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Physical inactivity in people with diabetes in low-income rural areas and associated factors: Amazonas results

Inatividade física em pessoas com diabetes em áreas rurais de baixa renda e fatores associados: resultados do Amazonas

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ABSTRACT

Physical activity (PA) is crucial for the management of type 2 diabetes mellitus (T2DM), but there is a paucity of research on adherence to PA guidelines, PA level, and associated factors in patients with T2DM living in remote areas. Objectives: To investigate adherence to PA, describe PA level, and identify associated factors among patients with T2DM treated in primary health care in Amazonas, Brazil. Methods: This is a descriptive cross-sectional study. Data were collected between 2020 and 2023, with patients from primary health care units in rural Amazonas. The PA level was assessed using the International Physical Activity Questionnaire, along with additional questionnaires on sociodemographic and clinical variables. A significance level of 5% was applied in all analyses. Results: The study included 965 participants, of whom 67.7% were classified as inactive and 80.5% did not meet PA recommendations. Factors positively associated with higher PA level included having ≥8 years of education (OR = 1.80; 95% CI: 1.31 - 2.48), body mass index (≥30 kg/m² (OR = 1.50; 95% CI: 1.04 - 2.17), adherence to prescribed medications (OR = 1.71; 95% CI: 1.15 - 2.54), receiving guidance on PA (OR = 1.98; 95% CI: 1.49 - 2.64) and a positive self-perception of health (OR = 1.41; 95% CI: 1.00 - 1.98). Conclusion: Better PA level was associated with higher education, obesity, medication adherence, PA orientation, and positive health perceptions. These findings highlight the importance of addressing multiple factors to promote PA among patients with T2DM in rural Amazonas.

Keywords: Physical activity; Type 2 diabetes mellitus; Primary Health Care; Rural areas.

RESUMO

A atividade física (AF) é crucial para o manejo do diabetes mellitus tipo 2 (DM2), mas há escassez de pesquisas sobre a adesão às diretrizes de AF, nível de AF e fatores associados em pacientes com DM2 que vivem em áreas remotas. Objetivos: Investigar a adesão à atividade física, descrever o nível de AF e identificar fatores associados a ele entre pacientes com DM2 atendidos na atenção primária à saúde no Amazonas, Brasil. Métodos: Trata-se de um estudo transversal descritivo. Os dados foram coletados entre 2020 e 2023, com pacientes de unidades de atenção primária à saúde na zona rural do Amazonas. O nível AF foi avaliado por meio do Questionário Internacional de Atividade Física, juntamente com questionários adicionais sobre variáveis sociodemográficas e clínicas. Um nível de significância de 5% foi aplicado em todas as análises. Resultados: O estudo incluiu 965 participantes, dos quais 67,7% foram classificados como não ativos e 80,5% não atingiram as recomendações de AF. Fatores positivamente associados com maior nível de AF incluíram ter ≥8 anos de educação (OR = 1,80; IC 95%: 1,31 - 2,48), índice de massa corporal ≥30 kg/m² (OR = 1,50; IC 95%: 1,04 -2 ,17), adesão aos medicamentos prescritos (OR = 1,71; IC 95%: 1,15 - 2,54), receber orientação sobre atividade física (OR = 1,98; IC 95%: 1,49 - 2,64) e uma autopercepção positiva de saúde (OR = 1,41; IC 95%: 1,00 - 1,98). Conclusão: Melhor nível de AF foi associado com maior educação, obesidade, adesão à medicação, orientação em AF e percepções positivas de saúde. Esses achados ressaltam a importância de abordar múltiplos fatores para promover AF entre pacientes com DM2 na área rural do Amazonas.

Palavras-chave: *Atividade física; Diabetes mellitus tipo 2; Atenção Primária à Saúde; Áreas rurais.*

Introduction

The importance and benefits of physical activity (PA) are well-documented in the literature; however, insufficient PA levels have shown a growing trend worldwide[1]. In Brazil, almost half of adults still do not meet the World Health Organization[2] recommendations despite presenting a growing trend in the last 15 years[3]. Physical inactivity and other factors contribute to the rapid increase in chronic non-communicable diseases[4]. On the other hand, the practice of PA is fundamental for preventing and treating these diseases[5].

Among chronic diseases, diabetes mellitus is a condition that has been following a global growth trend, with Brazil being one of the countries with the highest incidence projection for the coming decades[6]. Vigitel data indicate that 10,2% of Brazilian adults reported having a diagnosis of diabetes mellitus, and in Manaus, the capital of Amazonas the frequency was 8,2%[7]. More specific attention is important, considering that type 2 diabetes mellitus (T2DM) represents more than 90% of all disease cases. The practice of PA is one of the most recommended nonpharmacological interventions for its treatment[8-10], as it delays and prevents pre-diabetes.

To achieve these benefits through PA, the World Health Organization has published guidelines for the global population and guides countries in creating their guidelines[11]. In Brazil, in 2021, the Physical Activity Guide for the Brazilian population was launched, which recommends guidelines for the practice of PA in all cycles of life[12]. In a more targeted way for T2DM, the Brazilian Diabetes Society[13] and the Ministry of Health[14] have specific guidelines for people with T2DM and the professionals involved in caring for these people, including helping managers of Primary Health Care (PHC) plan their actions. PHC is responsible for the first line of disease management; in some contexts, it is the only one accessible[15].

In PHC in the state of Amazonas, a study identified that more than half (58.8%) of the action goals for preventing and managing T2DM included PA[16], according to the recommended guidelines. However, the provision of actions for the practice of PA is not necessarily reflected in better levels of PA level, as several factors act as barriers to its practice. The literature on data from Amazonas that describes the PA level of people with T2DM is scarce. Therefore, we do not know whether they meet the recommendations and what factors are associated with PA.

Considering that Amazonas is the largest state in territorial extension in Brazil, but only 4.2% of this territory is urbanized[17], it is natural that there are differences between its 62 cities. With vast tropical forest vegetation and an extensive river basin, the state that represents most of the Legal Amazon[18] still faces inequalities in access to healthcare when compared to other regions of Brazil. In many cities far from urban areas, PHC is the only health service available[19]. Difficulty accessing health services can negatively impact the treatment of people with T2DM since adequate management of the disease involves multidisciplinary work and continuous and qualified monitoring[20].

