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Physical Activity and Sedentary Time as Key Moderators in the Stress-Quality of Life Relationship Among the Older Adults

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Abstract

Background:

Stress is one of the important factors influencing the quality of life (QoL) among older adults. However, the buffering and exacerbating factors influencing this relationship remain unclear. This study aimed to investigate the moderating effects of physical activity and sedentary behavior on the relationship between stress and quality of life (QoL) in elderly living in low- and middle-income countries.

Methods:

This cross-sectional study analyzed data from 7,905 adults aged > 60 years in the WHO Study on Global Ageing and Adult Health (SAGE) across five developing countries (China, Ghana, India, the Russian Federation, and South Africa). Stress, QoL, physical activity, sedentary behavior, and sociodemographic variables were assessed through standardized questionnaires. Hierarchical regression models and PROCESS moderation analyses were conducted to examine whether physical activity and sedentary time moderated the relationship between stress and QoL.

Results:

Higher stress levels were significantly associated with lower QoL ($p < .001$). Physical activity positively predicted QoL, while sedentary time showed a negative association. Moderation analyses indicated that physical activity attenuated the negative impact of stress on QoL, whereas prolonged sedentary time exacerbated this effect. The combined model revealed that high physical activity levels and limited sedentary time exerted a significant moderating influence on the impact of stress determinants of on QoL.

Conclusions:

The findings suggest that physical activity and sedentary behavior play significant moderating roles in the stress-QoL relationship among older adults. Engaging in regular physical activity and reducing prolonged sedentary time may serve as effective strategies for stress and QoL managements in aging populations.

Introduction

As life expectancy increases, the number of older adults is poised to rise for an extended period of time. According to the report of World Health Organization (WHO), the number of people aged 60 and over is expected to grow by 56% to 1.4 billion by 2050 (1). Meanwhile, the challenges faced by the older adults are becoming more complex and severe, including social isolation, increased health costs, decreased physical performance, and high risk of chronic diseases (2, 3). Therefore, it is imperative to formulate some corresponding strategies that foster the well-being and enhance the quality of life (QoL) for older adults.

QoL is a key aspect of measuring how well people living conditions are as it describes their overall well-being, health status and social integration (4, 5). However, aging means a series of personal and material losses, which makes the quality of life of older adults likely to be lower than that in young and middle-aged people, and further deteriorates with age (6, 7). Moreover, stress has been identified as a major determinant of QoL in older adults (8). Stress experienced by the older adults can lead to a variety of psychological and physiological problems, thereby reducing their QoL (9, 10). Given this inverse association between stress and QoL, it is crucial to explore mechanisms that can mitigate the detrimental effects of stress.

Recent research has increasingly highlighted that active participation in physical activities and reducing sedentary time may buffer the negative impact of stress on QoL. For example, da Silva et al. conducted a survey among middle-aged adults, revealing that although 70% of middle-age adults reported higher levels of stress, regular physical activity weakened the negative impact of stress on QoL(11). In another study, A'Azman et al. found that engagement in physical activity reduced the adverse impact of stress and negative emotions on caregivers' QoL by conducting a multivariate regression analysis using data from 278 adult caregivers aged 23–90 in Singapore(12). However, most of these studies have been conducted in middle-aged populations with a small sample size, leaving a gap in research focusing on older adults.

In addition, it is widely acknowledged that reducing sedentary time can contribute to stress reduction and improve QoL of older adults (13). A longitudinal analysis conducted by Owari demonstrated that excessive sedentary time leads to higher levels of stress, and this stress in turn leads to increased sedentary time, creating a negative cycle(14). Numerous research has provided empirical evidence supporting the association between prolonged periods of sedentary time and diminished QoL (15–17). Notably, Cho pointed out that the QoL of the older adults who has prolonged sedentary behavior are more likely to have their QoL affected by stress and suicidal thoughts compared with those with shorter sedentary time(18). However, the relationship between sedentary time and stress and QoL in the older adults remain elusive.

Although studies have shown that sedentary time and physical activity are negatively correlated among the elderly(19), other studies have shown that long periods of sitting during the day do not necessarily affect daily physical activity (20), which shows that the relationship between the two is complex and their impact on quality of life should be studied together. Despite the growing body of evidence on physical activity and sedentary behavior, to our knowledge, there has been no such investigation of their moderating effects in the link between stress and QoL in older age. We used cross-sectional survey data from the WHO's Study of Global Aging and Adult Health (SAGE) survey to investigate whether physical activity and sedentary behavior in older adults moderate the effects of stress on quality of life. In line with this, we hypothesize:

H1: Physical activity moderates the relationship between stress and QoL in the older adults

H2: Sedentary behavior moderates the relationship between stress and QoL in the older adults

H3: Physical activity and sedentary behavior jointly moderate the relationship between stress and QoL in the older adults

By testing these hypotheses, the study seeks to elucidate the roles of physical activity and sedentary duration in shaping the relationship between stress and QoL in older adults.

