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ORIGINAL ARTICLE

The Impact of Yoga Practice on Self-Reported Health Outcomes Among Middle-Aged Adults

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ABSTRACT

Background. While the health benefits of yoga are widely acknowledged, its impact on self-reported health among middle-aged adults in Vietnam, particularly in Ho Chi Minh City, remains understudied. **Objectives.** This research aims to assess the impact of regular yoga practice on self-reported health indicators among middle-aged adults in Ho Chi Minh City. Specifically, it aims to determine whether participating in a five-month yoga intervention can improve physical and mental health. **Methods.** This randomized controlled intervention study included 132 participants, aged 48 to 60 years, randomly allocated to a yoga group (YG, n=68) or a control group (CG, n=64). The YG engaged in twice-weekly 60-minute yoga sessions for 5 months, while the CG maintained regular routines without adopting new exercise programs. Pre- and post-intervention assessments of self-reported health were conducted using the SF-36 questionnaire, encompassing eight distinct domains: physical capabilities, restrictions in daily activities due to physical health issues, pain levels, overall perceptions of health, energy and vitality, social engagement, emotional challenges affecting daily roles, and psychological well-being. Analysis of variance was employed to compare changes between the groups. **Results.** After 5 months, the YG demonstrated statistically significant improvements ($p<0.001$) in all eight domains of the SF-36 compared to the CG. Specifically, the YG experienced significant improvements in physical functioning ($F=53.916$, $P=0.000$), physical role ($F=51.412$, $P=0.000$), reduced bodily pain ($F=31.578$, $P=0.000$), improved general health ($F=59.870$, $P=0.000$), enhanced vitality ($F=54.631$, $P=0.000$), increased social functioning ($F=41.385$, $P=0.000$), improved role emotional ($F=65.320$, $P=0.000$), and enhanced mental health ($F=43.653$, $P=0.000$). **Conclusion.** This study proves regular yoga can confer significant physical and mental health benefits to Ho Chi Minh City middle-aged adults. These findings highlight the potential of yoga as a feasible approach to improving health and well-being in a middle-aged population.

INTRODUCTION

Physical activity is crucial for middle-aged adults' health and well-being (1, 2). Numerous studies have demonstrated the positive impact of yoga on the physical and mental health of middle-aged individuals (3, 4). Regular yoga practitioners often report improvements in stress reduction, enhanced emotional well-being, and better sleep quality, critical factors influencing overall health during midlife (5-7). In addition, the frequency of yoga practice has been linked to more incredible

health benefits, suggesting that those who engage in yoga more consistently are likely to experience more pronounced improvements in both physical fitness and mental health outcomes (8). Moreover, the beneficial effects of yoga extend beyond general wellness; they also include specific enhancements in cognitive functions, indicating that regular yoga practice may improve attention, processing speed, and executive functioning, which are essential for effective functioning in daily life and coping with the demands of middle age (5). To further elucidate the multifaceted benefits of yoga, it is essential to recognize that many practitioners describe significant improvements not only in their physical health but also in psychological resilience, thereby reinforcing the idea that yoga serves as a powerful tool for promoting holistic health across various domains (5, 8).

Despite the growing popularity of yoga in Ho Chi Minh City, there is a lack of comprehensive research examining its impact on the self-reported health of middle-aged adults in this specific context. This study seeks to fill this gap by employing a cross-sectional design that will collect data on yoga practice frequency, perceived health improvements, and overall well-being among participants, thereby providing valuable insights into how yoga may support healthy aging and enhance the quality of life in this population (9-12). Furthermore, by investigating individual experiences and perceptions related to yoga practice, the study aims to identify specific health outcomes, such as enhanced mobility, improved mindfulness, and decreased symptoms of anxiety and depression, thereby contributing to a more nuanced understanding of how yoga can play a pivotal role in promoting the physical and mental health of middle-aged adults in Ho Chi Minh City (3, 13).

In light of the factors mentioned above, it is anticipated that regular yoga practice will yield significant improvements in self-reported health metrics, including enhanced mood, reduced anxiety and depression, and better overall well-being, ultimately demonstrating yoga's potential as a beneficial intervention for supporting healthy aging in this population (14-17). The findings of this study will not only add to the existing literature on the benefits of yoga but also serve as a foundation for further investigations that explore the environmental and cultural factors influencing yoga practice among middle-aged adults, particularly in urban settings like Ho Chi Minh City (12, 18, 19).