Given the importance of PA in managing T2DM and Amazonas's socio-geographical peculiarities, studies that provide evidence of helping promote health in this state are necessary. Therefore, the objective of the present study was to describe the PA levels of patients with T2DM treated by PHC in cities in the interior of Amazonas, verifying whether they meet PA recommendations, and which factors are associated.

Methods

Study design

This is a cross-sectional study belonging to the carried out in cities in Amazonas, Brazil, between August 2020 and March 2023. The study included people with T2DM treated at PHC units and was approved by the Human Research Ethics Committee of the Federal University of Amazonas (registration: 3,937,812). The consent of the state and municipal health departments and the management of the PHC units was requested. All participants signed informed consent forms.

Study population

The PHC units were randomly selected via electronic draw to carry out the study. To recruit the participants, the interviewers and the supervisor accompanied the community health workers during routine home visits to patients undergoing treatment for T2DM. At the patient's residence, the community health workers introduced the interviewers to the patients and invited them to participate in the research. People with T2DM followed by the PHC for at least 6 months were included, and those with a cognitive impairment that made it impossible to understand the questionnaires were excluded[21].

The sampling design considered 142 PHC units distributed in 13 cities, with a margin of error of 5% and a confidence level of 95%. Thus, 34 units were ob-

tained, which corresponds to 955 patients. Proportional stratified sampling was used to estimate the number of interviews per city. The choice of patients for collection was carried out using the simple random sampling method. This process is described in detail in the SAP-PA methodology article[21].

Data collection procedures and instruments

Data collection was carried out through individual interviews at the PHC setting or the participants' own homes, depending on their choice. Before data collection, interviewers underwent training and repeatedly applied the Study of Health in Primary Care of the Amazon Population form. All questionnaires were uploaded in digital form and filled out by interviewers at the time of collection.

In the first evaluation stage, tests were used to evaluate patients' cognitive abilities. The 10-point Cognitive Screener test[22] and the figure recognition test[23]. Patients who did not present cognitive impairment continued to fill out the sociodemographic, clinical, and behavioral information questionnaire and the International Physical Activity Questionnaire (IPAQ) short version[24].

Regarding the sociodemographic questionnaire, patients answered questions related to sex (male/female), age (<50/ 50-59/ ≥60 years), color/race (brown/ other), marital status (with partner/without partner), education (<5/ 5-8/ >8 years) and occupation (work or retirement/ no occupation). For the clinical questionnaire, the questions were related to T2DM: time since T2DM diagnosis (<5/ 5-9/ ≥10 years), use of medication for T2DM (yes/ no), and memory difficulty (yes/ no). The behavioral questionnaire asked about adherence to T2DM management actions (yes/no), receipt of guidance on PA (yes/no), and the comparison of their health with that of other people of the same age (equal/ worse/much worse/better/much better).

Patients responded to the frequency (days), duration (minutes), and intensity (walk, moderate, vigorous) of their PA practice in a usual week, considering all domains to assess the level of PA. The following reference values were considered to determine the metabolic equivalent of the task: 3.3 for walking, 4.0 for moderate activity, and 8.0 for vigorous activity. For classification in the IPAQ, the following criteria were adopted:

- Low PA level: does not meet the criteria for moderate or high PA level; Moderate PAL: a) 3 or more days of vigorous PA, of at least 20 minutes per day; b) 5 days or more of moderate PA or walking, for at least 30 minutes per day; c) 5 days or more of any intensity of PA that together reach at least 600 MET's (minute/week); High PA level: a) 3 or more days of vigorous PA that reach a minimum of 1500 METs (minute/week); b) 7 days or more of any combination of intensities that add up to at least 3,000 METs (minute/week). In the present study, PA levels were grouped, and patients were classified into two categories: Active (those classified as moderate or high PA level) and Non-Active (those classified as low PA level).

In the next stage, anthropometric assessments were carried out. Weight was measured using a digital scale (model Digital Glass 7 FW, G-TECH), and height was measured using a tape measure with a precision of 1 mm, with the participant in a full standing position (in the Frankfort horizontal plane). From the weight and height data, the body mass index was calculated using weight (in kilograms) divided by height (in meters) squared. The criteria proposed by the World Health Organization were followed for classification[25]. body mass index values were categorized for the analyses: <25 kg/m^2/ 25-29.9 kg/m^2/ ≥30 kg/m^2.

The weekly intensity and frequency guidelines were stratified from the national[13,14] and international[9,10,26] T2DM guidelines and the Physical Activity Guide for the Brazilian Population[12] to check whether the patient's PA level meets the recommended recommendations. The practice of 150 minutes of PA per week, of moderate to vigorous intensity, referred to in the IPAQ, was considered a reference, and patients were classified as meeting or not meeting.

Statistical analysis

Descriptive statistics were used to analyze all variables. The nominal frequencies were presented in absolute and percentage values and the mean and standard deviation values of continuous variables. Bivariate analysis was used using the Chi-square test to evaluate the association between PA level and nominal variables (sex, age, color/race, marital status, education, occupation, T2DM duration, body mass index, use of medications for T2DM, adhesion to shares at PHC, PA guidance, memory difficulty, health perception). For continuous variables (type of PA, METs), the Student t-test was used for independent samples, and the Man-Whitney

test was used for data that did not present homogeneity and normality. A significance level of $p<0.05$ was considered for all bivariate analyses.

In the logistic regression analysis, variables that showed significance of $p<0.05$ in the bivariate analysis were included. Three crude models were made, grouping the variables according to their class (sociodemographic/clinical/behavioral). The final adjusted model maintained the variables that presented a significance of $p<0.05$ in the raw restricted models. The effect size was estimated by the odds ratio (OR), considering the significance level of $p < 0.05$ and the confidence interval (CI) of 95%.