Methods

Data Collection

This study used cross-sectional data from the WHO's SAGE survey (wave 1, collected from 2007 to 2010), which examines the health and well-being of aging and adult populations. SAGE selected China, Ghana, India, the Russian Federation, and South Africa to cover Asia, Africa, and Europe, representing different levels of economic development (low- and middle -income countries) and stages of population health transition (rapid aging vs. early aging), ensuring the global applicability of the data(21). Detailed methodologies of SAGE have been outlined in previous studies(22, 23).

Participants

The analysis focused on participants aged 60 years and above, excluding those aged 106 and older, following the recommendations of Zeng et al., as these cases were considered potentially invalid because of insufficient information for verification(24). In order to meet the eligibility of criteria of this study, participants were required to satisfy the following requirement: 1) age ≥ 60 years; 2) complete data related to demographic information, physical activity, sedentary behavior, stress, QoL, and etc. The final dataset included 7,905 older adults aged between 60 and 100 years, comprising 3,936 men and 3,969 women. The SAGE study received ethical approval from the WHO's Ethical Review Board, along with national approvals from each participating country, and all participants provided informed consent before taking part in the study.

Measures

Physical Activity

it was measured using the Global Physical Activity Questionnaire (GPAQ), assessing frequency and duration of physical activities in work, travel, and recreation(25, 26). According to GPAQ, physical activity levels were classified into insufficient (0–600 MET·min/week), moderate (601–3000 MET·min/week), and vigorous (> 3000 MET·min/week). Adequate activity was determined by whether participants met recommended levels (i.e., ≥ 601 MET·min/week) (27), coded as 1 if met and 0 otherwise. Concurrent validity between the GPAQv1 and the IPAQ demonstrated moderate to good correlation (r = 0.54) and high repeatability between administrations (0.67–0.81) (25).

Sedentary Time: it was assessed using a question from the GPAQ: "How much time do you usually spend sitting or reclining on a typical day? This includes activities such as sitting at a desk, sitting with friends, traveling in a car, bus, or train, reading, playing cards, or watching television." Based on the self-reported sedentary time, participants were categorized into two groups: those with less than 8 hours of sedentary time per day (marked as 1) and those with 8 hours or more (marked as 0) (22).

Stress

it was assessed using two items from the Perceived Stress Scale (PSS) by Cohen et al. (28), similar to previous research(29, 30). Participants rated how often they felt unable to control important aspects of their lives and cope with their tasks, on a scale from 1 (never) to 5 (very often). Factor analysis with polychoric correlations examined the questions' covariance, and factor scores were calculated using regression scoring, rescaled to a 2–10 range, with higher scores indicating greater perceived stress (30). The scale has been widely used in developing countries and had a Cronbach's a of 0.72 (31).

QoL: QoL was evaluated using the 8-item WHO Quality of Life (WHOQoL) instrument, which consisted of two questions in each of the four major domains: physical, psychological, social, and environmental(32). Participants rated their satisfaction with various aspects of their life, such as finances, health, and relationships, as well as their overall life satisfaction on a five-point scale ranging from very satisfied to very dissatisfied. A composite score was derived by summing the responses across all questions to a 8–40 scale, with higher scores indicating a higher QoL. The scale showed strong internal consistency reliability (Cronbach's α > 0.80) and good concurrent validity (r = 0.63–0.82).

Covariates:

The selection of covariates was based on previous studies. Considering the factors that may affect the relationship between stress, physical activity, sedentary behavior and quality of life, the following covariates were included in this study:

- Age: Aging may reduce physical activity levels and affect QoL (33).
- Country and Rurality: Studies have shown that older people in urban areas report higher quality of life scores compared with rural older people (34).

- Gender: Studies have shown that women may have lower QoL than men in old age, partly due to social isolation, health problems and economic conditions (35).
- Education Level: Higher education level is associated with better health decision-making ability and higher physical activity level, which in turn affects QoL (11).
- Employment Status: Employment status may affect the economic independence and social participation of the elderly, thereby affecting their QoL (36).
- Cohabitating Status: Elderly people living alone may face higher stress levels and lower social support, which in turn affects QoL (37).
- BMI (Body Mass Index): BMI may affect physical activity and is associated with QoL (38).
- Smoking and drinking: Unhealthy lifestyles are associated with lower QoL (39).

Analysis

Data analysis was conducted using IBM SPSS Statistics (version 27). Firstly, descriptive statistics were calculated to summarize demographic characteristics of the study participants, including means, standard deviations or percentages. A correlation matrix was constructed to explore relationships between the key variables.

