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Functional health literacy and associated factors in older adults with type 2 diabetes *mellitus*

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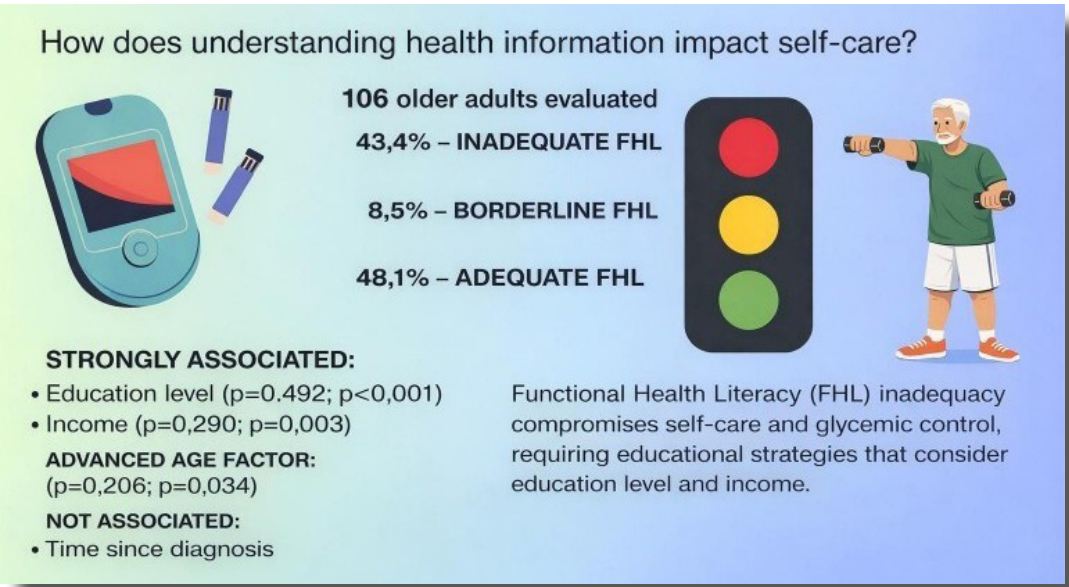
Graphical Abstract



Highlights

- *Prevalence of 43.4% of inadequate functional health literacy among older adults.*
- *Education level as the main factor associated with performance on the B-TOFHLA.*
- *Negative correlation between age and functional health literacy.*
- *Need for tailored educational strategies for older adults with DM2.*

Abstract

The aim of the present study was to assess functional health literacy (FHL) among older adults with type 2 diabetes mellitus (T2DM) who performed self-monitoring of capillary blood glucose (SMCBG) and to analyze associated sociodemographic and clinical factors. This is an observational, analytical, cross-sectional study conducted with 106 older adults receiving care at health units in Ribeirão Preto, São Paulo, between February and October 2024. A sociodemographic and clinical questionnaire and the Brief Test of Functional Health Literacy in Adults (B-TOFHLA) were used. Descriptive analyses, Pearson's chi-square or Fisher's exact tests, and Spearman's correlation were performed, adopting a significance level of 5%. The mean age was 69.97 years (SD=6.23), with a mean of 8.71 years of schooling (SD=4.49) and a mean monthly family income of R$ 2,833.41 (SD=1,911.38). Regarding FHL, 48.1% of participants had adequate levels, 8.5% borderline, and 43.4% inadequate. A statistically significant association was observed between education level and FHL categories (p<0.001). Positive correlations were also found between the B-TOFHLA score and years of schooling (ρ=0.492; p<0.001) and income (ρ=0.290; p=0.003), as well as a negative correlation with age (ρ=-0.206; p=0.034). Time since T2DM diagnosis was not significantly associated (ρ=0.081; p=0.411). It is concluded that more than half of the participants presented borderline or inadequate FHL, with education level being the main factor associated with performance on the B-TOFHLA. These findings highlight the need for continuous, clear, and tailored educational interventions adapted to the educational and socioeconomic conditions of older adults with T2DM.