Results

The sample characteristics are presented in Table 1. The majority were female (67.7%) and self-identified as brown (74.4%), with an average age of 61.6 years, and 60.8% were 60 years or older. Most lived with a partner (57.5%) and had less than five years of education (54.7%), with an average schooling period of 5.05 years. Additionally, 79.2% were employed, and the average duration since T2DM diagnosis was 8.05 years. Regarding body mass index, the majority of individuals were either in the overweight range (25–29.9 kg/m2; 36.8%) or the obese range (≥ 30 kg/m2; 35.6%), highlighting a high frequency of excessive weight. The variables age ($p < 0.002$), marital status ($p < 0.030$), education ($p < 0.001$), duration of T2DM ($p = 0.043$), body mass index ($p = 0.015$), use of medication for T2DM ($p = 0.006$), guidance for PA ($p < 0.001$) and health comparison were associated with PA level, in the bivariate analysis (Table 1).

As for pharmacological treatment, 81.6% of participants responded that they used medication for T2DM, and only 27.4% stated that they participated in the disease management actions developed in the PHC. Just over half of the participants (50.7%) stated that they had received guidance on PA, and 54.9% had memory difficulties. When comparing their health with that of other people of the same age, the majority responded that they thought it was better (33.7%) or the equal (32.1%).

Table 2 describes information regarding PA level according to IPAQ. Only 32.4% of the sample reached the PA recommended levels in this study and were classified as active. Walking was the prevalent type of PA (118 minutes/week). Only 19.8% of participants met the recommended PA level by T2DM guidelines of at least 150 minutes of moderate to vigorous PA per week. Participants who met the guidelines had the highest frequencies and averages of positive PA level indicators.

The variables that showed a significant association in the bivariate analysis (Table 1) were included in the logistic regression analysis (Table 3) and grouped into three restricted crude models. In the sociodemographic model, patients with eight or more years of education were more likely to be active when compared to those with less than 5 years of education (OR = 1.78; 95% CI: 1.28 - 2.46). In the clinical model, patients with a body mass index equal to or greater than 30 kg/m^2 (OR = 1.55; 95% CI: 1.09 - 2.21) were more likely to be active. The group not taking medication for T2DM was used as the reference in the analysis (OR = 1), and those who were not taking medication were less likely to be active (OR = 0.61; 95% CI: 0.41 - 0.89).

In the behavioral model, those who did not receive PA guidance were less likely to be active when compared to those who did (OR = 0.47; 95% CI: 0.35 - 0.62), with the group that did not receive PA guidance used as the reference category (OR = 1) in the analysis. Patients who perceived their health to be better than others their age tended to be more physically active (OR = 1.31; 95% CI: 0.94 - 1.82), and those who perceived their health to be worse were less likely to be physically active (OR = 0.61; 95% CI: 0.41 - 0.89), when compared to those who perceived their health to be equal.

In the adjusted model, all variables statistically significant in the crude model remained significant. Patients with eight or more years of education were 80% more likely to be active than those with less than 5 years of education. As for body mass index, patients with 30 or more kg/m^2 were 50% more likely to be active than patients with 25 kg/m^2 or less.

Those who took medication for T2DM (OR = 1.71; 95% CI: 1.15 - 2.54) and those who received guidance for PA (OR = 1.98; 95% CI: 1.49 - 2.64) were also more likely to be active. Patients who perceived their health to be better than others their age were 41% more likely to be active, while for those who perceived their health to be worse, the association remained inverse (OR = 0.64; 95% CI: 0.43 - 0.95).

Discussion

The present study revealed that most patients with T2DM, attended by PHC in cities in the interior of the Amazonas, have a low PA level and do not meet the recommendations established by the main health institutions (at least 150 minutes of intense PA moderate

Table 1 – Sociodemographic, clinical, and behavioral characteristics of the participants.

Variables (N = 965)	n	%	Physical activity level		p-value*
			Active n (%)	Not active n (%)	
			312 (32.3)	653 (67.7)	
Sex					
Male	312	32.3	100 (32.1)	212 (32.5)	0.898
Female	653	67.7	212 (67.9)	441(67.5)	
Age (years)					
<50	169	17.5	63 (20.2)	106 (16.2)	
50 - 59	209	21.7	84 (26.9)	125 (19.1)	0.002
>60	587	60.8	165 (52.9)	422 (64.6)	
Color/ race					
Brown	718	74.4	226 (72.4)	492 (75.3)	0.333
Other	247	25.6	86 (27.6)	161 (24.7)	
Marital status					
With partner	555	57.5	195 (62.5)	360 (55.1)	0.030
Without partner	410	42.5	117 (37.5)	293 (44.9)	
Education (years)					
<5	527	54.7	141 (45.3)	386 (59.2)	
5–8	162	16.8	56 (18.0)	106 (16.3)	<0.001
> 8	274	28.5	114 (36.7)	160 (24.5)	
Occupation					
Work or retirement	747	77.4	247 (79.2)	500 (76.6)	0.367
No occupation	218	22.6	65 (20.8)	153 (23.4)	
Type 2 diabetes mellitus duration (years)					
<5	363	37.9	120 (39.0)	243 (37.4)	
5–9	339	35.4	121 (39.3)	218 (33.5)	0.043
≥10	256	26.7	67 (21.8)	189 (29.1)	
Body mass index (kg/m^2)					
<25	265	27.6	71 (22.8)	194 (30.0)	
25 - 29.9	353	36.8	112 (35.9)	241 (37.2)	0.015
≥30	341	35.6	129 (41.3)	212 (32.8)	
Use of medications for type 2 diabetes mellitus					
Yes	787	81.6	270 (86.5)	517 (79.2)	0.006
No	178	18.4	42 (13.5)	136 (20.8)	
Adhesion to shares at Primary Health Care					
Yes	264	27.4	83 (26.6)	181 (27.7)	0.716
No	701	72.6	229 (73.4)	472 (72.3)	
Physical activity guidance					
Yes	489	50.7	197 (63.1)	292 (44.7)	<0.001
No	476	49.3	115 (36.9)	361 (55.3)	
Memory difficulty					
Yes	530	54.9	170 (54.5)	360 (55.1)	0.770
No	434	45.1	142 (45.5)	292 (44.7)	
Health perception					
Equal	310	32.1	102 (32.7)	208 (31.9)	
Worse	241	25.0	57 (18.3)	184 (28.2)	
Much worse	35	3.6	7 (2.2)	28 (4.3)	0.002
Better	325	33.7	129 (41.3)	196 (30.0)	
Much better	37	3.8	12 (3.8)	25 (3.8)	

n (%) Absolute Frequency and Relative Frequency; % = Percentage; *Chi-Square Test.