Hierarchical Regression Analysis

Hierarchical regression analyses were performed to evaluate the impact of stress, physical activity, and sedentary behavior on QoL. The following four models were tested:

Model 1: Stress → QoL

Model 2: Stress + Physical Activity → QoL

Model 3: Stress + Sedentary Time → QoL

Model 4: Stress + Physical Activity + Sedentary Time → QoL

Moderation Analysis

After confirming that all four models had sufficient explanatory power, the SPSS PROCESS macro (version 3.5, Hayes, 2018)(40) was used to test the moderating effects of physical activity and sedentary behavior, and the following moderation models were tested:

Hypothesis 1

The moderating effect of physical activity was tested using PROCESS Model 1, with stress (X) as the independent variable, physical activity (M) as the moderator, and QoL (Y) as the dependent variable.

Hypothesis 2

The moderating effect of sedentary behavior was tested using PROCESS Model 1, with stress (X) as the independent variable, sedentary behavior (M) as the moderator, and QoL (Y) as the dependent variable.

Hypothesis 3

The joint moderating effects of physical activity and sedentary behavior were examined using PROCESS Model 2, with stress (X) as the independent variable, physical activity (M1) and sedentary behavior (M2) as moderators, and QoL (Y) as the dependent variable.

For all models, the assumptions of linearity, normality of residuals, and uncorrelated errors were verified and met. A simple slope test was used to interpret the moderating effects. A significant interaction term ($p < 0.05$) indicated the presence of a moderation effect.

Results

The unweighted characteristics of the study participants are summarized in Table 1. The sample comprised a total of 7,905 individuals aged 60 years and older, with a nearly even distribution of male (49.79%) and female participants. The average age (analyzed as a continuous variable) was 69.40 years (SD = 7.03), and the mean BMI was 25.69 (SD = 5.35). Participants were predominantly from China (46.33%) and Russia (43.16%). The majority resided in urban areas (68.67%), compared to 31.33% in rural settings. Most participants were not employed (76.88%) and were cohabiting (67.69%). The educational attainment varied, with 14.99% had no formal education and 43.74% had less than primary school education, 27.73% had completed secondary school, and 13.53% had completed high school or equivalent. Regarding smoking habits, 65.82% of participants were non-smokers, while 34.18% were either current or former smokers. Besides, the proportion of drinkers was nearly equal to that of non-drinkers (51.09% vs. 48.91%).

Table 1
Demographic characteristics of respondents

Covariate		N	M(SD)/%
Age	Years	7905	69.40(7.03)
BMI	kg/m^2	7905	25.69(5.35)
Sex	Male	3936	49.79
	Female	3969	50.21
Country	China	3662	46.33
	India	565	7.15
	Russian Federation	3412	43.16
	South Africa	258	3.26
	Ghana	8	0.1
Rurality	Lives in a urban area	5428	68.67
	Lives in a rural area	2477	31.33
Employment status	Working	1828	23.12
	Not working	6077	76.88
Cohabitation status	Living alone	2554	32.31
	Living together	5351	67.69
Education	No formal education	1185	14.99
	Less than primary school	3458	43.74
	Secondary school completed	2192	27.73
	High school (or equivalent) completed	1070	13.53
Smoking	Non-smoker	5203	65.82
	Ex-smoker	920	11.64
	Smoker	1782	22.54
Drinking	Non-drinker	3866	48.91
	Drinker	4039	51.09

Table 2 shows the correlation matrix for all variables (except country). The results showed that except rurality, all model variables and demographic variables were significantly related to QoL ($p < 0.01$). The three strongest correlations were observed for stress ($r = -0.522$, $p < .01$), sedentary behavior ($r = -0.243$, $p < .01$), and physical activity ($r = 0.195$, $p < .01$), suggesting that higher stress and sedentary behavior were associated with lower QoL, whereas higher physical activity was associated with better QoL.

Table 2
Descriptive statistics and correlations among all variables (except countries)

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Sex	1.502	0.5	--										
2. Rurality	1.313	0.464	− .201**	--									
3. Employment status	1.769	0.422	.165**	− .380**	--								
4. Cohabitation status	0.677	0.468	− .368**	.142**	− .135**	--							
5. Education	1.811	1.349	.042**	− .322**	.111**	− .051**	--						
6. Smoking	0.342	0.474	− .585**	.193**	− .165**	.218**	− .116**	--					
7. Drinking	0.511	0.5	− .147**	-0.005	-0.018	− .058**	.165**	.244**	--				
8. Age	69.401	7.026	.038**	− .161**	.290**	− .269**	− .042**	− .098**	0.019	--			
9. BMI	25.692	5.347	.254**	− .147**	.148**	− .191**	.184**	− .197**	.139**	.040**	--		
10. Physical Activities	0.643	0.479	− .032**	0.009	− .123**	.070**	.083**	.051**	.084**	− .215**	− .036**	--	
11. Sedentary	0.851	0.356	− .037**	0.022	− .065**	.128**	− .055**	0.005	− .073**	− .174**	− .086**	.205**	--
12. Stress	5.083	1.834	.107**	.041**	.085**	− .163**	.031**	− .026**	.115**	.134**	.124**	− .106**	− .21
13. Quality of life	28.034	4.879	− .118**	-0.011	− .129**	.170**	.065**	.034**	− .071**	− .155**	− .114**	.195**	− .24

** Correlation is significant at the 0.01 level (2-tailed).

All research hypotheses were tested through hierarchical regression analysis, and the results are presented in Table 3. The results revealed some important findings. (1) All variables significantly affected QoL except rurality, (all $p < 0.05$). (2) Women had lower QoL than men (significant positive relationship in models 1 to 4, $\beta = -0.047$ to $-.051$, $p < .01$). (3) Both age and BMI were negatively related to QoL. (4) Living together, not working, and not smoking or drinking were related to higher QoL. (5) Groups with higher education levels were associated with higher QoL (significant positive correlations in all 4 models ($\beta = 0.083$ to 0.099, $p < 0.01$).

