sectional survey, conducted in Southern Tasmania, applied to 222 participants with DM the The Short Test of Functional Health Literacy in Adults (S-TOFHLA) and a knowledge questionnaire about the disease. It also performed foot inspection to identify risk factors, indicating that older people had a high risk for diabetic foot, low levels of HL and inadequate knowledge about the disease, corroborating the findings of this study. In a univariate analysis, the increase in the score in the HL questionnaire was associated with a 4% lower chance for high risk of diabetic foot (Odds Ratio 0.96, 95% CI 0.93 to 0.99), but when crossed with the variables age, gender, loss of protective sensitivity, peripheral arterial disease and bone deformity in the feet, there was no statistical significance[14].

When descriptively analyzing the risk for diabetic foot at age ≤59 years, it was observed that 61.1% (n=11) of the participants in this age group had high risk, even with adequate knowledge and satisfactory HL level. This factor may be associated with low glycemic control, in addition to the ignorance of some aspects of the disease, such as those observed in the lower-rated SKILLD questions (Table 2), referring to the signs and symptoms of hyper and hypoglycemia, Hb1Ac normality value and the frequency of foot examination. In the SKILLD validation research

for the Spanish version, with 111 Hispanic Americans, the questions related to the signs and symptoms of hyperglycemia (question 1; 17.1%) and normal HbA1c value (question 8; 18.0%) also obtained the lowest scores[15].

Other factors observed that may influence the lack of control of DM, inadequate knowledge and increased risk for diabetic foot, were the low means of HL in structural factors UHI and SHI (Table 1), especially in the question related to the understanding of information in drug leaflets, which may contribute to the failure of treatment adherence. In contrast to this result, a validation study of HLAT-8 for the Chinese language with 650 adolescents presented the highest average in the question of understanding the information in the leaflets (3.83 ± 1.04)[16].

In this study, participants who used ≤5 daily medications had lower levels of HL and knowledge of the disease compared to those who used >5 medications/day (11; 57.9% versus 8; 42.1% in both variables) (Table 3). It should be noted that it was not the objective of this study to evaluate drug treatment, but to analyze whether the amount of medications/day was related to the knowledge of the disease, HL and risk for diabetic foot.

The question regarding the ability to determine high and low quality information on the Internet had the lowest mean scale (Table 1). This result corroborates the HLAT-8 validation research for Brazil, which, although it was conducted with a sample of young university students, also demonstrated the lowest score in this question[12], as well as in the validation of HLAT-8 for China[16].

The use of technological equipment, such as Internet access, has proven to be an auxiliary tool in supporting the knowledge and self-management of DM, since there is awareness, understanding and technological skills on the part of users to access quality information[17]. A cross-sectional study conducted in Ethiopia with 423 participants with chronic diseases showed that younger people obtained greater knowledge and high HL ability, especially those who used the Internet daily and had online resources[18].

One factor that may compromise the search for health information on the Internet is the low level of education. This variable may be related to cognitive issues and interpretative difficulties that influence knowledge about the disease, the search for health information and adherence to therapy[19]. In this study, it was possible to compare that the percentages of satisfactory HL and adequate knowledge were higher in the participants with more than four years of schooling (HL: 17; 65.4% versus 9; 34.6% and knowledge of the disease: 16; 61.5% versus 10; 38.5%) (Table 3). Similar findings were found in the validation of SKILLD for the Brazilian Portuguese, which showed a positive correlation between schooling and knowledge of DM (6.6±5.1, p=0.003)[13].

It was found that adequate knowledge and satisfactory HL were higher in participants with more than five years of diagnosis (16; 64.0% versus 9; 36.0% for both variables) (Table 3). This result is in line with the cross-cultural validation of the SKILLD instrument for Brazil, with 129 elderly people with DM, which obtained a positive correlation between knowledge of the disease and the time of diagnosis (16.5 ± 8.8, p=0.022)[13]. People with longer disease time are more exposed to health and treatment information, which enables the development of skills and knowledge over time[19].

However, a cross-sectional study conducted in Montes Claros, Minas Gerais, with 353 participants with DM2, showed that 54.9% had a diagnosis time longer than five years and 65.1% were sedentary[20]. In this study, 91.0% (n=30) did not practice physical activity regularly, a factor that can contribute to overweight and high risk for the development of diabetic foot. However, it was observed that 50.0% (n=8) of the participants with BMI ≥30kg/m2 presented low/moderate risk for the development of foot complications, and it was necessary to investigate other factors associated with this finding.

