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Research Article:

Sleep Quality, Physical Activity, and Social Engagement Among Older Adults in Sulaimani, Iraq: A Cross-Sectional Study

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Abstract

Background: Sleep quality, physical activity, and social interaction are crucial for the health and well-being of older adults. These factors are interconnected; however, their cumulative impact remains inadequately examined, particularly in developing country contexts.

Aim: This study aimed to investigate the interrelationship between sleep quality, physical activity, and social engagement among older adults in Sulaimani, Iraq, and to assess their combined impact on health.

Methods: A cross-sectional descriptive study was conducted involving 200 community adults aged 60 years and older, selected through purposive sampling. From October 2025 to February 2026, structured questionnaires were used to gather data. These included the Pittsburgh Sleep Quality Index (PSQI), the Physical Activity Scale for the Elderly (PASE), and the Social Activities Participation (SAP) questionnaire. The data were analysed using SPSS version 22. The Mann–Whitney U test, chi-square test, and Spearman's correlation were used for the non-parametric data, establishing a statistical significance threshold at $p < 0.05$.

Results: The majority (81.5%) of participants were classified as having poor sleep quality, with a mean PSQI score of 8.77 ± 3.44. while the mean PASE and SAP scores were 274.95 ± 209.75 and 9.27 ± 3.18, respectively, showing moderate levels of physical activity and social participation. Sleep quality was negatively correlated with physical activity ($\rho = –0.471$, $p < 0.001$) and social engagement ($\rho = –0.320$, $p < 0.001$); indicating that higher levels of physical activity and social engagement were associated with better sleep quality. In contrast, physical activity was positively correlated with social participation ($\rho = 0.477$, $p < 0.001$), suggesting that more physically active individuals were also more socially engaged.

Conclusion: In older adults, sleep quality, level of physical activity, and social engagement are all closely related. Implementing broad interventions that target these domains concurrently may improve well-being and assist them in a healthy way. Additional longitudinal studies are recommended to clarify the causal relationships.

Keywords: *Healthy ageing; older adults; physical activity; sleep quality; social engagement.*

1. Introduction

Global population aging is accelerating, with the number of adults aged 60 and above expected to nearly double by 2050 [1]. Population aging is an emerging public health concern in Iraq, where increasing life expectancy has shifted attention toward healthy aging and quality of life. In this context, sleep quality, physical activity, and social engagement are key determinants of health among older adults. Evidence from Iraq indicates that physical activity contributes significantly to both physical and mental health, while sleep quality and daily activity patterns are closely related to functional ability and overall health. These factors are interrelated, collectively affect health outcomes and life satisfaction in the elderly population [2].

The quality of sleep has a significant impact on the health of older adults. People's sleep patterns naturally alter

as they age. For instance, they get up earlier in the morning, wake up more frequently during the night, sleep insufficiently, and take longer to fall asleep [2]. Cognitive impairment, depression, cardiovascular disorders, compromised immunity, and a higher risk of mortality have all been related to sleep deprivation [3]. As a result, good sleep quality is vital for maintaining health and well-being in older populations.

By promoting older people's physical and emotional well-being, physical activity also contributes significantly to healthy aging. Regular exercise is associated with improved cardiovascular health, increased muscle strength, better balance, enhanced independence, and a lower risk of chronic diseases such as diabetes and hypertension [4,5]. Furthermore, physical activity contributes to better sleep regulation compared to persons who have sedentary lifestyles. Research shows that active people tend to have better sleep quality, decreased sleep latency, and more efficient sleep [6,7]. These benefits can be explained by increased energy expenditure, circadian rhythm management, and decrease in anxiety and depressive symptoms.

Social engagement, which involves maintaining relationships, participating in social activities and being active in community life, is an important predictor of health in older adults. Social isolation and loneliness have been linked to increased risks of depression, cognitive decline, cardiovascular disease and mortality, which are recognized as major public health issues for this population [8,9]. Besides, people with social lives tend to have less stress, anxiety and loneliness, all of which are known to interfere with sleep. Consequently, social engagement may influence sleep quality through psychological and behavioural mechanisms [10].

Although social engagement, physical activity, and sleep quality tend to be examined independently, there is growing evidence that they are deeply connected and may have complicated effects on one another. People who are physically active, for instance, are more likely to participate in social activities, and social engagement can promote participation in physical activity, such as community events or group walks. Both physical activity and social participation can improve sleep quality, whereas a cyclical association between these elements may result from inadequate sleep, which may lower motivation to continue being socially and physically active [11,12].

The association between sleep quality, physical activity, and social engagement among older persons in Sulaimani City remains poorly recognized despite growing interest in healthy aging. Rather than incorporating these elements within the geriatric population, prior research conducted in Iraq has mostly concentrated on them either independently or in younger/general adult groups. This emphasizes the need for focused research on older persons in order to support healthy aging interventions and gain a better understanding of these interconnected aspects.

2. Methodology:

2.1. Study Design and Setting

The study used a cross-sectional design to explore the association between sleep quality, physical activity, and social engagement in older adults. The study was conducted among community elder population in Sulaymaniyah City, Kurdistan Region, Iraq, from October 2025 to February 2026.