Table 3
Effects of control and model variables on quality of life

Variables	Model 1	Model 2	Model 3	Model 4
Control variable				
Sex	-0.048**	-0.051**	-0.047**	-0.05**
Rurality	-0.012	-0.009	-0.009	-0.007
Employment status	-0.074**	-0.065**	-0.073**	-0.066**
Cohabitation status	0.053**	0.052**	0.046**	0.046**
Education	0.092**	0.083**	0.099**	0.099**
Smoking	-0.027*	-0.029*	-0.023	-0.025*
Drinking	-0.023*	-0.033**	-0.019	-0.029**
Age	-0.049**	-0.027*	-0.032**	-0.015*
BMI	-0.039**	-0.034**	-0.033**	-0.03*
Model variables				
Stress	-0.49**	-0.481**	-0.468**	-0.463
Physical Activity		0.122**		0.104**
Sedentary			-0.125**	-0.107**
Adjusted R^2	0.298	0.312	0.312	0.322
F	328.471**	318.776**	319.58**	306.413**

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows the moderating effects of physical activities and sedentary (including interaction effects) on the relationship between stress and QoL. All four models showed that there was a significant relationship between stress and QoL (β=-0.209 to -0.288, p < 0.01).

Table 4
Moderating effect of physical activities and sedentary on the relationship between stress and quality of life

Model	Variable	B	SE (B)	t-value	p-value	R	R^2	ΔR^2	F-test
1	(Constant)	29.922	0.166	180.153	< 0.01	0.551	0.304	-	1123.105
	Stress	-0.209	0.004	-49.728	< 0.01				
	Physical Activities	1.237	0.099	12.500	< 0.01				
	Sedentary Behavior	-1.555	0.135	-11.475	< 0.01				
2	(Constant)	32.169	0.156	205.991	< 0.01	0.546	0.298	-0.006	1094.206
	Stress	-0.261	0.007	-39.936	< 0.01				
	Physical Activities	0.056	0.193	0.289	0.773				
	Interaction (Stress ×Physical Activities)	0.070	0.008	8.351	< 0.01				
3	(Constant)	32.194	0.276	116.849	< 0.01	0.543	0.295	-0.009	1076.536
	Stress	-0.279	0.010	-28.210	< 0.01				
	Sedentary Behavior	0.083	0.293	0.284	0.777				
	Stress × Sedentary Behavior	-0.082	0.011	-7.509	< 0.01				
4	(Constant)	31.861	0.286	111.440	< 0.01	0.558	0.311	0.007	697.099
	Stress	-0.288	0.010	-28.052	< 0.01				
	Physical Activities	0.257	0.195	1.317	0.188				
	Sedentary Behavior	-0.032	0.294	-0.110	0.913				
	Stress × Physical Activities	0.049	0.009	5.633	< 0.01				
	Stress × Sedentary Behavior	0.061	0.011	5.425	< 0.01				

H1: Physical Activity as a Moderator

The interaction term (stress × physical activity) was significant (B = 0.070, t = 8.351, p < .01), indicating that physical activity buffered the negative association between stress and QoL. Simple slope analysis (Fig. 1) showed that stress had a stronger negative effect on QoL among participants not meeting physical activity recommendations (b = − .206, IC 95% [-.273, − .247], t = -39.94, p < .001) compared to those who met the recommendations (b = − .190, IC 95% [-.201, -0.180], t = -35.65, p < .001).

Figure 1. Moderating effect of physical activities on the relationship between stress and quality of life

H2: Sedentary Behavior as a Moderator

Similarly, the interaction term (stress × sedentary behavior) was also significant (b = 0.082, t = 7.509, p < 0.01), indicating that sedentary behavior strengthened the negative association between stress and QoL. Simple slope analysis (Fig. 2) showed that stress had a greater negative effect on QoL among individuals with high sedentary time (b = − .279, IC 95% [-.299, − .260], t = -28.21, p < .001) compared to those with lower sedentary time (b = − .179, IC 95% [-.206, -0.188], t = -42.29, p < .001).