Table 2 – Level of physical activity according to International Physical Activity Questionnaire and Type 2 diabetes mellitus guidelines.

Variable	Frequency or mean	Percentage or standard deviation	Type 2 diabetes mellitus guidelines		p-value***
			Meet	Does not meet	
			Frequency or average (% or standard deviation)		
			188 (19.5)	777 (80.5)	
Physical activity level (n or %)					
Low	653*	67.7	16 (8.5)	637 (82.0)	<0.001
Moderate	214*	22.2	84 (44.7)	130 (16.7)	
High	98*	10.2	88 (46.8)	10 (1.30)	
Type of physical activity (minute/week)					
Walk	118**	± 284	259 (395)	83.4 (238)	<0.001
Moderate	95.8**	± 270	444 (471)	11.6 (30.1)	
Vigorous	28.5**	± 135	139 (280)	1.67 (9.95)	
METs (minutes/week)					
Total	1005**	± 2352	3853 (4004)	333 (837)	<0.001
Walk	391**	± 958	883 (1339)	275 (801)	
Moderate	383**	± 1081	1775 (1883)	46.3 (120)	
Vigorous	228**	± 1081	1115 (2241)	13.3 (79.6)	

METs = Metabolic Equivalent of the Task; *Frequency Absolute; **Mean; ***Man-Whitney Test.

Table 3 – Logistic regression models results for odds of physical activity.

Variable	Odds Ratio (CI 95%) Raw	p-value	Odds Ratio (CI 95%) Adjusted	p-value
Model 1- Sociodemographic				
Age (years)				
<50	1.00	0.325	-	-
50 - 59	1.23 (0.80 - 1.89)		-	-
≥60	0.81 (0.55 - 1.18)		-	-
Marital status				
No Companion	1.00	0.068	-	-
With partner	1.29 (0.98 - 1.71)		-	-
Education (years)				
<5	1.00	<0.001	1.00	<0.001
5-8	1.37 (0.93 - 2.02)		1.33 (0.90 - 1.97)	
> 8	1.78 (1.28 - 2.46)		1.80 (1.31 - 2.48)	
Model 2 - Clinical			-	-
Type 2 diabetes mellitus duration (years)			-	-
<5	1.00	0.091	-	-
5–9	1.11 (0.81 - 1.53)		-	-
≥10	0.73 (0.51 - 1.05)		-	-
Body mass index (kg/m^2)				
<25	1.00	0.014	1.00	0.029
25 - 29.9	1.25 (0.87 - 1.78)		1.17 (0.81 - 1.69)	
≥30	1.55 (1.09 - 2.21)		1.50 (1.04 - 2.17)	
Use of medications for Type 2 diabetes mellitus				
No	1.00	0.012	1.00	0.007
Yes	1.63 (1.11 - 2.38)		1.71 (1.15 - 2.54)	
Model 3 - Behavioral				
Physical activity guidance				
No	1.00	<0.001	1.00	<0.001
Yes	2.12 (1.60 - 2.80)		1.98 (1.49 - 2.64)	
Health perception				
Equal	1.00	0.012	1.00	0.027
Better	1.31 (0.94 - 1.82)		1.41 (1.00 - 1.98)	
Much better	1.07 (0.51 - 2.24)		0.97 (0.45 - 2.05)	
Worse	0.61 (0.41 - 0.89)		0.64 (0.43 - 0.95)	
Much worse	0.53 (0.22 - 1.29)		0.59 (0.24 - 1.44)	

or vigorous). It was observed that having eight years or more of education, body mass index equal to or greater than 30 kg/m², taking medication for T2DM, receiving guidance on practicing PA, and perceiving one's health as better than that of other people of the same age are positively associated with active PA level. In contrast, worse health perception was negatively associated.

The low adherence to PA recommendations among patients with T2DM is worrying. The regular practice of PA is one of the central nonpharmacological interventions in managing the disease[27] It is associated with significant benefits for its control and improved quality of life. Furthermore, studies demonstrate that helps to achieve HbA1c reduction of up to 0.7%[26], reduces glycemic variability[28] and the incidence of complications and death from the disease[29,30]. This statement highlights the importance of developing effective strategies to encourage and support PHC patients to adopt a more active lifestyle, as national and international guidelines already provide the necessary recommendations to achieve good results.

The positive association between PA level and having eight or more years of study reveals an interesting relationship between educational level and adherence to PA practice in people with T2DM. In Brazil, regardless of the disease, people with higher education have a higher prevalence of PA. Data vary from 56% among people with higher education and 20.6% among those without formal education[31], although this relationship in the population with T2DM has not yet been established. Previous studies have presented contradictory results. One of the studies found no association[32] and another indicated an inverse association to that of the present study[33]. However, the literature still lacks studies that investigate this relationship. Studies have focused on education and literacy related to disease. Therefore, valuing education as positively associated with PA reinforces the importance of an adapted approach in delivering actions, mainly considering that the patient understands the recommendations and how to do them[9,10].

The positive association between body mass index equal to or greater than 30 kg/m² and PA level was surprising and may give rise to additional reflections. Although a higher body mass index is expected to be related to a less active lifestyle[34], a fact already presented in other studies in the T2DM population[8], the existence of this positive association suggests that patients with a higher body mass index are possibly actively seeking to engage in physical activities as part of their strategies to improve health and control disease. However, this finding must be interpreted with caution, and future research is needed to deepen the understanding of this relationship and evaluate possible factors that contribute to this contradictory association.

Medication used for T2DM was another factor positively associated with PA level, with the number of people not using medication for T2DM being low (18.4%). Higher adherence to drug treatment compared to non-drug treatment is a trend observed worldwide in the management of T2DM. In the specific context of the state of Amazonas, a study identified that only 5.8% of PHC patients with T2DM simultaneously adhered to both therapies (medication and non-medication)[35]. Those patients who regularly use medications may be more engaged in a comprehensive treatment plan, seeking to balance medication therapy with positive lifestyle changes. In this context, the combination of structural and organizational organization and provision of services in PHC, which includes the provision of medicines, guidance, and behavioral prescriptions, is essential to promote greater adherence to the proposed treatments[36].