Utilizing the SF-36 health survey, this study will assess various dimensions of health, including physical functioning, mental health, and overall vitality, to provide a comprehensive evaluation of yoga's impact on this demographic and contribute to the understanding of how regular practice may facilitate healthy aging in the Ho Chi Minh City context.

MATERIALS AND METHODS

Participants and Procedures. The sample size of 132 participants was established through a power analysis conducted before the study to achieve adequate statistical power. The analysis was carried out using G*Power software (version 3.1.9.7), with parameters set at an effect size of 0.5 (moderate effect), a significance level (alpha) of 0.05, and a power (1-β) of 0.80. The power analysis results suggested that at least 118 participants were needed to identify statistically significant differences between the groups. To account for potential attrition and ensure proper representation, a total of 132 participants were recruited, which was considered sufficient to obtain reliable and valid outcomes; aged 48 to 60 years (mean age 56±4.1) were recruited for this study through a multifaceted approach, including face-to-face interviews, email correspondence, social media outreach via Facebook, and the popular messaging application Zalo. Inclusion criteria mandated the ability to comprehend and complete the SF-36 questionnaire. Participants were not included in the study if they fulfilled any of the following criteria: symptomatic coronary artery disease, angina pectoris, substantial cognitive impairment, uncontrolled hypertension (≥160/100 mmHg), functional dependence, or regular use of assistive devices.

Eligible participants were randomly assigned to a yoga group (YG, n=68) and a control group (CG, n=64). The YG engaged in a structured 5-month yoga program led by experienced yoga instructors. The program comprised 60-minute sessions, conducted twice weekly, with each session incorporating a 15-minute warm-up and a 15-minute cool-down period, and was designed based on existing protocols and guidelines for yoga interventions aimed at improving health outcomes among middle-aged adults (20, 21). The intensity of the yoga training was monitored and controlled throughout the study. The yoga sessions were designed to be of moderate intensity, following the

American College of Sports Medicine guidelines for physical activity in middle-aged adults. The CG was instructed to maintain their habitual lifestyle without participating in new exercise regimens throughout the study.

Attrition of Participants: During the study, an attrition rate was observed among participants. At the mid-study point, the YG had 66 participants (n=66) after two dropouts, and the CG had 60 participants (n=60) after four dropouts. By the end of the intervention, the YG had 63 participants (n=63) due to an additional three dropouts, and the CG had 55 participants (n=55) due to an additional five dropouts.

The reasons for participant dropout included:

YG: Two participants withdrew due to personal scheduling conflicts, while three additional participants dropped out due to unrelated health issues.

CG: Four participants withdrew due to a lack of interest in continued participation, and five additional participants were lost to follow-up or reported a lack of motivation to maintain the study requirements.

By documenting the attrition and its reasons, we aimed to ensure transparency regarding participant retention and to understand any potential impacts on the study results.

Measurement Tools and Outcome Variables.

Self-reported health, the primary outcome variable, was measured using the SF-36 questionnaire. This well-established instrument has demonstrated validity and reliability in evaluating health-related quality of life across diverse populations (22), including healthy individuals and those with various medical conditions. The questionnaire consists of 36 items (23), assessing eight health domains:

Physical Functioning: Capacity for daily physical tasks.

Role Physical: Impact of physical health on work and social engagement.

Bodily Pain: Severity and influence of physical pain.

General Health: Self-perceived health status and well-being.

Vitality: Energy levels and mental alertness.

Social Functioning: Ability to participate in social activities and relationships.

Role Emotional: Impact of emotional issues on work and social engagement.

Mental Health: Mood, emotional state, and overall psychological well-being.

The Vietnamese version of the SF-36, employed in this study, has been translated and validated for cultural equivalence using a back-translation methodology. Summary scores for physical and mental health were calculated based on participant responses to the questionnaire (24).

Data Collection Points.

To evaluate the effects of the yoga intervention over time, assessments were conducted at three key points: baseline (pre-intervention), mid-intervention (after 10 weeks), and endpoint (post-intervention after 20 weeks). The mid-intervention assessment was implemented to capture interim changes in the self-reported health outcomes and to understand the progression of the intervention's impact.

Data Analysis.