Figure 2. Moderating effect of sedentary behavior on the relationship between stress and quality of life

H3: Joint Moderation by Physical Activity and Sedentary Behavior

The three-way interaction (stress × physical activity × sedentary behavior) was significant (b1 = 0.049, t1 = 5.633, p < 0.01 for physical activity; b2 = 0.061, t2 = 5.425, p < 0.01 for sedentary behavior). Simple slope analysis (Fig. 3) revealed that the greatest negative impact of stress on QoL was observed among participants who met neither physical activity nor sedentary time recommendations (b = − .288, IC 95% [-.308, − .268], t = -28.05, p < .001). In contrast, the negative effect of stress on QoL was smallest among those who met both physical activity and sedentary behavior recommendations (b = − .179, IC 95% [-.190, − .168], t = -32.88, p < .001).

Discussion

This study examined whether physical activity and sedentary behavior moderate the association between stress and quality of life (QoL) in older adults. The key findings indicate that stress was negatively associated with QoL, while physical activity was positively associated with QoL, and sedentary behavior was negatively associated with QoL. Moreover, physical activity buffered the negative association between stress and QoL, whereas sedentary behavior strengthened this negative association. Older adults who met both physical activity and sedentary time recommendations, on average, reported the highest QoL and experienced the least impact from stress, indicating a combined protective effect. These findings highlight the importance of lifestyle behaviors in mitigating the effects of stress on QoL among older adults.

Our result shows a negative relationship between stress and QoL, which is consistent with previous studies (41–43). Stress, whether it stems from health problems, financial problems or social isolation, can have a significant impact on the physical, psychological and social dimensions of QoL in older adults (8). Therefore, reducing stress in older adults is crucial to improving their QoL and mental health.

Similarly, previous studies have reported that prolonged sedentary behavior is associated with greater psychological distress and lower QoL (18, 44). Our study adds further evidence by showing that sedentary behavior not only correlates with lower QoL but also amplifies the adverse effects of stress. This finding underscores the importance of addressing both physical activity and sedentary time in interventions designed to enhance well-being in older adults.

Mechanistically, physical activity may mitigate stress's impact on QoL through several pathways. Physiologically, physical activity promotes endorphin release, which enhances mood and emotional resilience (8, 45, 46). Additionally, engaging in physical activity fosters greater social interaction, which provides emotional support and strengthens coping mechanisms against stress (47, 48). Conversely, sedentary behavior may exacerbate stress-related declines in QoL by increasing social isolation, reducing physical health, and heightening the risk of chronic diseases (44, 49, 50).

As mentioned above, sedentary behavior and physical activity may not be simply negatively correlated and may be related to many factors (such as physical health status, living environment, etc.)(20). Nevertheless, our findings revealed that combining enhanced levels of physical activity with reduced sedentary behavior regulated the relationship between stress and QoL. In particular, older adults who met the physical activity and sedentary time recommendations collectively had the highest QoL and were least related to stress. This suggests that only increasing physical activity or only reducing sedentary time may not necessarily maximize the quality of life of older adults. Measures need to be taken from both aspects to better improve the quality of life of the older adults.

To promote higher physical activity and lower sedentary behavior, several targeted strategies can be implemented. At the individual level, structured programs such as low-intensity aerobics, resistance training can enhance mobility while reducing sedentary time. At the community level, creating age-friendly environments with walking paths, senior fitness centers, and social programs can encourage active lifestyles. Public health campaigns can promote standing breaks and light walking to reduce prolonged sitting. Finally, healthcare providers should integrate sedentary behavior assessments and physical activity counseling into routine check-ups to support personalized interventions for improving QoL in older adults.

As for the impact of demographic characteristics, this study found that higher QoL in the older adults is associated with gender, cohabiting, not working, having higher education, and not smoking or drinking. Conversely, increasing age and BMI are linked to lower QoL. These findings align with previous research indicating that women tend to have lower QoL due to loneliness and susceptibility to illness (35, 51). Cohabitation, higher education, and healthier lifestyle choices significantly contribute to better QoL in older adults (3, 52). This study also found that women had significantly lower QoL than men, and this trend was consistent across all age groups (60–69 years, 70–79 years, 80 + years) ($p < 0.05$). This result is consistent with previous studies (53, 54). This may be due to factors such as women being more likely to experience health problems, social isolation, economic instability, and increased care responsibilities in old age (53, 55).

Comparative analysis between countries showed significant differences in stress, QoL, sedentary behavior, and physical activity levels. Russia had the highest stress, lowest QoL, most sedentary time, and least physical activity, while China had the highest QoL and lowest stress. India had the highest level of physical activity and the least sedentary time, while South Africa was in between. However, despite the differences in means across countries, the relationships between the core variables remained consistent. Across all countries, stress was consistently negatively associated with QoL, physical activity was positively associated with QoL, and sedentary behavior was negatively associated with QoL ($p < 0.001$). Additionally, to assess the impact of BMI as a covariate on the results, we conducted a sensitivity analysis comparing the results of the model with and without the BMI variable. The results showed that after removing BMI as a covariate, the main relationships between stress, physical activity, sedentary behavior and QoL remained significant ($p < 0.05$) and in the same direction.