2.2. Study Population and Sampling

A sample size of 200 participants was calculated using the standard formula for estimating a population proportion with 95% confidence level and a margin of error of approximately 7% (minimum sample of 196, rounded to 200). A larger sample would be required if a 5% margin of error was to be considered, however 200 participants were considered reasonable and consistent with similar cross-sectional studies that examined sleep quality and physical activity among community-dwelling adults aged ≥60 years. Given the population size of 32,000–35,000, the finite population correction had a negligible effect, supporting the adequacy of the selected sample size [13].

A non-probability purposive sampling technique was used to recruit the participants. The researchers pre-selected participants that met the specified inclusion criteria to match the study objectives. According to the WHO definition (WHO Toolkit, 2008) [14], older people were defined as those aged 60 years and above. Potential participants were approached in community settings, including neighbourhoods and community gathering places. Community leaders helped the researchers to pinpoint possible candidates who might be eligible.

Each potential participant was given information about the purpose and procedures of the study and was screened for eligibility using the following inclusion criteria: aged 60 years or older, community dwelling, and willingness to provide informed consent. Individuals with severe cognitive impairment or terminal illness were excluded by self-report, family confirmation or available medical information as appropriate. Those who met the eligibility criteria and were willing to participate, were enrolled into the study after obtaining their written informed consent.

2.3. Data Collection Tool

A structured questionnaire with five main sections was utilized to gather data in order to assess demographic traits, health and behavioural health.:

1. Sociodemographic and Health Information

This section includes variables on demographic characteristics including age, gender, education, marital status, income, employment, alcohol use, smoking and living arrangement. Health background (chronic disease, medication use, hospitalisation, health rating, use of assistive devices).

2. Sleep Quality – PSQI

The PSQI is a standard tool used to assess sleep quality during the past month. It is composed of 19 self-rated items consist of seven components:

- Subjective sleep quality
- Sleep latency
- Sleep duration
- Habitual sleep efficiency
- Sleep disturbances
- Use of sleep medication
- Daytime dysfunction

Each component is scored from 0 to 3, with higher scores indicating greater difficulty. The overall scores are summed to calculate a global PSQI score ranging from 0 to 21. A score of ≤5 indicates good sleep quality, while a score >5 indicates poor sleep quality [15].

3. Physical Activity – PASE

The PASE is a standard assessment tool to measure physical activity during the past week, household, covering leisure, and work-related activities. It includes items such as walking, recreational activities ranging from light to vigorous intensity, caregiving, strength exercises, and volunteer tasks. Each activity is scored based on a weight intensity. The overall PASE score is calculated by multiplying the frequency of each activity by its corresponding weight and then summing all items. The overall scores ranged from 0 to above 400, higher scores demonstrate greater levels of physical activity. Participants' activity levels were categorized into three groups: low (0–40 points), moderate (41–90 points), or high (91+ points) according to tertile distributions [16].

4. Social Engagement – SAP :

The SAP assesses the social participation quality through three parts:

- Part A: SAP: Included nine items rated on a 4-point Likert scale (0 = Never to 3 = Frequently). The total possible scores ranged from 0 to 27; higher scores show greater social involvement. The total scores categorisation is divided into three groups: low (0–9), moderate (10–18), and high (19–27).
- Part B: Frequency and Satisfaction: Assesses older adults' communication with others, satisfaction rate with social contact, and perceived loneliness.
- Part C: Barriers to Social Engagement: Identifies factors that restrict participation in social engagement, such as health and financial issues, transportation, or lack of companionship [17].

5. Pilot Testing

A pilot study was conducted to assess the clarity, reliability and cultural acceptability of the questionnaire using a small subgroup of the elderly (10% of the study sample size). The reliability coefficient test for each assessment component is above the acceptability standard (Cronbach's alpha = 0.65), demonstrating appropriate internal consistency for community-based population research.

2.4. Data Collection Procedure

Data was collected through face to face interview method by a trained field researcher. The data collection session lasted for about 25-30 minutes and was conducted in private and confidential settings that were appropriate for the participants. The collected data were checked daily for completeness and accuracy.

2.5. Data Analysis

Data were analysed with SPSS version 22. Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to present the characteristics of the participants. The normality of distribution of data was checked by Shapiro-Wilk test. The results showed that most of the variables were not normally distributed, and non-parametric tests were used. Differences between two independent groups of continuous variables were identified using the Mann-Whitney U-test. For more than two groups, the Kruskal-Wallis H test was used. Categorical variables were analyzed by Chi-square tests. The Spearman's rank correlation coefficient was used to determine the association between sleep quality, physical activity and social engagement with statistical significance at $p < 0.05$.

3. Results and Discussion

3.1. Demographic characteristics

The sociodemographic details of the research participants are shown in Table 1. Half of the participants (50%) were between the ages of 60 and 69. The mean age was 70.85 ± 6.70 years, with a range of 60 to 90 years. Nearly half (49%) were married, and the majority (65.5%) were male. About half of the participants (49%) have no formal education.

The highest percentage of participants were categorized as "others" (39.5%), followed by those who were unemployed (36.5%). Of the participants, 47% lived with family members or children. The largest percentage (39%) reported having insufficient monthly income. Regarding lifestyle characteristics, the majority of individuals reported not consume alcohol (98%) and were non-smokers (60%).