Data analysis was conducted with SPSS, version 20.0. Continuous variables were summarized using means and standard deviations. The Shapiro-Wilk test was used to assess the normality of the distribution of SF-36 scores for both the YG and CG at baseline and post-intervention. One-way ANOVA was employed to compare SF-36 scores between the YG and CG at both baseline and endpoint, with a significance level of $p \leq 0.05$.

RESULTS

Descriptive statistics for the participants were collected to provide a comprehensive overview of the study population. The summary of the baseline characteristics of the participants in the YG and CG is shown in Table 1 below.

Table 1. Baseline Characteristics of YG and CG (M±SD).

Characteristic	(YG, n=68)	(CG, n=64)	Total (n=132)
Age (years)	56.3±3.9	55.8±4.3	56.0±4.1
Gender (male/female)	34/34	33/31	67/65
Height (cm)	162.7±7.1	163.2±6.8	162.9±7.0
Weight (kg)	65.4±9.3	64.8±8.7	65.1±9.0
BMI (kg/m²)	24.6±3.1	24.3±3.2	24.5±3.1

M: Mean; SD: Standard deviation; YG: Yoga group; CG: Control group.

The analysis of variance (ANOVA) results in Table 2 reveal no statistically significant differences between the YG and the CG across all measured domains of self-perceived health at the baseline. Participants' physical functioning shows a mean score of 53.43 for YG and 50.44 for CG, with an F-value of 0.784 and a p-value of 0.392, indicating no significant difference. Similarly, the role physical subscale reports a mean of 41.43 (YG) and 37.99 (CG), with an F-value of 0.732 and a p-value of 0.366, further supporting the lack of significant variance between the groups. Bodily pain is nearly identical between the groups, with mean scores of 57.1 for YG and 56.72 for CG and an F-value of 0.716 (p=0.358). No significant between-group differences were observed for general health, vitality, social functioning, emotional role, or mental health (all p>0.05).

Neither the physical nor mental health composite score differed significantly between the groups, with p-values of 0.386 and 0.509, respectively. The SF-36 global score, which aggregates all subscales, likewise reflects no significant baseline difference, with a mean score of 50.72 for YG and 50.25 for CG and an F-value of 0.814 (p=0.407).

Table 2. Baseline Differences in Self-Reported Health: Yoga Group vs. Control Group.

Outcome Measures	YG (n=68)		CG(n=64)		F	Sig*
	M	SD	M	SD		
Physical Functioning	53.43	31.96	50.44	31.88	0.784	0.392
Role Physical	41.43	40.56	37.99	40.38	0.732	0.366
Bodily pain	57.1	19.51	56.72	19.54	0.716	0.358
General Health	41.54	15.75	43.70	17.74	0.970	0.485
Vitality	55.76	10.81	59.77	12.37	1.892	0.946
Social functioning	47.72	15.89	49.81	19.3	1.296	0.648
Role emotional	46.21	39.79	40.39	43.29	0.722	0.361
Mental health	59.54	11.46	63.12	13.22	1.688	0.844
Physical Health Composite Score	50.3	21.36	49.5	22.37	0.772	0.386
Mental Health Composite Score	50.34	16.68	51.44	19.36	1.018	0.509
SF-36 Global Score	50.72	20.44	50.25	22.39	0.814	0.407

*: Analyzed using ANOVA; M: Mean; SD: Standard deviation; YG: Yoga group; CG: Control group.

In summary, the initial analysis suggests that before the intervention, the YG and CG were comparable across all health dimensions assessed, indicating a well-matched sample and providing a robust foundation for evaluating the effects of the subsequent yoga intervention on these health parameters.

Based on the findings presented in Table 3, one-way ANOVA revealed statistically significant differences between the YG and the CG in self-reported health outcomes at the mid-intervention mark (week 10). Notably, the YG demonstrated substantial improvements across various health indicators compared to the CG.

Enhanced physical functioning and reduced limitations: The YG exhibited significantly higher mean scores for "Physical functioning" (M=84.46, SD=20.05) compared to the CG (M=51.53, SD=22.82), with F(1.83)=32.567, p<0.05. This suggests that yoga practitioners experienced enhanced capacity to perform physical activities. Furthermore, "Role limitations due to physical health" were significantly reduced in the YG (M=72.46, SD=28.65) compared to the CG (M=39.08, SD=31.32), with F(1.83)=38.053, p<0.001.

