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Self-Care Techniques and Their Association with Glycemic Control in Older Mexican Adults with Type 2 Diabetes in a Primary Care Centre

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Abstract

Introduction: The guidelines of the International Diabetes Federation (T2D) emphasise the importance of self-care in the comprehensive management of the disease. A high level of self-care for both the patient and their family reduces complications and hospitalisations. Self-care techniques are associated with glycemic control in populations from the Middle East, Europe, and Asia, with limitations in Mexican studies. **Objective:** To associate self-care techniques and glycemic control in older Mexican adults with Type 2 diabetes. **Material and Methods:** A cross-sectional, analytical study was conducted in adults aged 60 to 70 years old diagnosed with T2D and without complications. Glycosylated haemoglobin levels were recorded, and the Self-Care Practice Survey for Older Adults with Diabetes was applied. For statistical purposes, the poor and regular categories of self-care were combined resulting in a dichotomous scale: Poor and good self-care techniques. A multiple binary lo-

gistic regression model was performed with the variables: self-care techniques, gender, evolution < 10 years, and use of hypoglycemic agents, obtaining exponential B (Exp B), 95% CI, and p value. **Results:** Of the 204 subjects, 54.9% were women, 69.1% had poor self-care techniques, and 51% had poor glycemic control. In the adjusted model, poor self-care techniques had an Exp B of 2.9 [95% CI 1.5 - 5.5] and $p < 0.05$. **Conclusions:** These findings emphasise the relevance of using psychobehavioural variables, such as self-care, in the comprehensive care of geriatric patients with T2D in primary care centres.

Keywords

Self-Care, Diabetes, Glycemic Control, Adults, Risk Factors

1. Introduction

Type 2 diabetes (T2D) currently represents one of the main public health challenges worldwide [1]-[3]. Its prevalence has increased considerably in recent decades as a consequence of the modern lifestyle, characterized by a high-calorie diet and physical inactivity, factors that have significantly contributed to the increase in obesity and a higher incidence of chronic diseases [1] [2]. From a pathophysiological point of view, T2D is characterised by chronic hyperglycemia derived from inadequate insulin production and peripheral insulin resistance in tissues such as muscle and adipose [1].

Globally, it is estimated that between 340 and 536 million people live with diabetes, with a projection exceeding 800 million by 2040 [1] [2]. In Mexico, this disease is the second cause of mortality and the main cause of loss of healthy life years, especially in the older adult population [2] [3]. Despite diagnostic and therapeutic advances, adequate glycemic control remains a challenge, particularly in this age group, in which comorbidities, polypharmacy, frailty and functional limitations negatively impact disease management [3] [4].

Glycemic control, commonly assessed by measuring glycated hemoglobin (HbA1c), is a fundamental pillar in the prevention of micro and macrovascular complications [5]-[7]. However, achieving adequate control requires more than pharmacological intervention; patient-centred strategies, such as health education and self-care promotion, have been shown to be effective in improving clinical outcomes [8]-[10].

Self-care is the set of behaviours that a person consciously and actively performs in order to manage their disease, including adherence to treatment, glucose monitoring, dietary control, physical activity, and foot care [11] [12]. In older adults, its application may be limited by factors such as low educational level, poor understanding of the disease, unfavourable socioeconomic conditions, and the presence of functional or cognitive impairment [13]-[15].

Several studies have shown that high levels of self-care are associated with better metabolic control and a reduction in the occurrence of complications in Asian

and Middle Eastern populations [16]-[18]. Nevertheless, evidence also shows that many patients fail to apply, or are unaware of these practices adequately, which highlights the importance of their inclusion in the first level of care as an axis of self-care promotion [19] [20]. In the Mexican population, a decrease in T2D related mortality has been documented over time, coinciding with the implementation of the PREVENIMSS program among *Mexican Social Security Institute* (IMSS) beneficiaries. This program incorporates prevention and health promotion components, including self-care practices as part of a comprehensive approach to the disease. This association suggests a positive impact of institutional preventive strategies on the individual health and clinical outcomes of patients with diabetes. However, it is important to note that PREVENIMSS does not specifically and systematically consider the teaching or formal monitoring of self-care techniques, as this study does [21]-[23].

In this context, the present study aims to determine the association between the level of self-care and glycemic control in older Mexican adults with T2D.