Table 1: The Distribution of the Studies' Demographic Characteristics

Variables	Categories	Frequency (No.)	Percentage (%)
Age groups	60-69	100	50
	70-79	66	33
	80-90	34	17
Gender	Male	131	65.5
	Female	69	34.5
Marital Status	Single	10	5
	Married	98	49
	Widowed	80	40
	Divorced	12	6
Education Level	No formal education	98	49
	Primary	41	20.5
	Secondary	22	11
	Diploma	22	11
	Bachelor's or Higher education	17	8.5
Employment Status	Retired	41	20.5
	Employed	7	3.5
	Unemployed	73	36.5
	Others (labour, driver….)	79	39.5
Living Arrangement	Alone	22	11
	With spouse	84	42
	With children or family	94	47
Monthly Income Level	Sufficient	46	23
	Barely sufficient	76	38
	Insufficient	78	39
Currently smoke	Yes	38	19
	No	120	60
	Ex-smoker	42	21
Consume alcohol	Yes	4	2
	No	196	98
	Ex- consumer	0	0

3.2. Pittsburgh Sleep Quality Index (PSQI)

3.2.1. Pittsburgh Sleep Quality questions

The mean usual bedtime (PM) was 7:16 (SD 4.96) hours. The average time taken to fall asleep was 31 (SD 20.53) minutes, ranging from 5 to 120 minutes. The mean usual wake-up time was 3.22 (AM) (SD 3.49) hours. Participants stated an average of 6.9 (SD 1.52) hours of actual sleep per night, with a minimum of 3 hours and a maximum of 9 hours. These early sleep and wake times likely reflect seasonal differences, because data were collected during autumn and winter, when this age group in our community tend to sleep and wake earlier, partly affected by seasonal daylight changes and routine early morning activities such as prayer.

Regarding the distribution of self-reported trouble sleeping factors, as assessed by the PSQI, difficulties initiating sleep were common, with about one third of participants had difficulty to fall asleep within 30 minutes once or twice a week, and 63 (31.5%) three or more times a week. Likewise, frequent awakenings during the night or early morning were reported by half of them once or twice a week and about one third three or more times a week. Nocturnal bathroom use was highly prevalent, with 76 (38%) reporting this once or twice weekly and half of them three or more times weekly.

Breathing difficulties during sleep were reported less frequently, experiencing this problem, loud coughing or snoring occurred in about half of participants once or twice weekly and in a quarter three or more times weekly. Temperature-related discomfort was also notable; 83 (41.5%) felt too cold once or twice weekly, while 128 (64%) felt too hot three or more times weekly. Bad dreams were reported by about a quarter once or twice weekly and 43 (21.5%) three or more times weekly. Finally, sleep disruption due to pain was experienced by (41%) once or twice weekly and less than a quarter three or more times weekly (Table 2).

Table 2: Frequency of Trouble Sleeping Factors Among Participants Based on the PSQI

Trouble Sleeping Factor	Not during the past month No. (%)	Less than once a week No. (%)	Once or twice a week No. (%)	Three or more times a week No. (%)

Cannot sleep within 30 min	35 (17.5)	42 (21)	60 (30)	63 (31.5)
Wake up at night/early	11 (5.5)	25 (12.5)	101 (50.5)	63 (31.5)
Need to use the bathroom	6 (3)	18 (9)	76 (38)	100 (50)
Cannot breathe comfortably	66 (33)	35 (17.5)	76 (38)	23 (11.5)
Cough or snore loudly	27 (13.5)	32 (16)	94 (47)	47 (23.5)
Feel too cold	45 (22.5)	44 (22)	83 (41.5)	28 (14)
Feel too hot	8 (4)	0 (0)	64 (32)	128 (64)
Have bad dreams	57 (28.5)	47 (23.5)	53 (26.5)	43 (21.5)
Have pain	45 (22.5)	26 (13)	82 (41)	47 (23.5)

Table 3 presents participants' self-reported sleep quality, sleep-related behaviours, and disturbances as assessed by the PSQI. Overall, the largest proportion of participants rated their sleep quality as fairly bad (45%), followed by fairly good (34%), while a smaller proportion reported very good sleep (21%).

Regarding sleep medication use, the most common response was use once or twice per week (39.5%), although over one-third of participants reported no use in the past month (36.5%). Difficulty staying awake during daily activities was most frequently reported once or twice per week (49%). In terms of daytime functioning, lack of enthusiasm was most commonly described as a somewhat of a problem (39.5%). Slightly more than half of participants reported having a bed partner or roommate (52.5%). Among those with a bed partner, the most frequently reported sleep disturbance was snoring, which occurred rarely or sometimes in the majority of cases. Mid-day napping was common, with nearly half of participants reporting naps three or more times per week (48%).