Improved bodily pain and general health: The YG reported significantly better "bodily pain" perception (M=88.13, SD=7.60) compared to the CG (M=57.81, SD=10.48), with F(1.83)=7.876, p<0.001, indicating the effectiveness of yoga in pain management. Similarly, "General Health" perceptions were significantly higher in the YG (M=72.57, SD=11.02) compared to the CG (M=44.79, SD=13.78), with F(1.83)=10.67, p<0.001.

Positive effects on energy, social functioning, and mental health: Significant improvements were also observed in other health domains for the YG, including "Vitality" (F(1.83)=20.812, p<0.05), "Social functioning" (F(1.83)=14.256, p<0.05), "Role limitations due to emotional problems" (F(1.83)=37.942, p<0.05), and "Mental Health" (F(1.83)=18.568, p<0.05). These findings highlight the positive impact of yoga on various aspects of well-being.

Table 3. Mid-Study Self-Reported Health: Yoga vs. Control Group.

Outcome Measures	YG (n=66)**		CG (n=60)**		F	Sig*
	M	SD	M	SD		
Physical Functioning	84.46	20.05	51.53	22.82	32.567	0.002
Role Physical	72.46	28.65	39.08	31.32	38.053	0.000
Bodily pain	88.13	7.60	57.81	10.48	7.876	0.000
General Health	72.57	11.02	44.79	13.78	10.67	0.000
Vitality	86.79	9.81	58.81	13.54	20.812	0.000
Social functioning	78.75	3.98	50.9	10.24	14.256	0.001
Role emotional	77.24	27.88	41.48	34.23	37.942	0.000
Mental health	90.57	10.08	64.21	12.56	18.568	0.000
Physical Health Composite Score	81.33	9.45	50.59	13.31	8.492	0.000
Mental Health Composite Score	81.37	4.77	50.75	10.3	11.198	0.003
SF-36 Global Score	81.75	8.53	50.32	13.33	30.098	0.000

*: Analyzed using ANOVA; **: The YG experienced attrition of two subjects, while the CG had four subjects drop out; M: Mean; SD: Standard deviation; YG: Yoga group; CG: Control group.

Enhanced physical and mental health summary scores: The composite scores for "physical health" and "mental health" further emphasized the superiority of the YG over the CG, with F values of 8.492 and 11.198, respectively ($p<0.05$ for both).

Significant improvement in overall quality of life: Finally, the YG achieved a significantly higher mean "SF-36 Total Score" (M=81.75, SD=8.53) compared to the CG (M=50.32, SD=13.33), with $F(1.83)=30.098$, $p<0.001$. This underscores the profound impact of yoga in enhancing the overall quality of life among participants.

Sustained Benefits of Yoga on Self-Reported Health: A One-Way ANOVA Analysis of Post-Intervention Outcomes.

A one-way ANOVA conducted on data from Table 4 revealed statistically significant differences between the YG and the CG in self-reported health outcomes post-intervention. These results demonstrate the sustained and superior improvement of the YG across all health indicators compared to the CG.

Continued Enhancement of Physical Function and Reduction in Limitations: The YG maintained significantly higher mean scores for "Physical Functioning" (M=98.67, SD=10.15) compared to the CG (M=48.51, SD=23.63), with $F(1.67)=53.916$, $p<0.001$. This indicates a substantial difference in the capacity to perform physical activities, favoring yoga practitioners. Similarly, "Role Limitations due to Physical Health" remained significantly lower in the YG (M=87.4, SD=21.32) compared to the CG (M=39.08, SD=21.30), with F=51.412, $p<0.001$.

Long-Term Improvements in bodily pain and general health: The YG continued to report significantly better "Bodily Pain" perception (M=93.07, SD=8.62) compared to the CG (M=59.76, SD=10.45), with F=31.578, $p<0.001$. This highlights the long-term positive impact of yoga on pain management. Furthermore, the YG maintained significantly higher "General Health" perceptions (M=87.51, SD=9.22) compared to the CG (M=46.78, SD=18.71), with F=59.870, $p<0.001$.

Sustained Positive Effects on Energy, Social functioning, and Mental Health: The YG consistently outperformed the CG in other key health domains, including "Vitality" ($F(1.67)=54.631$, $p<0.001$), "Social Functioning" ($F(1.67)=41.385$, $p<0.001$), "Role Limitations due to Emotional Problems" ($F(1.67)=65.320$, $p<0.001$), and "Mental Health" ($F(1.67)=43.653$, $p<0.001$). These findings underscore yoga's sustained positive influence on mental and social functioning.