2. Methodology

A cross-sectional, analytical study was conducted in a primary care centre in Mexico between March and December 2024. Men and women aged 60 - 70 years old diagnosed with T2D, with a 10-year history of T2D progression, normal weight (BMI 18.5 - 24.9 kg/m^2), overweight (BMI 25 - 29.9 kg/m^2), and GI obesity (BMI 30 kg/m^2) were included. Those with complications of T2D, autoimmune diseases, geriatric syndromes, neuropsychiatric conditions, and those with master's or doctoral degrees in education or related fields were excluded.

The sample was calculated with the OpenEpi version 3.01 program, using a formula for the difference in proportions, considering an alpha of 0.05% and power statistics of 80%. Considering the estimated prevalence of those exposed with an effect of 76.9% and of 56.1% with those exposed without an outcome, obtaining an n = 204 [22] [23]. A 1:1 ratio was used, and non-probability sampling was used for consecutive cases. The sample was collected from subjects who attended scheduled and unscheduled appointments at the family medicine outpatient clinic.

To evaluate self-care techniques, the survey questionnaire to assess self-care practices in older adults with T2D [24], validated in the Hispanic population and with a good internal consistency (Cronbach's $\alpha = 0.799$) was applied. The instrument yields scores ranging from 0 to 52 points, categorized as poor (0 - 13 points), average (14 - 26 points), and good (27 - 52 points); for stadistical purposes, the poor and regular categories were combined resulting in a dichotomous scale: Poor (0 - 26 points) and good (27 - 52 points). For the evaluation of glycemic control, Hb1Ac was recorded from the digital clinical record and an Hb1Ac > 7% was considered as glycemic imbalance [25].

For the descriptive analysis, qualitative variables (gender, education, socioeconomic level, time of evolution, pharmacological treatment, self-care techniques

and glycemic control) were expressed in frequencies and percentages. In the case of age, its distribution was evaluated by using the Kolmogorov-Smirnov test ($p > 0.05$), as well as using the criteria of skewness (values between −0.5 and 0.5) and kurtosis (values between −0.2 and 2) and was reported with median and IQR (25, 75).

Sociodemographic and clinical characteristics were compared with self-care techniques, using the Krussall-Wallis, Pearson's chi-square, linear trend, and Mann-Whitney U tests, based on mathematical assumptions. A value of $p < 0.05$ was considered factor dependence. Pearson's chi-square test was used to determine the association between self-care techniques and glycemic control, yielding OR, 95% CI, and p values.

In addition, a multiple binary logistic regression model was built, which included the variables poor self-care techniques, male gender, evolution time < 10 years and treatment with oral hypoglycemic agents, obtaining values of β, exponential of β, 95% CI, standard error, Nagelkerke's R^2, global percentage of the model, Hosmer-Lemeshow test and ROC of model prediction. It was represented with a Forest Plot by using the GraphPad Software. Age, educational level, and socioeconomic level were excluded as they were not statistically significant in bivariate analysis and did not improve model fit.

3. Results

3.1. Descriptive Results

Of a total of 204 older adults diagnosed with Type 2 diabetes, their sociodemographic and clinical characteristics were identified, finding that the median age was 65 years old (63 - 68 years old), 54.9% (112) of the participants were female, with a primary education level of 39.7% (81) and a low socioeconomic level of 57.8% (118). Regarding treatment, it was found that 58.3% (119) used oral hypoglycemic agents exclusively. It was found that 30.9% (63) used poor self-care techniques, 38.2% (78) used average self-care techniques and that 51% (104) had poor glycemic control (Table 1).

Table 1. Sociodemographic and clinical characteristics of older adults with Type 2 diabetes.

Parameters	n = 204 (%)
Age, IQR, (25, 75), years	65 (63, 68)
Sex	
Feminine	112 (54.9)
Masculine	92 (45.1)
Education	
Illiterate	7 (3.4)
Primary	81 (39.7)
Secondary	64 (31.4)

Continued

High School	38 (18.6)
Bachelor's Degree	14 (6.9)
Socioeconomic Level	
Low	118 (57.8)
Medium	75 (36.8)
High	11 (5.4)
Evolution time	
Short evolution (<10 years)	102 (50)
Long evolution (>10 years)	102 (50)
Pharmacological treatment	
Insulin	35 (17.2)
Oral hypoglycemic agents	119 (58.3)
Both	50 (24.5)
Self-care techniques	
Good	63 (30.9)
Average	78 (38.2)
Bad	63 (30.9)
Glycemic control	
Controlled	100 (49)
Uncontrolled	104 (51)

n = frequency; % = percentage; IQR = Interquartile range.