Keywords: Type 2 Diabetes *Mellitus*. Elderly. Health Literacy. Blood Glucose Self-Monitoring. Sociodemographic Factors.

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INTRODUCTION

Type 2 diabetes *mellitus* (T2DM) is one of the main public health problems due to its high prevalence, chronic nature, and potential to trigger microvascular and macrovascular complications, with relevant impacts on quality of life and healthcare utilization[1,2]. Among T2DM management strategies, self-monitoring of capillary blood glucose (SMCBG) plays a relevant role in therapeutic follow-up, especially when integrated with health education and clinical decision-making[2].

In this context, functional health literacy (FHL) becomes a central element for self-care, as it involves the ability to access, understand, and apply information related to treatment and prevention of complications[3,4,5]. Low levels of FHL may impair the interpretation of prescriptions, glycemic results, and professional guidance, negatively affecting treatment adherence, clinical outcomes, and risk of hospitalization[5,6,7].

Among older adults, these difficulties may be even greater due to lower educational attainment, sensory limitations, and age-related cognitive decline[5,8,9,10]. Despite the relevance of the topic, there are still gaps in the literature regarding the analysis of FHL in older adults with T2DM receiving healthcare, especially among those who perform SMCBG. Given this context, this study aimed to assess FHL in older adults with T2DM who perform SMCBG and to analyze associated sociodemographic and clinical factors.

METHODS

Study design, setting, and ethical aspects

An observational study conducted in health units in the municipality of Ribeirão Preto, São Paulo, with data collection carried out between February and October 2024. The study was approved by the Research Ethics Committee of the Escola de Enfermagem de Ribeirão Preto da Universidade de São Paulo in January 2024, under CAAE No. 75699923.5.0000.5393 and Opinion No. 6,559,454. All participants were informed about the study objectives and signed the Informed Consent Form, in accordance with Resolutions No. 466/2012 and No. 510/2016 of the National Health Council.

Participants

Individuals with T2DM aged 60 years or older who performed SMCBG were included, with a confirmed diagnosis for at least six months and sufficient reading and communication abilities to respond to the instruments, as assessed by the Mini-Mental State Examination[11]. Individuals with cognitive impairments or visual, auditory, or speech limitations that precluded instrument administration were excluded. The sample was non-probabilistic, by convenience, totaling 106 participants.

Assessment instruments

Sociodemographic and clinical data were obtained through a structured questionnaire. To assess FHL, the Brief Test of Functional Health Literacy in Adults (B-TOFHLA), translated and culturally adapted to the Brazilian context, was used[3,4,12].

The B-TOFHLA assesses reading comprehension and numeracy skills in health-related situations, with a total score ranging from 0 to 100 points. The adopted classification was: inadequate (0–53), borderline (54–66), and adequate (67–100)[4,12].

The original instrument (TOFHLA) consists of two sections: reading comprehension, with 50 items organized into three health-related texts, and numeracy, with 17 items assessing the ability to handle numerical information in everyday situations, such as reading prescriptions, interpreting medication labels, monitoring blood glucose, maintaining appointment schedules, and seeking financial support[3].

Due to the longer administration time of the full TOFHLA (approximately 22 minutes), a shortened version, the B-TOFHLA[12], was developed, maintaining comparable reliability and validity, with greater practicality and shorter administration time (generally less than 10 minutes).

The reduced version includes two reading passages and four numeracy items, preserving the instrument's assessment capability.

Data analysis

Data were entered into an electronic spreadsheet, with double independent data entry by two researchers, and subsequently analyzed using IBM SPSS Statistics software. Initially, descriptive analysis was performed, presenting absolute and relative frequencies for categorical variables and mean, standard deviation, median, minimum, and maximum values for continuous variables.

Associations between FHL categories and sociodemographic and clinical variables (including gly-

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cated hemoglobin) were assessed using Pearson's chi-square test or Fisher's exact test, according to expected frequency adequacy. The relationship between B-TOFHLA scores and variables such as age, years of schooling, family income, and time since T2DM diagnosis was analyzed using Spearman's correlation coefficient. A significance level of 5% was adopted.