Lasting Enhancement of Overall Physical and Mental Health: The YG demonstrated significantly higher composite scores for both "Physical Health" (M=86.07, SD=9.43) and "Mental Health" (M=96.31, SD=6.73) compared to the CG, with F values of 41.403 and 41.391, respectively ($p<0.001$ for both). This emphasizes the comprehensive and lasting benefits of yoga on overall well-being.

Significant and Sustained Improvement in Overall Quality of Life: Post-intervention, the YG maintained a significantly higher mean "SF-36 Total Score" (M=82.54, SD=9.51) compared to the CG (M=52.37, SD=18.32), with $F(1.67)=34.422$, $p<0.001$. This reinforces yoga's

significant and sustained positive impact on overall quality of life.

These findings provide compelling evidence that yoga practice not only enhances physical functioning but also comprehensively improves various aspects of health, including mental and Social functioning, contributing significantly to a better quality of life for participants. The sustained improvements observed post-intervention further strengthen the case for incorporating yoga into health-promotion strategies.

Table 4. Post-Intervention Self-Reported Health: Yoga vs. Control Group.

Outcome Measures	YG(n=63)**		CG (n=55)**		F	Sig*
	M	SD	M	SD		
Physical Functioning	98.67	10.15	48.51	23.63	53.916	0.000
Role Physical	87.4	21.32	39.08	21.30	51.412	0.000
Bodily pain	93.07	8.62	59.76	10.45	31.578	0.000
General Health	87.51	9.22	46.78	18.71	59.870	0.000
Vitality	91.92	7.85	60.83	13.52	54.631	0.000
Social functioning	77.04	5.07	52.91	11.23	41.385	0.000
Role emotional	92.18	21.81	43.45	36.03	65.320	0.000
Mental health	98.12	11.05	58.75	12.50	43.653	0.000
Physical Health Composite Score	86.07	9.43	47.53	16.33	41.403	0.000
Mental Health Composite Score	96.31	6.73	53.05	10.37	41.391	0.000
SF-36 Global Score	82.54	9.51	52.37	18.32	34.422	0.000

*: Analyzed using ANOVA; **: The YG experienced attrition of three subjects, while the CG had five subjects drop out; M: Mean; SD: Standard deviation; YG: Yoga group; CG: Control group.

DISCUSSION

This study revealed notable improvements in self-reported health outcomes among middle-aged adults who engaged in a structured 5-month yoga program. Participants in the YG showed statistically significant gains across all eight domains of the SF-36 questionnaire, including enhancements in physical functioning, reduction in bodily pain, better general health, increased vitality, improved social functioning, and fewer role limitations related to physical health, emotional problems, and mental health. These results suggest that regular yoga practice can be a valuable strategy for promoting physical and mental well-being in this demographic, aligning with prior research that underscores the broad-ranging benefits of yoga on health-related quality of life (2, 3, 25).

The observed improvements in physical health outcomes, such as enhanced physical functioning and reduced bodily pain, may be attributed to several physiological mechanisms associated with yoga. Regular engagement in yoga has been shown to increase muscle strength, flexibility, and balance, which are critical factors in maintaining physical function, particularly in middle-aged adults. Additionally, yoga incorporates static and dynamic postures that promote muscular endurance and flexibility, thereby reducing musculoskeletal pain and enhancing joint mobility (26, 27). The reduction in bodily pain observed in our study may also be influenced by yoga's impact on the body's inflammatory response. Research indicates that yoga can modulate pro-inflammatory cytokines, such as IL-6 and TNF-α, potentially decreasing systemic inflammation that often contributes to chronic pain conditions (27).

Furthermore, the mental health benefits observed in the Yoga Group, such as reduced anxiety, depression, and improved overall mental well-being, could be explained by both physiological and psychological factors (28). Yoga practice has been shown to enhance parasympathetic nervous system activity and decrease the activation of the hypothalamic-pituitary-adrenal (HPA) axis, which is commonly hyperactive in stress-related disorders (29, 30). This shift towards parasympathetic dominance reduces cortisol levels and promotes a relaxation response, alleviating anxiety and improving mood. Additionally, yoga's focus on mindfulness and breath control may enhance self-awareness and emotional regulation, leading to better coping strategies in dealing with stress and depressive symptoms (30).