The positive association between receiving guidance for the practice of PA among patients with T2DM reinforces the importance of the role of health professionals in promoting the practice of PA. According to a literature review, receiving information about PA is a facilitator for achieving regular levels of PA, while the absence of such guidance was considered a barrier[37]. Therefore, patients who receive guidance are more likely to gain confidence and motivation to engage in regular PA, which can lead to better adherence to treatment and disease control[37]. In this sense, valuing the importance of guidance for the practice of PA requires a more comprehensive approach in PHC, with health professionals acting as facilitators and motivators for adopting a more physically active lifestyle[38].

Regarding health perception, the study revealed that patients who rated their health better than others of the same age were more likely to be physically active. This finding can provide relevant perspectives on psychosocial factors that influence adherence to PA in patients with T2DM, confirming the study's results and highlighting personal motivation as a facilitator of this adherence[37]. On the other hand, feelings of demotivation or hopelessness were defined as strong barriers[35]. This statement was also confirmed in our findings, with the finding of a negative association between the perception of health as worse and PA level. Health profes-

sionals should consider the importance of addressing self-esteem and emotional well-being in patients with T2DM, offering psychosocial support and motivational guidance to encourage them to adopt and maintain an active lifestyle.

In short, our findings highlight that the PA level among patients with T2DM in cities in the interior of Amazonas is low and does not meet the ideal goals for managing the disease, presenting associations with sociodemographic, clinical, and behavioral. It is important to emphasize that these interventions can and should address PHC factors, aligning with evidence-based practices to offer more effective actions. When considering the relationship between PA level and PHC, it is essential to consider the peculiarities of health services in the cities studied since access to this most basic form of health care is affected by the geographic characteristics of the Amazon region[19,39]. Therefore, it is crucial to develop public policies and actions to improve this service's access and provision.

Finally, this study has some limitations related to using questionnaires to measure variables. These limitations include response bias, dependence on participants' self-report, the possibility of memory errors when reporting past physical activities, and difficulty differentiating between light, moderate, and vigorous activities, which may affect the accuracy of the results. The study's cross-sectional nature does not represent a limitation, as the main objective was to verify the relationships between the variables, not seeking to establish causality between them. Furthermore, the study demonstrated methodological robustness and strengths by overcoming careful sample calculation, ensuring a representative sample of adequate size, and strengthening the results' reliability and validity. It is worth highlighting that the study addressed a gap in literature, as few similar studies were conducted in states in the North region, especially in Amazonas.

In conclusion, the study revealed that most patients with T2DM in the interior of Amazonas have a low PA level and do not meet the recommendations for regular practice. Factors such as education, body mass index equal to or greater than 30 kg/m^2, medication use for T2DM, orientation towards PA, and positive perception of health are associated with greater PA. These findings highlight the importance of strategies to promote an active and healthy lifestyle among patients with T2DM. It is essential to encourage the adoption of PA in PHC, considering psychosocial factors and providing emotional support to patients. The findings of this study can guide improvements in the approach of health professionals and the development of more effective policies for managing T2DM in Amazonas.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Fernandes LS: Conceptualization; Methodology; Formal analysis; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Braga JAC and Cardoso MN: Formal analysis; Data curation; Writing – review & editing; Approval of the final version. Benedetti TRB: Methodology; Visualization; Writing – review & editing; Approval of the final version. Campos HLM: Visualization; Writing – review & editing; Approval of the final version. Leon EB: Conceptualization; Methodology; Investigation; Resources; Data curation; Supervision; Project administration; Visualization; Funding acquisition; Writing – original draft; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

For the development of this manuscript, the artificial intelligence tool ChatGPT was used for the following activities: text revision, text translation, and text organization. The authors declare that all material derived from such process has been reviewed, and the authors assume full responsibility for all the content of the manuscript.

Availability of research data and other materials

After publication the data will be available on demand to authors - a condition justified in the manuscript.

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sity of Amazonas (*Universidade Federal do Amazonas* - UFAM) for carrying out the statistical analyses. Finally, we cannot fail to thank each of the study participants and the supporting institutions: Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - CAPES – Financial Code 001) and the Amazonas Research Support Foundation (*Fundação de Amparo à Pesquisa do Amazonas* - FAPEAM – Universal 2028).