RESULTS

A total of 106 older adults with T2DM who performed SMCBG participated in the study. Age ranged from 60 to 89 years, with a mean of 69.97 years (SD=6.23). The mean time since T2DM diagnosis was 18.65 years (SD=11.99), the mean years of schooling was 8.71 (SD=4.49), and the mean monthly family income was R$ 2,833.41 (SD=1,911.38) (Table 1).

Table 1 - Continuous characteristics of participants. Ribeirão Preto, São Paulo, Brazil, 2024 (n=106).

Variables	n	Minimum	Maximum	Mean (SD)
Age	106	60	89	69.97 (6.23)
Time since DM diagnosis	106	2	63	18.65 (11.99)
Years of schooling	106	0	24	8.71 (4.49)
Family income	106	600	10,500	2,833.41 (1,911.38)

Source: Research data (2024). Legend: SD: standard deviation; DM: Diabetes *Mellitus*.

Regarding sociodemographic characteristics, a predominance of females was observed (51.9%). Most participants were aged between 60 and 79 years (91.5%), self-identified as White (51.9%), were not married (52.8%), and were retired or receiving a pension (75.5%). With respect to education, 34.0% reported having no formal schooling or incomplete primary education, whereas 15.1% had completed higher education. Regarding FHL, 48.1% presented an adequate level, 8.5% borderline, and 43.4% inadequate (Table 2).

Table 2 - Sociodemographic characteristics and FHL classification of participants. Ribeirão Preto, São Paulo, Brazil, 2024 (n=106).

Variables	n	%
Sex		
Female	55	51.9
Male	51	48.1
Age		
60–79	97	91.5
> 80	9	8.5
Race/Color		
White	55	51.9
Brown/Black	51	48.1
Marital Status		
Married	50	47.2
Not married	56	52.8
Education Level		
No formal education (able to read and write) and incomplete primary education	36	34.0
Complete primary education	22	20.8
Complete secondary education	32	30.2
Complete higher education	16	15.1
Occupation		
Employed	6	5.7
Unemployed/on leave/household work without pay	20	18.9

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...continuation - Table 2.

Variables	n	%
Retired/pensioner	80	75.5
Income		
Up to 1 minimum wage	36	34.0
From 1.1 to 2 minimum wages	28	26.4
From 2.1 or more minimum wages	42	39.6
B-TOFHLA Literacy Level		
Adequate (67–100)	51	48.1
Borderline (54–66)	9	8.5
Inadequate (0–53)	46	43.4

Source: Research data (2024). Legend: Family income categorized based on the minimum wage in force in Brazil in 2024 (R$ 1,412.00).

In the analysis of the association between FHL categories and sociodemographic and clinical variables, only education level showed a statistically significant association (p<0.001). Among participants with complete higher education, 93.8% presented adequate FHL, whereas among those with no formal education or incomplete primary education, inadequate FHL predominated (66.7%). No statistically significant associations were observed with sex (p=0.176), age group (p=0.772), race/color (p=0.206), marital status (p=0.877), occupation (p=0.169), or glycated hemoglobin (p=0.161) (Table 3).

Table 3 - Association between sociodemographic and clinical characteristics and functional health literacy categories. Ribeirão Preto, São Paulo, Brazil, 2024.

Variables	Health functional literacy			p-value
	Adequate n (%)	Borderline n (%)	Inadequate n (%)	
Sex				0.176*
Female	28 (50.9)	2 (3.6)	25 (45.5)	
Male	23 (45.1)	7 (13.7)	21 (41.2)	
Age				0.772**
60–79	47 (48.5)	9 (9.3)	41 (42.3)	
> 80	4 (44.4)	0 (0.0)	5 (55.6)	
Race/Color				0.206*
White	27 (49.1)	7 (12.7)	21 (38.2)	
Brown/Black	24 (47.1)	2 (3.9)	25 (49.0)	
Marital Status				0.877*
Married	23 (46.0)	4 (8.0)	23 (46.0)	
Not married	28 (50.0)	5 (8.9)	23 (41.1)	
Education Level				**< 0.001**
No formal education (able to read and write) and incomplete primary education	10 (27.8)	2 (5.6)	24 (66.7)	
Complete primary education	7 (31.8)	3 (13.6)	12 (54.5)	
Complete secondary education	19 (59.4)	4 (12.5)	9 (28.1)	
Complete higher education	15 (93.8)	0 (0.0)	1 (6.3)	
Occupation				0.169**
Employed	5 (83.3)	1 (16.7)	0 (0.0)	
Unemployed/on leave/household work without pay	9 (45.0)	1 (5.0)	10 (50.0)	
Retired/pensioner	37 (46.3)	7 (8.8)	36 (45.0)	
Glycated Hemoglobin				0.161*
Below 7	14 (58.3)	3 (12.5)	7 (29.2)	
Above 7	29 (41.4)	5 (7.1)	36 (51.4)	