Potential Mechanisms and Signaling Pathways: A central mechanism of yoga enhancing health involves modulating specific signaling pathways. For instance, yoga has been found to activate the

brain-derived neurotrophic factor (BDNF) pathway, which plays a crucial role in neurogenesis and synaptic plasticity. Elevated levels of BDNF are linked to better cognitive function, mood enhancement, and increased resilience to stress (31). Moreover, yoga regulates neurotransmitters such as gamma-aminobutyric acid, serotonin, and dopamine, which may further contribute to its positive effects on mental health by enhancing emotional well-being and reducing symptoms of depression and anxiety (31, 32).

The cardiovascular benefits of yoga are also well-documented. The practice of controlled breathing (pranayama) and relaxation techniques associated with yoga has been observed to improve heart rate variability, an indicator of autonomic flexibility critical for cardiovascular health and stress resilience. Additionally, yoga has enhanced endothelial function and reduced arterial stiffness, improving overall cardiovascular performance (28, 33).

In conjunction with yoga's psychological and emotional benefits, these physiological adaptations facilitate a comprehensive physical and mental health improvement. The capacity of yoga to modulate signaling pathways, regulate neurotransmitter levels, and enhance autonomic function highlights its potential as an effective health-promoting practice, particularly for middle-aged adults (28, 31, 32).

These findings are consistent with previous research that has demonstrated the efficacy of yoga in:

Enhancing Mental Well-being: Yoga has been shown to reduce stress, anxiety, and depression while improving sleep quality, memory performance, and other psychological indices (28-30).

Promoting Physical Health: Studies have linked yoga to improved cardiovascular function, increased muscular strength and flexibility, and enhanced health-related quality of life (30, 31, 34).

For instance, a study by Nguyen et al. (35) found that a 3-month yoga program significantly reduced stress and anxiety levels and improved participants' quality of life. Similarly, research by Smith et al. (36) demonstrated comparable benefits from a 10-week yoga intervention, with improvements maintained even after a 6-week follow-up period.

Limitations and Future Directions. This study is not without limitations. The sample population, while relatively homogenous in terms of age and socioeconomic background, may limit the generalizability of the findings to more diverse populations. Additionally, the reliance on self-reported data, though mitigated using the validated SF-36 instrument, introduces the possibility of response bias.

CONCLUSION

In conclusion, this study further proves that yoga is an effective intervention for improving physical and mental health in middle-aged adults. These findings have important implications for healthcare professionals, who may consider incorporating yoga into preventative health and disease management programs. Further research is warranted to investigate the underlying mechanisms responsible for yoga's benefits and determine the optimal dosage and styles for different populations.

APPLICABLE REMARKS

- It is recommended that public health initiatives incorporate structured yoga programs into health promotion strategies aimed at this demographic.
- Such programs should prioritize reducing bodily pain, enhancing physical and mental health, and improving quality of life.
- Furthermore, healthcare providers and community organizations should consider including yoga as an accessible, cost-effective intervention to foster middle-aged adults' physical and mental well-being.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Ha Minh Diu. Acquisition of data: Dao Chanh Thuc. Analysis and interpretation of data: Ha Minh Diu. Drafting the manuscript: Dao Chanh Thuc. Critical revision of the manuscript for important intellectual content: Ha Minh Diu. Statistical analysis: Dao Chanh Thuc. Administrative, technical, and material support: Ha Minh Diu. Study supervision: Ha Minh Diu.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this study. No financial, personal, or professional affiliations influenced the research processes, findings, or interpretations presented. All authors maintained transparency and objectivity in analyzing and reporting data, ensuring that the study's outcomes are solely attributable to its scientific merit and relevance to health interventions.

FINANCIAL DISCLOSURE

The authors declare that they have no financial interests related to the content of this manuscript.

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ETHICAL CONSIDERATION

The study was conducted following ethical standards outlined by relevant institutional review boards and adhered to the principles of the Declaration of Helsinki. All participants provided informed consent, were briefed about the study's aims, procedures, potential benefits, and risks, and could withdraw at any time without repercussions.

ROLE OF THE SPONSOR

As public entities, the funding institutions did not influence the design and conduct of the study, data collection, management, analysis, or the manuscript's preparation, review, and approval.

ARTIFICIAL INTELLIGENCE (AI) USE

The authors utilized OpenAI's tools to assist with grammar and word-checking throughout the manuscript preparation process.

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