References

1. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. Lancet Glob Health. 2018;6(10):e1077–e1086. doi: https://doi.org/10.1016/S2214-109X(18)30357-7
2. Brasil, Ministério da Saúde, Secretaria de Vigilância em Saúde e Ambiente, Departamento de Análise Epidemiológica e Vigilância de Doenças Não Transmissíveis. Vigitel Brasil 2023: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2023. 1st ed. Brasília: 2023.
3. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde e Ambiente. Departamento de Análise Epidemiológica e Vigilância de Doenças Não Transmissíveis. Vigitel Brasil 2006-2023: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica do estado nutricional e consumo alimentar nas capitais dos 26 estados brasileiros e no Distrito Federal entre 2006 e 2023: estado nutricional e consumo alimentar / Ministério da Saúde, Secretaria de Vigilância em Saúde e Ambiente, Departamento de Análise Epidemiológica e Vigilância de Doenças não Transmissíveis. – Brasília: Ministério da Saúde, 2024. 80 p.
4. Dempsey P, Friedenreich C, Leitzmann M, Bruman M, Lambert E, Willumsen J. Global public health guidelines on physical activity and sedentary behavior for people living with chronic conditions: a call to action. J Phys Act Health. 2021;18(1):76–85. doi: https://doi.org/10.1123/jpah.2020-0525
5. Coelho-Ravagnani CF, Sandreschi PF, Piola TS, Santos L, Santos DL, Mazo GZ, et al. Atividade física para idosos: Guia de Atividade Física para a População Brasileira. Rev Bras Ativ Fís. 2021;26:0216. doi: https://doi.org/10.12820/rbafs.26e0216
6. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. IDF Diabetes Atlas Committee. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract. 2019;157:107843. doi: https://doi.org/10.1016/j.diabres.2019.107843
7. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Secretaria de Gestão Estratégica e Participativa. Vigitel Brasil 2008: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico / Ministério da Saúde, Secretaria de Vigilância em Saúde, Secretaria de Gestão Estratégica e Participativa. – Brasília: Ministério da Saúde, 2009.554 p.: il. – (Série G. Estatística e Informação em Saúde)
8. Martin CG, Pomares ML, Muratore CM, Avila PJ, Apoloni SB, Rodríguez M, et al. Level of physical activity and barriers to exercise in adults with type 2 diabetes. AIMS Public Health. 2021;8(2):229–39. doi: https://doi.org/10.3934/publichealth.2021018
9. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee; Sigal RJ, Armstrong MJ, Colby P, Kenny GP, Plotnikoff RC, et al. Physical Activity and Diabetes. Can J Diabetes 2013;37 Suppl 1:S40-4. doi: https://doi.org/10.1016/j.jcjd.2013.01.018
10. American Diabetes Association Professional Practice Committee; 5. Facilitating Behavior Change and Well-being to Improve Health Outcomes: Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022;45(Supplement_1):S60-S82. doi: https://doi.org/10.2337/dc22-S005
11. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behavior. Br J Sports Med. 2020;54(24):1451–62. doi: https://doi.org/10.1136/bjsports-2020-102955
12. Brasil. Ministério da Saúde. Secretaria de Atenção Primária à Saúde. Departamento de Promoção da Saúde. Guia de Atividade Física para a População Brasileira / Ministério da Saúde, Secretaria de Atenção Primária à Saúde, Departamento de Promoção da Saúde. – Brasília: Ministério da Saúde, 2021. 54 p.
13. Bertoluci MC, Forti AC, Pititto BA, Vancea DMM, Malerbi FEK, Valente F, et al. Diretriz Oficial da Sociedade Brasileira de Diabetes. Diretriz Oficial da Sociedade Brasileira de Diabetes. 2022 Feb 4. Available from: https://diretriz.diabetes.org.br/2022/ [2024 January].
14. Brasil, Ministério da Saúde M. Protocolo Clínico e Diretrizes Terapêuticas do Diabete Melito Tipo 2. Portaria SCTIE/MS no 54, de 11 de novembro de 2020. Secretaria de Ciência, Tecnologia, Inovação e Insumos Estratégicos. 2020 119. Available from: https://www.gov.br/conitec/pt-br/midias/protocolos/20201113_pcdt_diabete_melito_tipo_2_29_10_2020_final.pdf/view [2024 January].
15. Seidu S, Cos X, Brunton S, Harris SB, Jansson SPO, Mata-Cases M, et al. 2022 update to the position statement by Primary Care Diabetes Europe: a disease state approach to the pharmacological management of type 2 diabetes in primary care. Prim Care Diabetes. 2022;16(2):223–44. doi: https://doi.org/10.1016/j.pcd.2022.02.002
16. Leon E, Fernandes L, Campos H, Almeida F. Management and prevention of diabetes in primary health care in Amazonas. Rev Bras Ativ Fis. 2022;27:1–13. doi: https://doi.org/10.12820/rbafs.27e0271
17. IBGE. Instituto Brasileiro de Geografia e Estatística. Amazonas. 2022. Available from: <https://www.ibge.gov.br/cidades-e-estados/am.html> [2024 January].
18. IBGE. Instituto Brasileiro de Geografia e Estatística. Amazônia Legal. 2022. Available from: <https://www.ibge.gov.br/geociencias/organizacao-do-territorio/estrutura-territorial/15819-amazonia-legal.html> [2024 January].
19. Guimarães AF, Barbosa VLM, Silva MP, Portugal JKA, Reis MHSS, Gama ASM. Access to health services for riverside residents in a municipality in Amazonas State, Brazil. Rev Pan-Amaz Saúde. 2020;11:e202000178. doi: https://doi.org/10.5123/S2176-6223202000178
20. American Diabetes Association; 5. Facilitating behavior change and well-being to improve health outcomes: Standards of medical care in diabetes–2021. Diabetes Care. 2021;44(Supplement_1):S53–S72. doi: https://doi.org/10.2337/dc21-S005

21. Leon EB, Campos HLM, Brito FA, Almeida FA. Study of Health in Primary Care of the Amazonas Population: Protocol for an Observational Study on Diabetes Management in Brazil. JMIR Res Protoc. 2022;11(9):e37572. doi: https://doi.org/10.2196/37572

22. Apolinario D, Lichtenthaler DG, Magaldi RM, et al. Using temporal orientation, category fluency, and word recall for detecting cognitive impairment: The 10-point cognitive screener (10-CS). Int J Geriatr Psychiatry. 2016;31(1):4–12. doi: https://doi.org/10.1002/gps.4282

23. Nitrini R, Lefèvre B, Mathias S, Caramelli P, Carrilho P, Sauaia N. Neuropsychological tests of simple application for diagnosing dementia. Arq Neuropsiquiatric. 1994;52(4):457–65. doi: https://doi.org/10.1590/s0004-282x1994000400001

24. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC, et al. International physical activity questionnaire (IPAQ): study of validity and reliability in Brazil. Rev Bras Ativ Fís Saúde. 2001;6(2):5–18. doi: https://doi.org/10.12820/rbafs.v.6n2p5-18

25. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i-xii, 1-253.

26. Kanaley JA, Colberg SR, Corcoran MH, Malin SK, Rodriguez NR, Crespo CJ, et al. Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine. Med Sci Sports Exerc. 2022;54(2):353–68. doi: https://doi.org/10.1249/MSS.0000000000002800

27. Zhang Y, Yang Y, Huang Q, Zhang Q, Li M, Wu Y. The effectiveness of lifestyle interventions for diabetes remission on patients with type 2 diabetes mellitus: A systematic review and meta-analysis. Worldviews Evid Based Nurs. 2023;20(1):64–78. doi: https://doi.org/10.1111/wvn.12608

28. Zhu X, Zhao L, Chen J, Lin C, Lv F, Hu S, et al. The Effect of Physical Activity on Glycemic Variability in Patients With Diabetes: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Front Endocrinol (Lausanne). 2021; 12:767152. doi: https://doi.org/10.3389/fendo.2021.767152