Contrasting these findings, a cross-sectional study with 69 participants with DM showed that BMI >30 kg/m2 increases the risk for

the development of diabetic foot by 13%[21]. Another cross-sectional institutional-based study conducted with 279 adults with DM in Ethiopia identified that 13.6% had foot ulcerations, and through multivariate logistic analysis, this lesion was correlated with DM2, overweight and obesity. High BMI is a factor that increases the pressure of support in the feet and decreases blood circulation in the lower extremities, increasing the risk for the development of complications[4]. Another factor that may respond to the association of these variables with the development of diabetic foot is the difficulty of glycemic control in the long term[22].

A systematic cross-analysis review, with the objective of determining the association between HL, diabetic foot, risk factors and foot self-care, presented controversial results before insufficient data in the studies, mostly cross-sectional with low evidence[23]. These findings warn that focusing only on HL may not be effective in reducing risk factors for diabetic foot, and robust longitudinal studies are needed to highlight this gap[14,23].

When considering the variable *per capita* income, it was found that participants with ≤1,045.00 BRL obtained inadequate knowledge (n=13; 56.5% versus n=10; 43.5%) and higher risk for diabetic foot (n=15; 65.2% versus n=8; 34.8%) when compared to those with adequate knowledge and satisfactory HL. This fact can be explained by the difficulty of access to services and health information directed to the prevention of DM complications[24]. To this end, organizations and health systems should be adapted to comprehensive and multidisciplinary care, in addition to training for professionals and family members, with a view to improving DM education and preventing diabetic foot[1].

DM education for patients and their families should be instigated from diagnosis in order to share knowledge and information for the development of self-care skills. It was observed that the highest mean HLAT-8 was in the structural factor HI, related to the provision of information or the help of family and friends to elucidate health doubts. This result expresses the potential of the social support network, which can be strengthened by the approximation of the various professionals, sectors, family and friends in order to monitor and control the disease and, consequently, postpone the complications of DM.

For this study, Cronbach's alpha reliability tests were applied for knowledge instruments and HL, because they were validated in different populations of the study sample. The value obtained for SKILLD (0.756) revealed good applicability for adults. However, the reliability of HLAT-8 (0.511) was median, since the literature indicates, as ideal, indexes above 0.7[25]. It should be noted that, in the validation of HLAT-8 for Brazil, Cronbach's alpha was 0.74; however, the scale was applied to 472 young adults, a sample higher than that studied in this research.

Limitations of this study are the low number of participants, which compromised the statistical analysis and the cross-sectional approach, which does not allow the generalization of the results.

The contributions of this study to the nursing area consist of the recognition of factors associated with HL levels, knowledge of the disease and risk for diabetic foot, by applying validated instruments, providing a framework for the formulation of strategies aimed at controlling and preventing complications of the disease, especially for people with low income and schooling. It reinforces the need for future studies that investigate the difficulty of understanding information and access to preventive health services, in order to optimize public policies for people with DM.

Conclusion

The results showed that satisfactory levels of HL are associated with adequate knowledge about the disease. However, when relating these variables to the risk for diabetic foot, there was no statistical significance. The data also showed that people with lower schooling, low per capita income and shorter diagnosis time require greater attention from primary services, with a view to promoting knowledge and HL, which are fundamental in structuring educational actions

aimed at changes in lifestyle and the prevention of complications related to DM.

Measuring HL levels, knowledge of the disease and risk for diabetic foot allowed identifying factors that favor or interfere in the autonomy of the person with DM for self-care. The findings, acquired through the instruments, enable the development of educational strategies aimed at gaps in knowledge about the disease and access to health information and for the strengthening of the social support network, with a view to prepare the person for daily decision making.

The reliability of the Eight-Item Health Literacy Assessment Tool and Spoken Knowledge in Low Literacy Patients with Diabetes instruments was favorable for application in the adult population. The use of these assessment instruments should be encouraged to identify the factors that compromise the self-care of the person with DM.

It is suggested to stimulate research on the subject, with more robust methods and with a greater number of participants, in order to identify the factors associated with the development of diabetic foot. Part of the studies that deal with this theme are cross-sectional and low-evidence, compromising the data and maintaining the gap on the subject.

Collaborations:

1 – conception, design, analysis and interpretation of data: Robson Giovani Paes, Maria de Fátima Mantovani and Ângela Taís Mattei da Silva;

2 – writing of the article and relevant critical review of the intellectual content: Robson Giovani Paes, Maria de Fátima Mantovani, Ângela Taís Mattei da Silva, Christian Boller, Saimon da Silva Nazário and Elaine Drehmer de Almeida Cruz;

3 – final approval of the version to be published: Robson Giovani Paes and Maria de Fátima Mantovani.

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