Source: Research data (2024).
Legend: * Pearson's chi-square test; ** Fisher's exact test. For glycated hemoglobin, data were available for 94 participants.

In the correlation analysis, the B-TOFHLA score showed a moderate positive correlation with years of schooling (ρ=0.492; p<0.001) and a weak positive correlation with family income (ρ=0.290; p=0.003). Age showed a weak negative correlation with the instrument score (ρ=-0.206; p=0.034). There was no statistically significant correlation between the B-TOFHLA score and time since T2DM diagnosis (ρ=0.081; p=0.411) (Table 4).

Table 4 - Correlation between B-TOFHLA score and continuous variables. Ribeirão Preto, São Paulo, Brazil, 2024.

Variables	Age		Years of schooling		Income		Time since DM diagnosis	
	ρ	p	ρ	p	ρ	p	ρ	p
B-TOFHLA score	-0.206	0.034	0.492	**<0.001**	0.290	**0.003**	0.081	0.411

Source: Research data (2024). ρ: Spearman's correlation coefficient; p: test significance value.

DISCUSSION

The results of the present study showed that a substantial proportion of older adults with T2DM presented limitations in FHL, as 43.4% of participants were classified as having inadequate FHL and 8.5% as borderline. This finding indicates that difficulties in accessing, understanding, and using health information remain frequent in this group, potentially affecting the interpretation of recommendations, prescriptions, test results, and guidance related to self-care.

These findings are supported by the international literature, which indicates lower levels of FHL among individuals of more advanced age and in contexts of greater social vulnerability[13,14,15]. Consistent with this scenario, national literature also presents similar results, as evidenced by a study conducted in the state of São Paulo with older adults, in which 56.6% of the sample presented inadequate FHL[16]. Taken together, these data suggest that impaired FHL remains a relevant issue among older adults, particularly in the context of managing chronic conditions such as T2DM.

In this context, FHL becomes especially relevant, as understanding the disease and its treatment may significantly influence treatment adherence and is even considered a predictor of this process[17]. Beyond merely receiving information, individuals must be able to interpret, apply, and make decisions based on it in their daily lives. When these competencies are present, there is a greater likelihood of adherence to healthcare professionals' recommendations, appropriate diet, physical activity, and pharmacological treatment. Supporting these findings, a study involving older adults with heart failure also demonstrated the importance of FHL for adherence to the therapeutic regimen[18].

Among the variables analyzed, education level stood out as the most strongly associated with performance on the B-TOFHLA, both in categorical analysis and in correlation with the continuous score. This finding reinforces that FHL is not evenly distributed among older adults but is embedded in educational inequalities accumulated over the life course.

Similarly, an international study identified that higher levels of education were associated with better FHL levels, whereas individuals with lower educational attainment tended to present poorer performance[19]. These findings suggest that older adults with low education face greater difficulties in understanding key information for T2DM management, such as prescriptions, clinical recommendations, and test results.

Family income, in turn, also showed a positive association with the B-TOFHLA score, although with lower magnitude. This finding suggests that more favorable socioeconomic conditions may expand access to information, services, therapeutic resources, and care opportunities, contributing to better FHL performance. Thus, FHL should not be understood solely as an individual attribute, but as a phenomenon constructed within concrete social conditions that may facilitate or limit the appropriation of health information.