29. Rietz M, Lehr A, Mino E, Lang A, Szczerba E, Schiemann T, et al. Physical Activity and Risk of Major Diabetes-Related Complications in Individuals With Diabetes: A Systematic Review and Meta-Analysis of Observational Studies. Diabetes Care. 2022;45(12):3101–11. doi: https://doi.org/10.2337/dc22-0886

30. Ren C, Liu W, Li J, Cao Y, Xu J, Lu P. Physical activity and risk of diabetic retinopathy: a systematic review and meta-analysis. Acta Diabetol. 2019;56(8):823–37. doi: https://doi.org/10.1007/s00592-019-01319-4

31. Botelho VH, Wendt A, Pinheiro E dos S, Crochemore-Silva I. Inequalities in sports and physical activity in the Brazilian macro-regions: PNAD, 2015. Rev Bras Ativ Fís Saúde. 2021;26:e0206. doi: https://doi.org/10.12820/rbafs.26e0206

32. Portela RA, Silva J, Nunes FF, Lopes M, Batista R, Silva A. Diabetes mellitus type 2: factors related to adherence to self-care. Rev Bras Enferm. 2022;75(4). doi: https://doi.org/10.1590/0034-7167-2021-0260

33. Santos P, Pereira R, Nakamura P, Moura R de. Factors that interfere with adhesion to the treatment of Diabetes Mellitus type 2. Res Soc Dev. 2022;11(1). doi: https://doi.org/10.33448/rsd-v11i1.24861

34. Santos IKS Dos, Conde WL. Bmi variation, dietary patterns and physical activity among adults aged 21-44 years. Cien Saude Colet. 2021;26:3853–63. doi: https://doi.org/10.1590/1413-81232021269.2.23562019

35. Gomes AC, Ribeiro GAM, Moraes MS, Gonçalves ICM, Sachett JAG. Adherence to pharmacological and nonpharmacological treatments in adults with type 2 diabetes. Mundo Saúde. 2020;44:381–96. doi: https://doi.org/10.15343/0104-7809.202044381396

36. Santos AL, Marcon SS, Teston EF, Back IR, Lino IGT, Batista VC, et al. Adherence to the treatment of Diabetes mellitus and relationship with assistance in primary care. Reme Rev Min Enferm. 2020;24:e-1279. doi: https://doi.org/10.5935/1415-2762.20200008

37. Cartagena MV, Tort-Nasarre G, Arnaldo ER. Barriers and facilitators for physical activity in adults with type 2 diabetes mellitus: A scoping review. Int J Environ Res Public Health. 2021;18(10):5359. doi: https://doi.org/10.3390/ijerph18105359

38. Kolchraiber FC, Rocha JS, César DJ, Monteiro OO, Frederico GA, Gamba MA. Level of physical activity in people with type-2 diabetes mellitus. Rev Cuid. 2018;9(2):2105–16. doi: https://doi.org/10.15649/cuidarte.v9i2.512

39. Silva AM, Fausto MCR, Gonçalves MJF. Care accessibility and availability for hypertensive patients in primary health care in a remote rural municipality in the state of Amazonas, Brazil, 2019. Cad Saude Publica. 2023;39(1):e00163722. doi: https://doi.org/10.1590/0102-311XPT163722

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Reviewers' assessment

The reviews of this article were originally conducted in Portuguese. This version has been translated using ChatGPT and subsequently reviewed by the Chief Editors.

Reviewer A

Rodrigo Sudatti Delevatti
Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil.

- Was there any indication of plagiarism in the manuscript?
  No
- Did the authors provide clarification regarding the ethical procedures adopted for conducting the research?
  Yes
  Comments to the authors
- Dear authors, congratulations on your work. I believe that, with some adjustments, it can be published. Please see the comments below:
- **Abstract:** In the introductory sentence "Physical activity (PA) plays a critical role in the management of type 2 diabetes mellitus (T2DM), especially in regions with unique sociogeographic contexts like Amazonas, Brazil", the research gap that the study aims to address is not clearly presented.In the results, "CI: 1.008" appears and should be standardized regarding the number of decimal places.
- **Introduction:** Review the sentence: "In many municipalities far from urban areas, PHC is the only health service available in most municipalities."The authors use the acronym PHC while also writing primary health care (APS). This should be redefined for consistency.
- **Methods:** What does the term SAPPA mean?As in the introduction, the authors use acronyms in Portuguese while the names of health services are in English, e.g., "Basic Health Units (UBS)". I suggest keeping the names in Portuguese as well or removing the acronyms.In the sentence "The choice of individuals and urban and rural units for collection was carried out using the simple random sampling method, this process is described in detail in the SAPPA methodology article", a period or semicolon should be used before "this".A section title for Statistical Analysis is required.
- **Results:** I suggest an English review, especially for the description of the results.
- **Tables:** Table captions are missing; Include the statistical tests that generated the p-values in the captions;There is no need to add an asterisk next to $p < 0.05$ if the significance level is already informed in the methods. This can also be noted in the caption. Bold may be used if you still want to highlight this value.Table 2 contains information in Portuguese;Be cautious with the finding "Users who perceived their health to be better than that of other people their age were more likely to be active (OR: 1.31; 95% CI: 0.94-1.82)".
- **Discussion:** Have the authors considered conducting an analysis integrating the independent variables? For example: how does body mass index behave with health perception, given that obesity should negatively impact self-perception?Despite the controversial association between body mass index and physical activity level, I agree with the speculation made and believe it could be further strengthened. The finding raises the hypothesis that patients might engage more in treatment due to obesity rather than glycemic levels.The last paragraph of the discussion could be removed. If retained, I suggest not starting with "In conclusion".
- **Final Decision:** Minor revisions required.

Reviewer B

Anonymous

Formatting

- Does the article comply with the submission guidelines of the Revista Brasileira de Atividade Física e Saúde?
  Partially
- Regarding formal aspects, is the manuscript well-structured with sections: introduction, methods, results, and discussion (with the conclusion as part of the discussion)?
  Partially
- Is the language appropriate, clear, precise, and objective?
  Yes
- Was there any indication of plagiarism in the manuscript?
  No
  Suggestions/Comments:

- 1. The manuscript has 3,711 words, exceeding the recommended limit of 3,500. However, I believe keeping the current content is justified.
- 2. The conclusion should not be a standalone section but integrated into the discussion.
- 3. The manuscript does not follow the journal's formatting guidelines for review (line numbering, double spacing, 2.5 cm margins).
- 4. The reference formatting needs careful revision, especially institutional references, such as those from the Ministry of Health, which are currently incorrect.