Although the study is limited by its reliance on older, cross-sectional data, the results provide valuable guidance for public health strategies aimed at improving mental and physical health in aging populations. The presence of several limitations should be acknowledged. First, the research relies on data from the SAGE survey, which may not fully capture all relevant variables. For instance, Senasu and Singhapakdi categorized QoL into three dimensions: Quality of Family Life, Quality of Community Life, and Quality of Work Life, which are not comprehensively addressed in this study(56). In addition, the amount of information contained in some variables in the survey may be insufficient: (1) Although the education variable includes different stages, there may be differences in the same stage of education between countries, which may mask the impact of education; (2) Work status is only divided into working and unemployed, which may ignore more detailed situations, such as the reasons for being unemployed (retirement, physical condition, family reasons, etc.); (3) Smoking and drinking conditions also only use simple binary variables, without recording the specific amount of alcohol consumed. Second, the cross-sectional nature of the data limits our ability to explore the causality and the long-term effects of physical activity and sedentary behavior on stress and QoL. Third, the data used in this study is temporally limited and may fail to adequately capture emerging contemporary factors the influence of recent factors, such as the widespread use of digital technologies and the COVID-19 pandemic on stress and QoL of the older adults. In addition, this article only discussed the unidirectional relationship between physical activity (sedentary behavior) and quality of life (the former affects the latter), while future studies can further

explore the potential bidirectional relationship: the mutual influence between physical activity (sedentary behavior) and quality of life (the former affects the latter), and further qualitatively the mediating or moderating role of the latter.

Conclusion

The findings of this study suggest that balanced health behaviors, including engaging in regular physical activity and minimizing prolonged sedentary time, may enhance well-being in aging populations. Future research should employ longitudinal designs and objective measurements to further validate these associations and explore age- and country-specific effects in older adults.

Declarations

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None.

Declaration of Interest Statements:

The authors declare no competing financial interests.

Authors' Contribution

SC, YZ, and JC conceptualised and designed the study. SC, CC, WL, JC, and YZ were responsible for the literature search. SC, CC, WL, and JC participated in data extraction and synthesis. SC, and JC and drafted, and SC, CC, WL, YZ, and JC reviewed and edited the manuscript.

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Ethical approval and informed consent statements

Not applicable, as the study utilized publicly available, de-identified data and did not involve human subjects. Ethical approval and informed consent were not required.

Clinical trial number:

Not applicable

Data availability statement

Data are available at the following URL: https://apps.who.int/healthinfo/systems/surveydata/index.php/catalog.

Consent for publication

All authors have read and approved the final version of this manuscript.