3.2. Bivariate Results

It was found that poor self-care techniques and the median age of 65 years old with a $p = 0.87$. Poor self-care techniques and the female gender with 54% (34) and $p = 0.37$, Cramer's V of 0.36. Primary education level and low socioeconomic level with poor techniques, had a $p = 0.23$ and $p = 0.41$, respectively. A time of evolution of the disease < 10 years, was found in 52.4% (33) ($p = 0.37$, with a Cramer's V of 0.57). In relation to treatment with oral hypoglycemic agents and poor techniques, it was found that 57.1% (36) (with a $p = 0.52$, Cramer's V of 0.40) (Table 2).

Regarding glycemic control and subject characteristics, it was found that the median age was 65 years old ($p = 0.42$) and the female gender was 57.7% (60) with an OR = 0.79 (95% CI 0.45 - 1.3, $p > 0.05$). The primary education level was 42% (42) ($p = 0.37$) and the low socioeconomic level was obtained in 62.5% (65) ($p > 0.05$). For the time of evolution < 10 years, an OR = 0.85 was found (95% CI, 0.49 - 1.48, $p > 0.05$). For treatment with oral hypoglycemic agents, 64.4% (67) ($p > 0.05$) was shown (Table 3).

Table 2. Sociodemographic and clinical characteristics of older adults with Type 2 diabetes associated with self-care techniques.

Parameters	Good self-care techniques n = 63 (%)	Average self-care techniques n = 78 (%)	Poor self-care techniques n = 63 (%)	*p* value	Cramer's V
Age, IQR (25, 75), years	65 (63, 69)	66 (63, 68)	65 (63, 69)	0.87[a]	-
Sex					
Feminine	39 (61.9)	39 (50)	34 (54)	0.37[b]	0.36
Masculine	24 (38.1)	39 (50)	29 (46)		
Education					
Illiterate	1 (1.6)	5 (6.4)	1 (1.6)	0.41[b]	0.57
Primary	21 (33.3)	31 (39.7)	29 (46)		
Secondary	24 (38.2)	24 (30.8)	16 (25.4)		
High School	12 (19)	13 (16.7)	13 (20.6)		
Bachelor's Degree	5 (7.9)	5 (6.4)	4 (6.4)		
Socioeconomic Level					
Low	31 (49.2)	47 (60.3)	40 (63.5)	0.23[b]	0.44
Medium	29 (46)	27 (34.6)	19 (30.2)		
High	3 (4.8)	4 (5.1)	4 (6.3)		
Evolution time					
Short evolution (<10 years)	28 (44.4)	41 (52.6)	33 (52.4)	0.37[b]	0.57
Long evolution (>10 years)	35 (55.6)	37 (47.4)	30 (47.6)		
Pharmacological treatment					
Insulin	14 (22.2)	9 (11.5)	12 (19)	0.52[b]	0.40
Oral hypoglycemic agents	32 (50.8)	51 (65.4)	36 (57.1)		
Both	17 (27)	18 (23.1)	15 (23.9)		

[a]Krusskall Wallis; [b]Linear trend test; IQR = Interquartile range.

Table 3. General characteristics of older adults with diabetes mellitus with glycemic control.

Parameters	Glycemic imbalance N = 104 (%)	Glycemic control N = 100 (%)	*p* value	OR with 95% CI
Age. IQR (25, 75), years	65 (63, 69)	65 (62, 68)	0.42[a]	-
Sex				
Feminine	60 (57.7)	52 (52)	0.41[b]	0.79 (0.45 - 1.3)
Masculine	44 (42.3)	48 (48)		
Education				
Illiterate	6 (5.8)	1 (1)	0.37[c]	-
Primary	39 (37.4)	42 (42)		
Secondary	35 (33.7)	29 (29)		
High School	18 (17.3)	20 (20)		
Bachelor's Degree	6 (5.8)	8 (8)		

Continued

Socioeconomic Level				
Low	65 (62.5)	53 (53)		
Medium	33 (31.7)	42 (42)	0.29[c]	-
High	6 (5.8)	5 (5)		
Evolution time				
Short evolution (<10 years)	50 (48.1)	52 (52)	0.57[b]	0.85 (0.49 - 1.48)
Long evolution (>10 years)	54 (51.9)	48 (48)		
Pharmacological treatment				
Insulin	13 (12.5)	22 (22)		
Oral hypoglycemic agents	67 (64.4)	32 (52)	0.19[c]	-
Both	24 (23.1)	26 (26)		

[a]Mann Whitney-U; [b]Pearson's chi-square; [c]Linear trend test; IQR = Interquartile range.