Table 3: Self-Reported Sleep Quality, Sleep Behaviours, and Sleep Disturbances Among Participants

Variables		**Categories**	**Frequency (No.)**	**Percentage (%)**
Sleep quality		Very good	42	21
		Fairly good	68	34
		Fairly bad	90	45
		Very bad	0	0
Sleep medicine use		Not during the past month	73	36.5
		Less than once a week	30	15
		Once or twice a week	79	39.5
		Three or more times a week	18	9
Trouble staying awake while driving, eating meals		Not during the past month	37	18.5
		Less than once a week	45	22.5
		Once or twice a week	98	49
		Three or more times a week	20	10
Lack of enthusiasm		No problem	18	9
		Only a very slight problem	66	33
		Somewhat of a problem	79	39.5
		A very big problem	37	18.5
Have a bed partner/roommate?		No	95	47.5
		Yes	105	52.5
Do you have a bed partner or roommate? If yes:	Loud snoring	Not at all	0	0
		Rarely	47	43.9
		Sometimes	45	42.1
		Often	6	5.6
		Very often	9	8.4
	Breathing pauses	Not at all	33	29.7
		Rarely	50	45
		Sometimes	15	13.5
		Often	7	6.3
		Very often	6	5.4
	Leg twitching	Not at all	17	15.6
		Rarely	45	41.3
		Sometimes	44	40.4
		Often	3	2.8
		Very often	0	0
	Confusion at night	Not at all	24	22
		Rarely	31	28.4
		Sometimes	44	40.4
		Often	10	9.2

How often have you had a mid-day sleep (nap)?	Very often	0	0
	Not during the past month	25	12.5
	Less than once a week	1	0.5
	Once or twice a week	78	39
	Three or more times a week	96	48

3.2.2. The Overall PSQI Scores

The majority of study participants experienced moderate sleep problems in a number of areas, according to the PSQI score analysis. Sleep latency, a measure of how long it takes to fall asleep, had the highest mean score (1.69), indicating that many of them had trouble falling asleep on time. Both subjective sleep quality (mean 1.24) and sleep disruptions (mean 1.26) were comparatively elevated, indicating that participants thought their sleep was inadequate and frequently interrupted.

Conversely, the mean scores for habitual sleep efficiency and sleep duration were lower (0.69 and 0.97, respectively), suggesting that the majority of participants maintained acceptable sleep efficiency and obtained a decent total sleep time. Daytime dysfunction (mean 1.44) showed that sleep issues had a moderate impact on the participants' daily function, while the low (mean 0.35) of using sleep medication demonstrates low reliance on pharmacological treatments.

The overall PSQI score categories of the participants showed a mean was 8.77 with SD 3.44, ranging from 3 to 19. Based on standard PSQI cut-off points, the majority of participants 163 (81.5%) were classified as having poor sleep quality, while only 37 (18.5%) demonstrated good sleep quality (Figure 1).

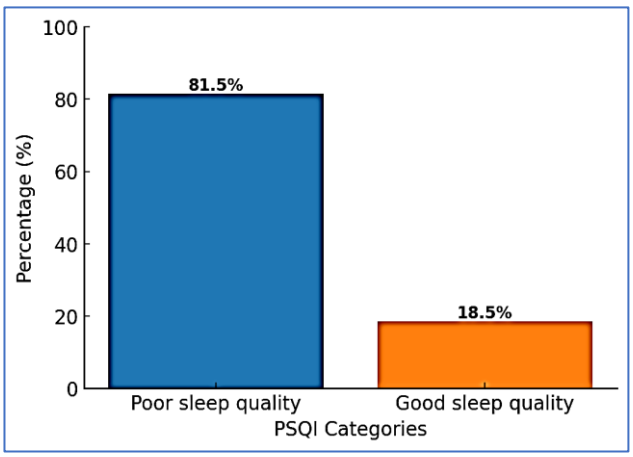


Figure 1: The Overall PSQI Score Categories

Although this frequency was high, it is consistent with studies from other countries where sleep disorders are common among the elderly. For instance, studies in Saudi Arabia found that 86% of elderly people had poor sleep quality, indicating that sleep disturbances are prevalent among the ageing populations in the Middle East [18]. Similarly, poor sleep quality was reported by 44.7% of Iranian older adults, suggesting that sleep problems are as common in neighbouring areas [19]. Despite varied incidence rates, sleep issues remain a significant health concern for older adults in developed countries. Prevalence rates might vary from 20% to 40%, depending on the demographic characteristics and assessment techniques used and age-related physiological changes, including disrupted circadian rhythms, decreased melatonin synthesis, and a higher incidence of chronic diseases, have been associated with poor sleep in older population [20]. The current study found that sleep latency and sleep disturbances are the most problematic features of sleep quality. These findings are in line with past research demonstrating that older people often report difficulty settling asleep and frequent awakenings during the night. Examples of sleep disturbances that might worsen fragmented sleep and reduced sleep efficiency include nocturia, pain, and temperature discomfort [21,22].

3.3. Physical Activity Scale for the Elderly (PASE)

Participants' engagement in physical activity over the past week was generally low to moderate, with walking being the most frequently reported activity. Most participants walked 1–2 days per week (56%), while a smaller proportion engaged in more frequent walking, and 14% reported no walking at all. Similarly, light and moderate recreational activities were mainly performed 1–2 days per week, whereas a considerable proportion of participants reported no engagement in moderate activities (32.5%).