Conversely, age showed a negative correlation with the B-TOFHLA score, suggesting that advancing age may be associated with greater vulnerability in processing health information. This finding is consistent with studies indicating a tendency for FHL to decline with increasing

age[14,20]. In this sense, this relationship may reflect the combined influence of different factors, such as lower cumulative educational attainment, sensory changes, functional decline, and increased complexity of self-care demands in aging. However, this association is not consensual in the literature, as other studies have not observed a significant relationship between age and FHL level[21,22], suggesting that age alone does not explain the phenomenon and should be understood in conjunction with social, educational, and clinical factors.

In turn, time since T2DM diagnosis was not associated with FHL, indicating that prolonged experience with the disease alone does not ensure better understanding of health information nor greater ability to use it in daily care. This result reinforces that accumulated experience with T2DM does not replace the need for continuous, adapted, and needs-sensitive educational processes for older adults.

From a care perspective, the findings reinforce the importance of incorporating FHL assessment into the planning of care for older adults with T2DM, especially in primary healthcare[19]. Educational strategies aimed at this population should consider the use of clear language, verification of understanding, repetition of guidance, support from illustrated materials, and adaptation of recommendations to the sociocultural context of each individual.

Additionally, international literature has observed that many older adults with T2DM had not received training about the disease, and those without such guidance presented lower levels of FHL[19]. Furthermore, older adults with T2DM need to have information, skills, and attitudes compatible with the demands of self-care, so that strengthening FHL may promote greater autonomy, improved decision-making, and more active participation in managing their own condition[20,23].

Although the present study did not directly assess outcomes such as chronic complications or successful aging, the literature suggests that low levels of FHL may be associated with less favorable care trajectories in individuals with T2DM. It is known that, with disease progression and inadequate control, the risk of chronic complications tends to increase, with relevant physical and psychological repercussions[23].

Similarly, a recent study found that older adults without chronic complications related to T2DM presented higher levels of FHL and better rates of successful aging when compared to those who developed such complications[19]. Although these relationships were not directly tested in this investigation, they reinforce the potential relevance of FHL as an important component in the care of older adults with T2DM.

Among the study limitations, the cross-sectional design stands out, which precludes causal inferences, as well as the convenience sample and the fact that the study was conducted in a single municipality, limiting the generalizability of the findings. In addition, the exclusion of older adults with significant reading or communication limitations may have led to an underestimation of the frequency of inadequate FHL. Nevertheless, the study contributes to expanding evidence on a topic still underexplored among older adults with T2DM performing self-monitoring of capillary blood glucose, highlighting the relevance of educational, socioeconomic, and age-related factors in the understanding and use of health information.

CONCLUSION

A high frequency of inadequate FHL was observed among older adults with T2DM who performed SMCBG, with more than half of the sample presenting borderline or inadequate levels. Education level was the main factor associated with performance on the B-TOFHLA, followed by income, while age showed a negative correlation with the instrument score. These results reinforce the need for continuous, inclusive, and tailored educational strategies adapted to the educational and socioeconomic profile of this population, in order to strengthen self-care and improve diabetes management.

CRediT author statement

Conceptualization: Tavares, MS; Medina, LAC; Teixeira, CRS. Methodology: Tavares, MS; Medina, LAC; Teixeira, CRS. Validation: Tavares, MS; Medina, LAC; Lima, GA; Pereira, LFC; Rezende, RTM; Amaral, ACG; Teixeira, CRS. Statistical analysis: Tavares, MS. Formal analysis: Tavares, MS; Pereira, LFC; Rezende, RTM; Amaral, ACG. Investigation: Medina, LAC. Resources: Teixeira, CRS. Writing – original draft preparation: Tavares, MS. Writing – review and editing: Tavares, MS; Medina, LAC; Lima, GA; Pereira, LFC; Rezende, RTM; Amaral, ACG; Teixeira, CRS. Visualization: Tavares, MS; Medina, LAC; Lima, GA; Pereira, LFC; Rezende, RTM; Amaral, ACG; Teixeira, CRS. Supervision: Lima, GA; Teixeira, CRS. Project administration: Teixeira, CRS.

All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the workreported in this paper.

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