Regarding the relationship between poor self-care techniques and glycemic control, an OR of 2.8 (95% CI, 1.5 - 5.3, $p = 0.001$) was obtained (Table 4).

Table 4. Self-Care and glycemic control techniques in older Mexican adults with Type 2 diabetes.

Parameters	Lack of control n = 104 (%)	Control n = 100 (%)	*p* value	OR (95% CI)
Poor self-care techniques	83 (79.8)	58 (58)	0.001[a]	2.8 (1.5 - 5.3)
Good self-care techniques	21 (20.2)	42 (42)		

n = frequency; % = percentage; OR = odds ratio; IC = confidence interval; [a]Pearson's chi-square.

3.3. Multivariate Results

In the adjusted model, poor self-care techniques, use of hypoglycemic agents, duration of <10 years, and male sex were found to have an Exp B of 2.9 [95% CI 1.5 - 5.5, $p < 0.05$]; Exp B of 1.6 [95% CI 0.8 - 2.9, $p > 0.05$]; Exp B of 1.3 [95% CI 0.7 - 2.5, $p > 0.05$], and Exp B of 1.2 [95% CI 0.6 - 2.2, $p > 0.05$], respectively (Table 5, Figure 1).

Table 5. Multivariate Model. Risk factors for glycemic imbalance in older Mexican adults.

	Parameters	B	Wald	Exp B	95% CI	*p*	SE
Nagelkerke's $R^2 = 0.10$ Global percentage = 62.3% Hosmer and Lemeshow test = 0.99 ROC = 0.60 (95% CI 0.53 - 0.68)	Intercept	−1.27	1.09	0.27	-	-	0.40
	Poor self-care techniques	1.07	10.85	2.91	(1.54 - 5.51)	0.001	0.32
	Oral hypoglycemic agents	0.48	2.46	1.62	(0.88 - 2.99)	0.11	0.31
	Evolution <10 years	0.32	1.09	1.37	(0.75 - 2.52)	0.29	0.30
	Male sex	0.22	0.55	1.25	(0.69 - 2.21)	0.45	0.30

B = regression coefficient: Exp B = beta exponential; CI = confidence interval; SE = standard error; R^2 = determination coefficient; ROC = area under the curve.

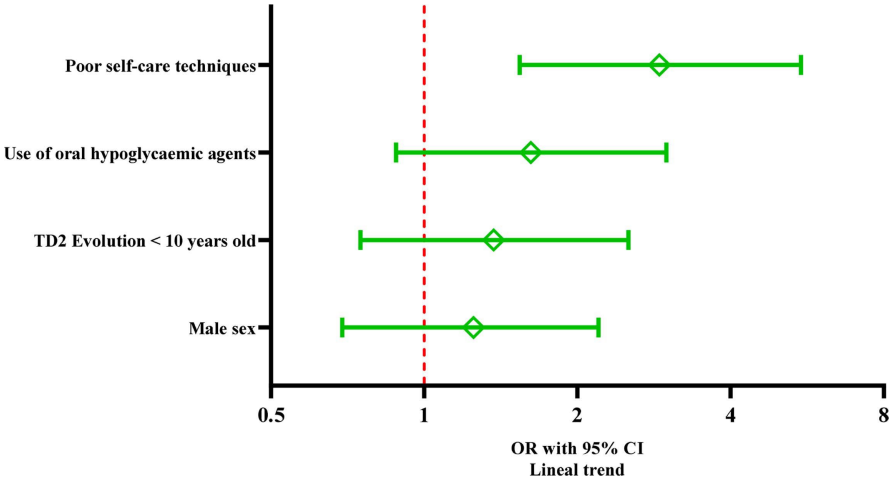

Figure 1. Multivariate model. Risk factors for glycemic imbalance in older Mexican adults.