On the other hand, most individuals reported not participating in strength or endurance workouts or intense physical activity (64% and 68.8%, respectively). Participants reported spending the most time on light and heavy housework when it came to household and associated activities; caregiving and volunteering, on the other hand, were less frequent and required the least amount of time per week. Overall, the results show that individuals mostly participated in household and low-intensity physical activities, with little involvement in organized physical training and higher-intensity exercise.

3.3.1. Physical Activity Scale for the Elderly (PASE) overall score

The overall physical activity levels of participants by the PASE showed that the mean PASE score was 274.95 (SD 209.75), indicating a moderate level of physical activity. Scores ranged widely from 0, representing no reported physical activity to a maximum of 774. (Figure 2)

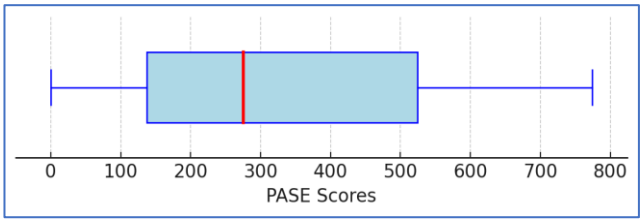


Figure 2: The Distribution of the Overall Physical Activity Levels of Participants

The current study found that people had modest levels of physical activity, with walking and household duties being the most common forms of exercise. Reports of demanding and strength-based activities were quite rare. Similar patterns have been observed in earlier research, indicating that older people are more likely to engage in light-to-moderate activities like walking, gardening, and housework than in formal exercise programs [23]. Regular physical activity is linked to better physical function, mental health, and sleep quality in older persons, according to studies from developed countries [4,24]. Exercise has also been demonstrated to enhance metabolic health, control circadian rhythms, and lessen insomnia symptoms [3,6]. Regularly active older persons report higher sleep quality than sedentary ones, according to research conducted in Asian and European populations [3,7]. The relatively low levels of severe physical activity involvement identified in this study may be caused by mobility limitations, age-related health problems, and a lack of structured exercise options. Cultural and environmental limitations, such as a lack of recreational activities, may also have an impact on older people's level of physical activity in developing countries [5].

3.4. Social Engagement Questionnaire

3.4.1. Social Activities Participation (SAP)

Engagement in social activities were varied among participants. Visiting family or friends at their homes was reported frequently by 29 (14.5%), occasionally by 56 (28%), rarely by 85 (42.5%), and never by 30 (15%) participants. Receiving visits from family or friends was more common, with 50 (25%) reporting frequent visits, 74 (37%) occasional visits, and 76 (38%) rare visits; none reported never receiving visits.

Attendance at religious services or prayer groups was frequent for 28 (14%), occasional for 86 (43%), and rare for 68 (34%) participants, while 18 (9%) never attended. Participation in community or neighbourhood events was mostly rare 96 (48%) or never 67 (33.5%), with fewer reporting occasional participation 37 (18.5%), and none frequently participated. Similarly, attendance at social clubs or elderly centres was limited, with 112 (56%) never attending, 68 (34%) rarely, and only 20 (10%) occasionally attending.

Activities such as shopping or going to a market with someone were mostly done rarely 121 (60.5%) or never 39 (19.5%), with 40 (20%) participating occasionally. Attendance at weddings, funerals, or other ceremonies rarely 135 (67.5%) or never 43 (21.5%), with only 22 (11%) attending occasionally. Volunteering in any activity or organisation rarely 74 (37%), never for 106 (53%), and occasional for 20 (10%). Recreational or cultural activities (e.g., games, music, crafts) were also infrequent, with 112 (56%) never participating, 79 (39.5%) rarely, 6 (3%) occasionally, and 3 (1.5%) frequently. Overall scores of the SAP scale showed a mean of 9.27 with SD 3.18, ranging from 2 to 14. Based on categorisation, most participants were classified as having moderate social activity participation 131 (65.5%), while 69 (34.5%) had low participation, and none were classified as having high participation. (Figure 3)