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Figures

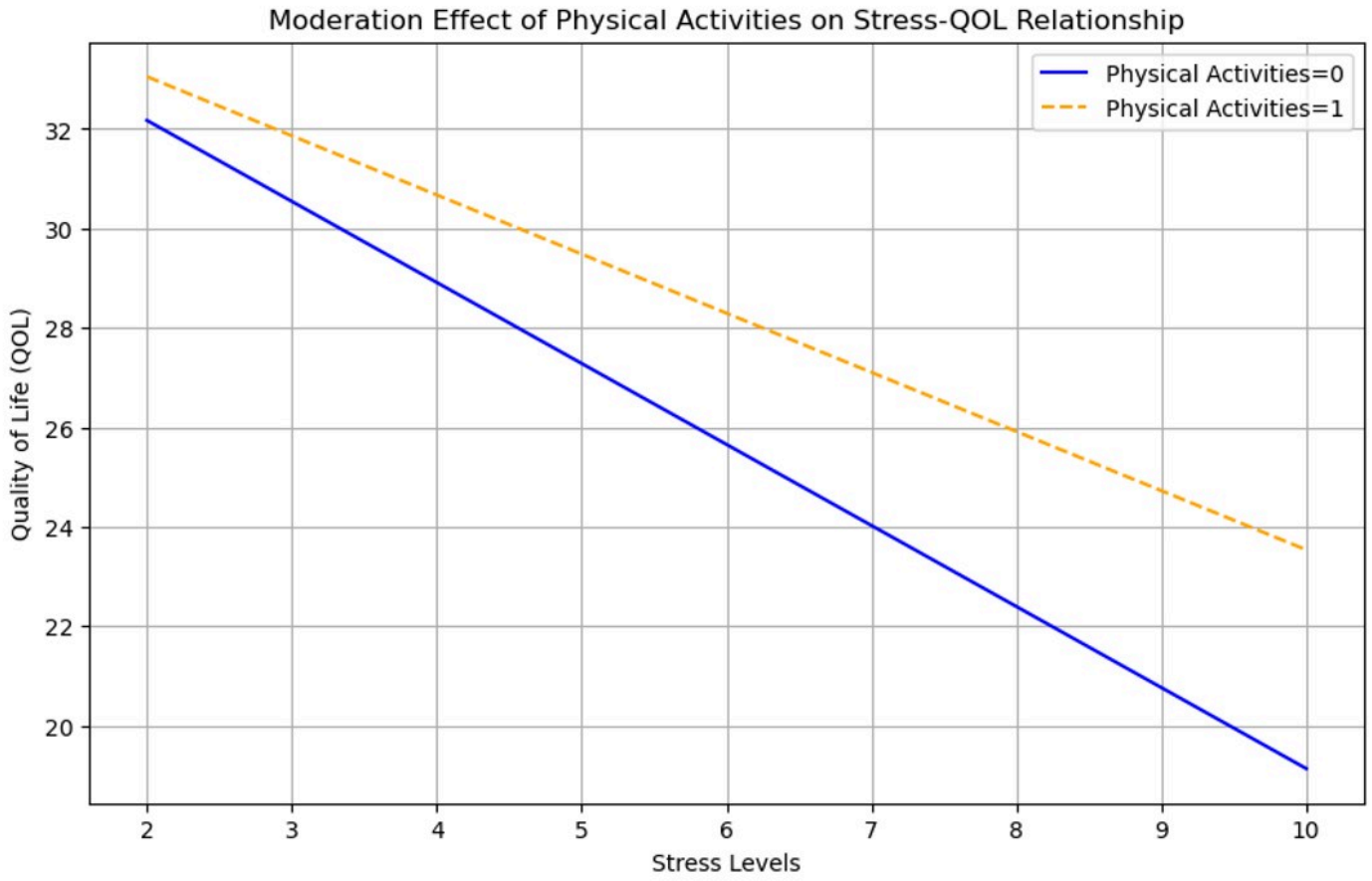


Figure 1

Moderating effect of physical activities on the relationship between stress and quality of life