4. Discussion

Among the results found in the present research, a predominance of the female sex was obtained. This is consistent with the data reported by the *Encuesta Nacional de Salud y Nutrición* (National Health and Nutrition Survey, ENSANUT, for its acronym in Spanish) 2022, which shows a higher percentage of Type 2 diabetes in Mexican women [2] [3] [26]. Likewise, a study whose objective was to determine self-care techniques in subjects with Type 2 diabetes, showed a greater presence of the disease in the female sex [27]. Both studies were conducted in the Mexican population, so the information found is consistent.

The median age was 68 years old. These data coincide with those of the ENSANUT 2022, which shows that the highest presence of disease is found in adults aged 65 to 70 years old [3]. This trend was reported in a clinical research that obtained a predominant age range between 66 and 70 years old [28] [29], however, self-care techniques or glycemic control were not studied.

The primary education level was present in the majority of the subjects. This is explained based on data from *Instituto Nacional de Estadística y Geografía* (National Institute of Statistics and Geography, INEGI, for its acronym in Spanish), which indicates that older Mexican adults have basic schooling [3] [30]. This finding coincides with what was reported in a study carried out in a public institution in Brazil, which showed that low schooling was associated with little knowledge of self-care and low efficacy in disease control [28]. It is worth mentioning that the sample size and statistical power were lower in relation to this research.

Likewise, a low socioeconomic level was determined. This can be interpreted based on data from *Consejo Nacional de Evaluación de la Política de Desarrollo Social* (National Council for the Evaluation of Social Development Policy, CONEVAL, for its acronym in Spanish), where the population over 65 years of age has an income below the poverty line [31]. This is consistent with clinical research that concludes that low economic level significantly influences the effectiveness of self-care [32].

The predominant treatment was oral hypoglycemic agents. This can be explained based on the *Sistema de Información Cultural* (Cultural Information System, SIC, for its acronym in Spanish), which determined that treatment regimens include the use of first-line metformin [33]. This is convergent with a study conducted in Ethiopia, which found that patients receiving oral hypoglycemic agents have lower adherence and a lower efficacy of self-care and glycemic control [23], however, the research design used differs from the present study.

This study showed a predominance of poor self-care techniques. This coincides with what has been reported in some clinical investigations, which conclude that poor self-care techniques are used in subjects with T2D [22]. Nonetheless, these results differ from those obtained in other countries, which conclude that there is a predominance of good self-care techniques associated with demographic and social characteristics [26] [31] [34].

Most subjects were found to have glycemic imbalance. These data are explained by data presented by ENSANUT, which determined that the majority of the Mexican population with T2D is imbalanced [30]. Likewise, a study determined that the majority of its population has glycemic imbalance, this in relation to age and therapeutic adherence [35].

The female sex did not show any association with poor self-care techniques or glycemic control. However, it should be considered that women with T2D are susceptible to glycemic imbalance related to hormonal and metabolic changes [36]. Conversely, the findings in this study differ from those shown by clinical research, which conclude that women with T2D had worse glycemic control [37]. Nevertheless, it is consistent with what was presented in a cohort study where no relevance of gender in the performance of self-care techniques was found [37]. Additionally, it is divergent, with respect to studies that conclude the female gender in the knowledge of self-care and adherence to T2D treatment, this is related to the level of awareness of their disease [38].

The time of evolution was not associated with poor self-care techniques or glycemic imbalance. This is not consistent with what has been described in clinical research, which indicates that one of the most important factors for poor self-care management is a short time of evolution, since it is related to a low knowledge of the disease [38]. This is explained by the fact that, the longer the time of adaptability to the disease, the greater the awareness and habit of self-care develops [39].

Treatment with oral hypoglycemic agents was not associated with glycemic imbalance or poor self-care techniques. This is explained by the fact that patients with better self-care practices achieve more effective glycemic control, which could allow them to continue their treatment exclusively with oral hypoglycemic agents [35]. Likewise, it agrees with research that concludes that adherence to treatment with oral hypoglycemic agents in people with T2D is influenced by the therapeutic regimen, the frequency of doses and the presence of side effects, therefore, it leads to poor self-care [40].

No association was found between age and glycemic control. However, ad-

vanced age is associated with physiological changes that may affect glycemic control. In addition, factors such as polypharmacy and comorbidities can complicate treatment adherence and glycemic control [39]. The results found are different from clinical studies, which concluded that advanced age is considered a risk factor for diabetes control, although it was not the only determinant [26].