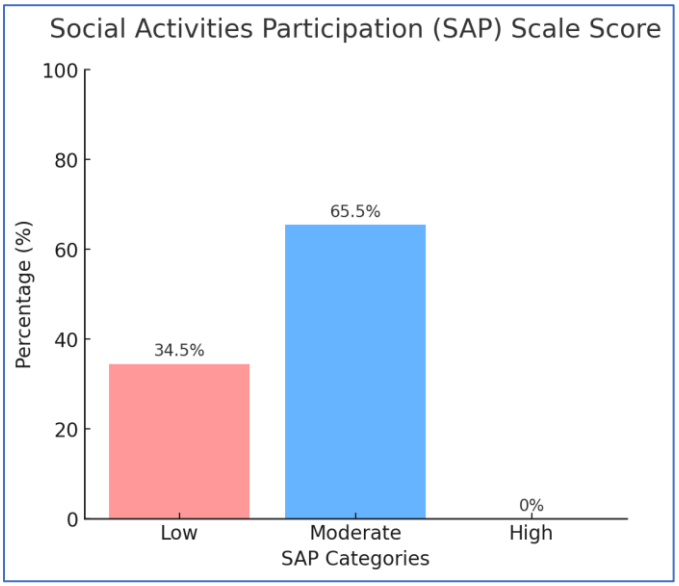


Figure 3: The Percentage of the SAP Sore Categories

3.4.2. Social Engagement Frequency and Satisfaction

Most participants reported daily communication with others, either in person, by phone, or online 109 (54.5%), while 39 (19.5%) communicated weekly, 33 (16.5%) a few times a week, and 19 (9.5%) rarely; none reported never communicating. Regarding social contact satisfaction, 83 (41.5%) participants reported satisfied, 57 (28.5%) were neutral, 45 (22.5%) were dissatisfied, 13 (6.5%) were very satisfied, and 2 (1%) were very dissatisfied. Despite maintaining regular communication, feelings of loneliness remained high 70 (35%) sometimes, 46 (23%) rarely, 27 (13.5%) always, 19 (9.5%) often, and 38 (19%) never.

A generally moderate level of social involvement was indicated by the majority of survey participants who reported irregular social activities but frequent communication with friends and family. Informal social connections appear to continue to be important in daily life for elderly people. However, participation in organised activities such as community events, social clubs, and recreational programmes was relatively low. Previous study has shown that family relationships, rather than formal social participation, are the main method by which older persons maintain social connections [25].

3.4.3. Barriers to Social Engagement

Health problems were the most commonly cited barrier, reported by 124 participants (62%), while 76 (38%) indicated no health-related limitations. Transportation issues and financial difficulties were each reported by 64 participants (32%), with the majority (68%) reporting no such barriers. Lack of interest was noted by 68 participants (34%), and 48 participants (24%) indicated that not having someone to accompany them limited their participation. Certain factors were not reported as barriers by any participants, including family restrictions, weather conditions, and other unspecified reasons (0%), indicating these did not meaningfully restrict social engagement in this sample. Multiple responses were allowed, so participants could report more than one limiting factor.

In this study, health issues were the most often mentioned barrier to social engagement. Previous study has shown that chronic diseases, mobility limitations, and transportation difficulties significantly decrease opportunities for social engagement among senior people [26]. Financial limitations and lack of friendship may also restrict participation in community activities [27]. Social isolation and loneliness are becoming recognised as major public health concerns among the elderly. Loneliness has been associated with increased mortality, depression, cardiovascular disease, and cognitive decline [8,9]. Thus, maintaining strong social networks is necessary to promote psychological well-being and healthy ageing.

The absence of recorded barriers, such as weather and family constraints, indicates that social interaction in this community was not significantly hampered by these circumstances. This suggests a relatively supportive environment with minimal external constraints. Current research indicates that barriers to social participation among older adults are more strongly associated with individual variables than with environmental factors, particularly mobility and health status [28].

3.5. Relationship between variables

The relationships between social interaction, physical exercise, and sleep quality among senior citizens in Sulaimani City were found in the current study. The results revealed a high incidence of poor sleep quality, modest levels of social engagement and physical activity, and strong correlations between these variables. These findings support the concept that a variety of interconnected lifestyle factors are necessary for healthy aging and show the complex relationship between behavioural and social determinants of health in senior persons [1,29].

3.5.1. Sociodemographic characteristics and sleep quality

Age showed a non-significant association with sleep quality (P-value 0.052), with the majority of poor sleepers aged 60–69 years 76 (46.6%), while good sleepers were more common in the same age group 24 (64.9%). Gender was significantly associated with sleep quality (P-value 0.045), with a higher proportion of males 19 (51.4%) reporting good sleep compared to females 18 (48.6%). Education level was also significantly associated with sleep quality (P-value 0.005); participants with no formal education were more likely to report poor sleep 89 (54.6%), whereas those with primary education had a higher proportion of good sleep 14 (37.8%). Living arrangement showed the strongest association (P-value 0.0001), with participants living with a spouse being more likely to have good sleep quality 30 (81.1%), while those living alone reported only poor sleep 22 (13.5%). Other variables, including marital status, employment status, monthly income, smoking status, and alcohol consumption, were not significantly associated with sleep quality ($p > 0.05$) (Table 4).

Table 4: Associations Between Sociodemographic Factors and Sleep Quality Categories

Variables	Categories	PSQI Scores categories				*P*-value
		Poor sleep quality		Good sleep quality		
		Frequency (No.)	Percentage (%)	Frequency (No.)	Percentage (%)	
Age groups	60-69	76	46.6	24	64.9	0.052
	70-79	55	33.7	11	29.7	
	80-90	32	19.6	2	5.4	
Gender	Female	51	31.3	18	48.6	*0.045
	Male	112	68.7	19	51.4	
Marital Status	Single	10	6.1	0	0	0.125
	Married	76	46.6	22	59.5	
	Widowed	65	39.9	15	40.5	
	Divorced	12	7.4	0	0	
Education Level	No formal education	89	54.6	9	24.3	*0.005
	Primary	27	16.6	14	37.8	
	Secondary	16	9.8	6	16.2	
	Diploma	18	11.0	4	10.8	
	Bachelor's or Higher education	13	8	4	10.8	
Employment Status	Retired	32	19.6	9	24.3	0.453
	Employed	5	3.1	2	5.4	