Abstract

- Does the abstract appropriately reflect the manuscript (objective, participants, variables, main results, and conclusion)?
  Yes
  Suggestions/Comments:
- No comments

Introduction

- Is the research problem clearly stated and defined?
  Partially
- Is the research problem adequately contextualized within existing knowledge, moving from general to specific?
  Partially
- Are the reasons justifying the need for the study well established?
  Partially
- Are the references current and relevant?
  Partially
- Is the objective clearly presented?
  Yes
  Suggestions/Comments:
- In the opening sentence "has shown a growing trend worldwide", it would be important to highlight that in Brazil, data from VIGITEL show an increasing trend in physical activity among the Brazilian population (noting that VIGITEL only covers state capitals and the Federal District). Check: https://bvsms.saude.gov.br/bvs/publicacoes/vigitel_2006_2023_pratica_atividade_fisica.pdf.
- Correct the reference to VIGITEL data; it refers to the capital Manaus, not the state.
- It is not appropriate to disclose something not yet published. Therefore, the mention of "DORI" in the third paragraph should be removed.
- The VIGITEL data used is incorrect. The self-reported prevalence for 2023 in Manaus is 8.2%. The authors used an outdated reference. Check: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/svsa/vigitel/vigitel-brasil-2023-vigilancia-de-fatores-de-risco-e-protecao-para-doencas-cronicas-por-inquerito-telefonico/view.
- In the fifth paragraph, correct the abbreviation to "Primary Health Care". The authors used APS, which is Portuguese.
- In the last paragraph of the introduction, when describing the objectives, the authors use the abbreviation "PAL", which was not previously defined. It is important to introduce it beforehand.
- Review the use of the term "users" when referring to SUS users, as it does not carry the same meaning in English.
- I also suggest a thorough review of all abbreviations throughout the manuscript, as several mistakes similar to those mentioned were identified.
- In the last paragraph, correct "sociogeographic" to "socio-geographical".
- A revision by a native speaker or professional translator is strongly recommended. Issues such as starting the introduction with a conjunction and using redundant expressions like *"recommendations recommended" indicate this need.

Methods

- Are the methodological procedures generally appropriate?
  Yes
- Are the procedures sufficiently detailed?
  Partially
- Was the participant selection or recruitment procedure adequate and clearly described?
  No
- Were the instruments and their psychometric properties described?
  Partially
- Is the data analysis plan adequate and well described?

Partially
- Are the inclusion/exclusion criteria appropriate and well described?
  Partially
- Did the authors provide clarification about ethical procedures?
  Yes

Suggestions/Comments:
- Use "Study design" instead of "General design".
- Ethical considerations should be grouped. I suggest moving the sentence "the consent of the state and municipal health departments, as well as the management of the UBS, was requested" to the paragraph where the ethics committee approval number is reported. Also, the ethics approval number differs from the one cited in the referenced methodological article.
- The sampling procedures described do not match those reported in the referenced methodological article: [https://pmc.ncbi.nlm.nih.gov/articles/PMC9523521/] (https://pmc.ncbi.nlm.nih.gov/articles/PMC9523521/). That article used a 15% margin of error, while the authors claim a 5% margin. Additionally, the methodological paper included 10 municipalities, but the authors report 13.
- How were patients with the specific condition selected? Was it from lists maintained by community health workers (ACS), health information systems, or through their attendance at health services? This is unclear.
- Why analyze physical activity based on IPAQ categories (low, moderate, vigorous)? Diabetes guidelines do not use this classification. It would be better to use "meets recommendations" / "does not meet recommendations".
- The variable categories presented in the methods do not match those in the results.
- The body mass index categories used were not specified, nor was the instrument for measuring weight and height.
- What reference guided the statistical analysis? Why was $p<0.05$ chosen for variable retention in the adjusted model instead of $p<0.20$ or $p<0.25$? How was the best model defined?

Results

- Are tables and figures appropriate and helpful?
  No
- Does the number of illustrations comply with the journal's guidelines?
  No
- Is the number of participants and information about losses/refusals presented?
  No
- Are participant characteristics adequately described?
  No
- Are results appropriately presented without unnecessary repetition?
  No

Suggestions/Comments:
- The results do not match the categories described in the methods. This makes it very difficult to analyze the results and discussion. I suggest the entire content, from methods to results, be revised before resubmission. For example, "Women" (gender) is used in the results, "female" (sex) in the methods, and "feminine" (sex) in the tables. This inconsistency repeats for variables like race/color ("mixed race" vs. "Brown"), education ("Education" vs. "literate"), and elderly classification. Additionally, the body mass index categories used in the results were not defined in the methods. This issue applies to all variables.

Discussion

- Are the main findings presented?
  No
- Are the strengths and limitations discussed?
  No
- Are the results discussed considering the study's limitations and existing knowledge?
  No
- Are the potential contributions of the findings discussed?
  No

Suggestions/Comments:
- The discussion cannot be properly analyzed until all the issues identified in the methods and results are addressed.

Conclusion

- Is the conclusion appropriate and coherent with the objectives?
  No
- Is the conclusion original?
  No

Suggestions/Comments:
- The conclusion cannot be properly analyzed until

all the issues identified in the methods and results are addressed.

References

- Are the references current and sufficient?
  Partially
- Are most references original research articles?
  Yes
- Do the references comply with the journal's format?
  Partially
- Are in-text citations appropriate and accurate?
  Partially
  Suggestions/Comments:
- Review the reference formatting carefully and consider updating some based on the comments provided.

Final Comments to the Authors

- The article's topic is highly relevant and contributes significantly to understanding the studied region. However, methodological aspects and the presentation of results need to be revised to avoid conceptual errors in interpretation and improve clarity. Additionally, a thorough textual review is necessary, as pointed out throughout this review. I also recommend reflecting on the use of the short version of the IPAQ to study populations in the northern region of Brazil. Consider whether this instrument adequately captures physical activity related to transportation (e.g., rowing a canoe) and work in non-urbanized regions.

Final Decision

Reject