Primary education level was not associated with glycemic imbalance or poor self-care practices. Nonetheless, a low educational level has been identified as hindering understanding of medical indications, adherence to treatment, and the implementation of lifestyle changes [41]. The results obtained are different from those found in a clinical investigation, which analysed the relationship between the educational level and knowledge about T2D, finding that patients with a higher educational level had a better knowledge of their disease [42].

Socioeconomic status was not associated with glycemic imbalance or poor self-care techniques. Globally, it has been determined that low income is associated with poor glycemic control [43]. The result obtained in the present research is also different from studies that conclude the risk of complications of T2D is associated with low income [44].

The time of evolution of T2D greater than 10 years predominated in the group with glycemic imbalance. It has been shown that the prolonged duration of the disease may be associated with a greater burden of complications and comorbidities [43]. A study conducted in Ethiopia found that patients with a diabetes duration greater than 7 years had a greater probability of presenting poor glycemic control, which is in accordance with this research [45].

Oral hypoglycemic agents were found to be predominant in patients with glycemic imbalance. Although oral hypoglycemic agents are a common therapeutic option in the management of T2D, their effectiveness may decrease over time due to disease progression and other factors [40]. These results are similar to clinical research, which concludes that exclusive treatment with oral hypoglycemic agents does not achieve optimal Hb1Ac levels [46].

Regarding the primary objective of the study, in the simple and adjusted analysis, it was found that poor self-care practices increase the probability of glycemic imbalance twofold. This is explained by the fact that adequate self-care management by subjects suffering from T2D is essential in order to maintain adequate blood glucose levels. These practices include dietary adherence, regular physical activity, continuous glucose monitoring, and adherence to pharmacological treatment [35]. These results are consistent with a multicentre study in Ethiopia, which aimed to demonstrate the effectiveness of self-care in glycemic control in a general hospital setting. It was shown that poor self-care increases Hb1Ac levels by more than 7%, so they are similar to those presented in this research. In contrast, it is important to note that the sociodemographic characteristics considered in the study are different from those of our population, in addition to considering a quantitative variable in its primary outcome [47]. Moreover, a prospective study, carried out in Africa, found an association between the level of self-care practice

and poor glycemic control, data consistent with those found in this research, but in a different ethnic group [48].

Among the strengths of this research are the implementation of a multivariate model and the consideration of multicausality, with a coefficient of determination that explains 10% of glycemic imbalance, a global percentage of 62.3%, which is not attributed to random error, a test of data fit to the model with $p = 0.99$ and a moderate discrimination of the model (60%). The instruments validated and adapted to the Hispanic context are also considered strengths, which increases the reliability of the results obtained.

Regarding the study's limitations, we can mention its cross-sectional design, which prevents a definitive causal association between the variables used. Therefore, prospective and longitudinal studies are needed to better establish the association between self-care and glycemic control. Another limitation is a potential information bias due to the self-care questionnaire's application, given its auto-heterologous nature. In addition, a non-probability consecutive sampling method was used, chosen for its feasibility in accessing the target population within the available timeframe; however, this may have introduced selection bias. The study sample was limited to individuals assigned to a single medical unit, making it difficult to generalise the results to other national or global populations.

5. Conclusion

The findings suggest that poor self-care techniques increase the likelihood of glycemic imbalance in older Mexican adults with T2D. This highlights the importance of considering psychobehavioural variables in the comprehensive treatment of diabetes, rather than just a biological model of health, by healthcare professionals in primary care centres in Mexico. Similarly, parameters that influence self-care techniques were provided, which can guide prevention and health care strategies for the Mexican population.

Ethical Considerations

The present research underwent an independent evaluation and obtained an institutional registration number R-2024-1406-004 by the Local Health Research Committee 1408 and from the Research Ethics Committee 1406-8 of the Mexican Social Security Institute.

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Author Contributions

T. V. P.; F. K. G. N.; F. V. H.: Study design, supervision of data collection, data analysis, manuscript writing.

M. G. S. M.; L. R. G. C.; E. V. A.: Supervision of data collection, data analysis, and manuscript writing.

J. A. T. C.; E. L. G. F.: Data analysis, manuscript review.

O. J. J.; F. V. H.: Supervision of data collection, data analysis, and manuscript review.

T. V. P.; F. K. G. N.: Data analysis, manuscript review.

E. G. C.; I. M. P. R.: Study design, results validation, manuscript review.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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