	Unemployed	58	35.6	15	40.5	
	Others	68	41.7	11	29.7	
	Alone	22	13.5	0	0	
Living Arrangement	With spouse	54	33.1	30	81.1	*0.0001
	With children or family	87	53.3	7	18.9	
	Sufficient	34	20.9	12	32.4	
Monthly Income Level	Barely sufficient	65	39.9	11	29.7	0.274
	Insufficient	64	39.3	14	37.8	
	No	97	59.5	23	62.2	
Currently smoke	Yes	34	20.9	4	10.8	0.285
	Ex-smoker	32	19.6	10	27	
Consume alcohol	No	159	97.5	37	100	1
	Yes	4	2.5	0	0	

* Significant P-values

3.5.2. Sociodemographic characteristics and Physical Activity score

Table 5 presents the relationships between participants' sociodemographic characteristics and overall physical activity score, measured by the PASE. Age was significantly associated with physical activity (P-value 0.0001), with participants aged 60–69 (mean ±SD) (311.91 ±213.74) and 70–79 (309.73 ±177.27) being more active than those aged 80–90 (98.71 ±166.70). Gender was also significantly associated with activity levels (P-value 0.0001), with females reporting higher PASE scores (434.67 ±218.12) than males (190.82 ±147.61). Marital status showed a significant effect (P-value 0.0001), with married participants being the most active (354.70 ±231.78), and single participants the least active (171.20 ±4.64). Education level was significantly related with physical activity (P-value 0.0001), participants who had secondary education or higher showing greater activity levels (e.g., secondary: 476.82 ±242.56; bachelor's or higher: 384.18 ±217.46) compared to those without formal education (207.51 ±163.83). Employment status was significant (P-value 0.01), with retired participants reporting higher activity (342.63 ±207.21) than others.

Living arrangement was strongly associated with activity (P-value 0.0001); participants living with a spouse had the highest PASE scores (406.19 ±226.88), whereas those live with children or family had the lowest (169.53±141.22). The monthly income level was significant (P-value 0.008), with sufficient income associated with higher activity. Smoking status was also significant (P-value 0.0001), with ex-smokers showing the lowest activity levels (99.57 ±74.5). Alcohol consumption was not significantly associated with PASE scores (P-value 0.923).

Table 5: Associations Between Sociodemographic Factors and Physical Activity Score Levels

Variables	Categories	PASE Scores		*P*-value
		Mean	SD	
Age groups	60-69	311.91	213.74	*0.0001
	70-79	309.73	177.27	
	80-90	98.71	166.70	
Gender	Female	434.67	218.12	*0.0001
	Male	190.82	147.61	
Marital Status	Single	171.20	4.64	*0.0001
	Married	354.70	231.78	
	Widowed	198.38	167.61	
	Divorced	220.50	89.92	
Education Level	No formal education	207.51	163.83	*0.0001
	Primary	276.90	204.42	
	Secondary	476.82	242.56	
	Diploma	285.41	211.59	
	Bachelor's or Higher education	384.18	217.46	
Employment Status	Retired	342.63	207.21	*0.01
	Employed	247.43	151.10	
	Unemployed	316.68	262.92	
	Others	203.68	124.14	
Living Arrangement	Alone	233.55	59.35	*0.0001
	With spouse	406.19	226.88	
	With children or family	169.53	141.22	
Monthly Income Level	Sufficient	333.70	266.85	*0.008
	Barely sufficient	297.79	162.21	
	Insufficient	218.04	201.5	
Currently smoke	No	319.43	218.97	*0.0001

	Yes	328.32	178.92	
	Ex-smoker	99.57	74.5	
Consume alcohol	No	276.31	211.65	0.923
	Yes	208.25	25.95	

* Significant P-value

3.5.3. Sociodemographic Characteristics and SAP Scores

Table 6 presents the relationships between participants' sociodemographic characteristics and their SAP scores. Age was significantly associated with SAP scores (P-value 0.0001), with participants aged 60–69 years having the highest scores (mean ±SD) (10.44 ±2.38) and those aged 80–90 years the lowest (5.74 ±3.23). Gender was not significantly associated with SAP scores (P-value 0.728). Marital status was significantly associated with social participation (P-value 0.0001), with married participants reporting the highest scores (10.43 ±2.30), followed by divorced (10.08 ±1) and widowed participants (8.06 ±3.81). Education level was also significant (P-value 0.0001); participants with higher education reported greater social participation, with bachelor's or higher education showing the highest scores (11.82 ±2.53) and those with no formal education the lowest (7.98 ±3). Employment status was significantly associated with SAP scores (P-value 0.0001), with retired participants reporting the highest social participation (11.83 ±2.05) and unemployed participants the lowest (8.07 ±3.68). Living arrangements were also significant (P-value 0.0001), with participants living with a spouse having the highest scores (10.75 ±2.55) and those live with children or family had the lowest (8.11 ±3.33). Monthly income showed a significant association (P-value 0.043), with sufficient income linked to higher participation scores (10.04 ±2.97). Smoking status was significant (P-value 0.0001); current smokers stated higher SAP scores (11.11 ±2.15) compared to ex-smokers (6.71 ±3.27). Alcohol consumption was not significantly associated with social participation (P-value 0.145).