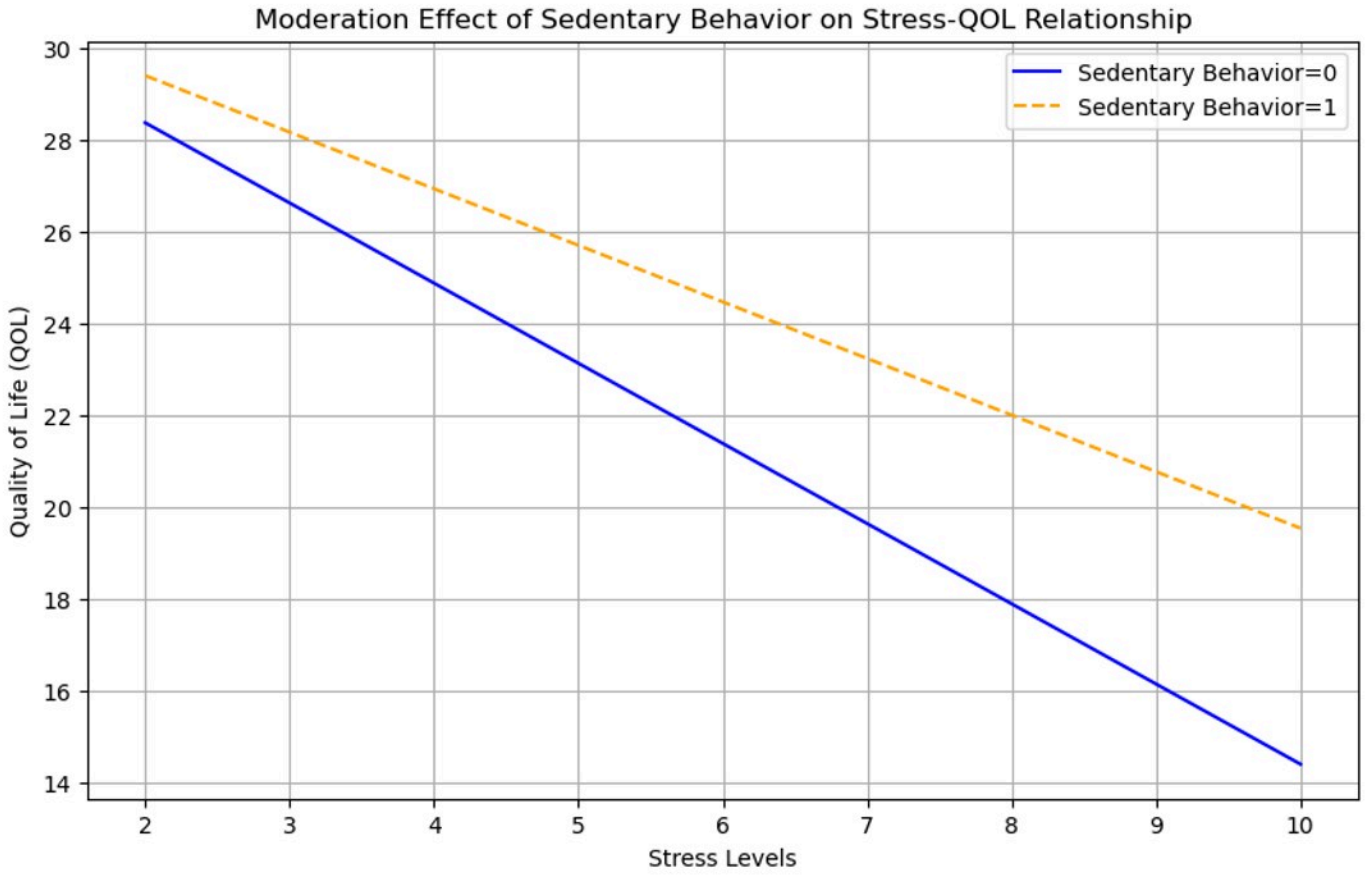


Figure 2

Moderating effect of sedentary behavior on the relationship between stress and quality of life

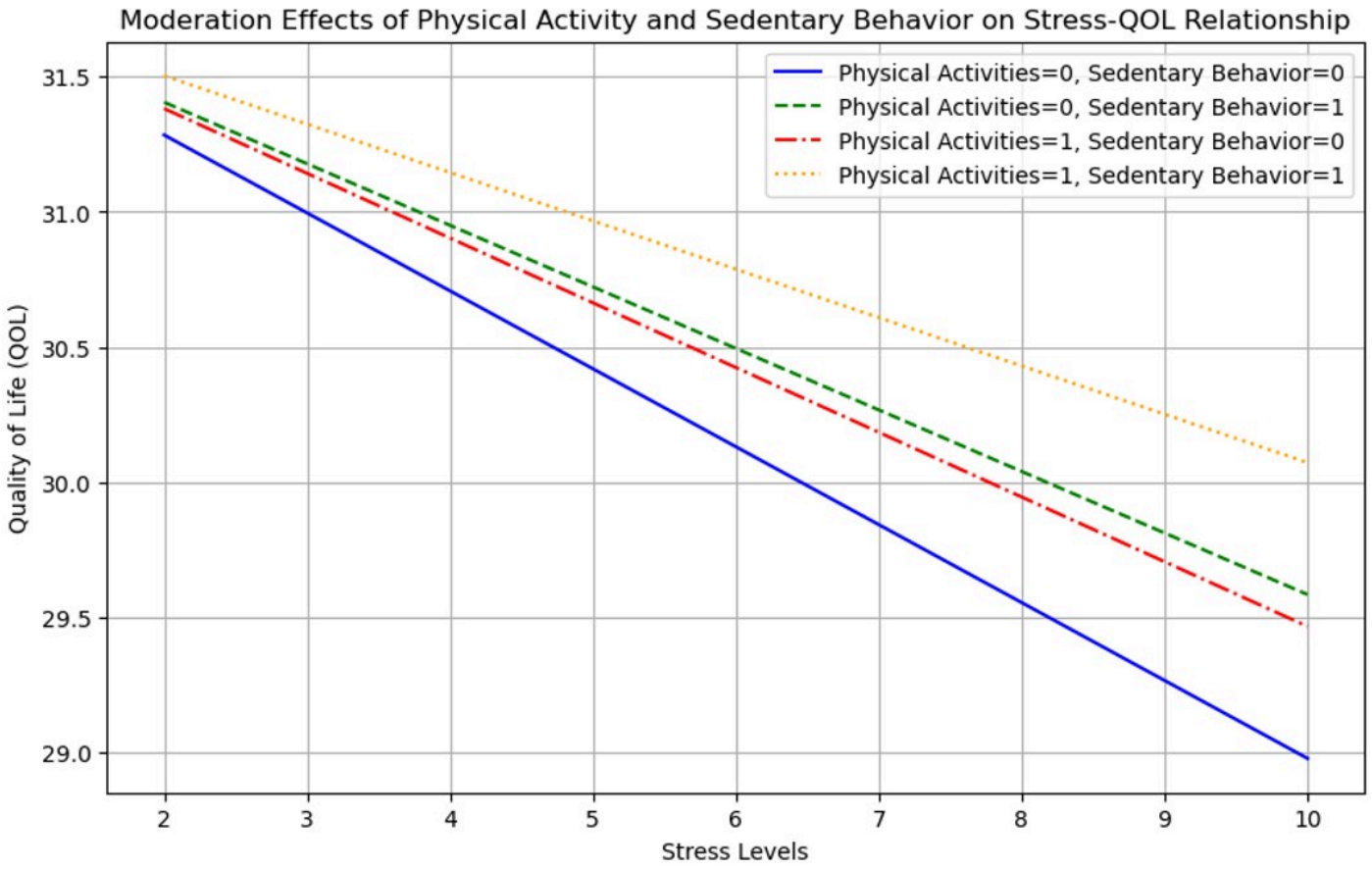


Figure 3

Moderating effects of physical activities and sedentary behavior on the relationship between stress and quality of life