Table 6: Associations Between Sociodemographic Characteristics and SAP Scores

Variables	Categories	SAP Scores		*P*-value
		Mean	SD	
Age groups	60-69	10.44	2.38	*0.0001
	70-79	9.32	2.89	
	80-90	5.74	3.23	
Gender	Female	9.49	2.83	0.728
	Male	9.15	3.35	
Marital Status	Single	6.60	1.26	*0.0001
	Married	10.43	2.30	
	Widowed	8.06	3.81	
	Divorced	10.08	1	
Education Level	No formal education	7.98	3	*0.0001
	Primary	9.29	3.04	
	Secondary	10.73	2.64	
	Diploma	11.55	2.02	
	Bachelor's or Higher education	11.82	2.53	
Employment Status	Retired	11.83	2.05	*0.0001
	Employed	8.86	2.27	
	Unemployed	8.07	3.68	
	Others	9.09	2.43	
Living Arrangement	Alone	8.82	2.34	*0.0001
	With spouse	10.75	2.55	
	With children or family	8.11	3.33	
Monthly Income Level	Sufficient	10.04	2.97	*0.043
	Barely sufficient	9.67	2.65	
	Insufficient	8.42	3.59	
Currently smoke	No	9.58	2.88	*0.0001
	Yes	11.11	2.15	
	Ex-smoker	6.71	3.27	
Consume alcohol	No	9.3	3.21	0.145
	Yes	8	0	

* Significant P-value

Physical activity, social engagement, and sleep quality were all associated with a number of sociodemographic characteristics. Participants who lived with a spouse reported better sleep outcomes than those who lived alone, indicating a robust correlation between living arrangement and sleep quality. Family members' social support may enhance emotional health and lower stress levels, both of which improve sleep [30]. Physical activity and social

involvement were substantially correlated with age. Compared to elderly individuals 80 years of age and more, younger older adults (60–69 years) were more active and socially involved. This finding is consistent with previous studies indicating that physical function and mobility decline with advancing age [5,23]. Higher levels of social interaction and physical exercise were also linked to income and education levels. Higher socioeconomic level individuals may have easier access to social opportunities that promote active lives, recreational facilities, and health information [31].

3.5.4. Sleep habits with sleep quality

The associations between participants' sleep habits and sleep quality showed that having a bed partner or roommate was significantly associated with sleep quality (P-value 0.0001); among participants with good sleep, 32 (86.5%) had a bed partner or roommate, whereas only 5 (13.5%) good sleepers slept alone. Conversely, poor sleepers were more likely to sleep alone 90 (55.2%) than with a partner or roommate 73 (44.8%). On the other hand, the frequency of mid-day naps was not significantly associated with sleep quality (P-value 0.558). Poor sleepers reported napping once or twice a week 65 (39.9%) or three or more times a week 79 (48.5%), similar to good sleepers 13 (35.1%) and 17 (45.9%) respectively, indicating that napping habits did not meaningfully differ between sleep quality groups.

3.5.5. Associations Between Social Habits, Perceived Barriers, and SAP Scores

Table 7 presents the relationships between participants' social habits, perceived barriers, and their (SAP) scores. Frequency of communication was significantly associated with SAP scores (P-value 0.0001), with participants communicating daily reporting higher scores (10.23 ±2.67) compared to those communicating rarely (7.32 ±3.68) or a few times a week (6.85 ±3.33). Satisfaction with social contact was also significantly associated with SAP scores (P-value 0.004); very satisfied participants reported the highest scores (10.77 ±1.74), while those very dissatisfied reported the lowest (3.5 ±0.71). Feelings of loneliness or social isolation were not significantly associated with SAP scores (P-value 0.264).

Among perceived barriers to social participation, lack of interest was significantly associated with higher SAP scores (P-value 0.0001), with participants reporting lack of interest having higher scores (10.44 ±2.77) than those without this barrier (8.67 ±3.22). Having no one to go with was also significant (P-value 0.016), with participants reporting this barrier having lower SAP scores (8.38 ±2.9) compared to those not reporting it (9.55 ±3.22). Health problems, transportation issues, and financial difficulties were not significantly associated with SAP scores (P-value > 0.05).

Interestingly, individuals who reported "lack of interest" as a barrier scored higher on social participation than those who did not. Because socially engaged older persons engage in a greater variety of activities and are therefore more likely to identify factors that occasionally limit their engagement, this finding may indicate higher levels of self-awareness among these individuals. People who routinely engage in low social interaction, on the other hand, might encounter other significant obstacles and be less likely to identify their lack of interest as a contributing cause. Nevertheless, this result should be interpreted cautiously given the cross-sectional nature of the study.

Table 7: Associations Between Social Habits and Perceived Barriers with SAP Scores

Variables	Categories	SAP Score		*P*-value
		Mean	SD	
How often do you communicate with others (in person, phone, or online, social media)?	Never	0	0	*0.0001
	Rarely	7.32	3.68	
	Weekly	9.59	2.68	
	A few times a week	6.85	3.33	
	Daily	10.23	2.67	
Do you feel satisfied with the amount of social contact you have?	Very dissatisfied	3.5	0.71	*0.004
	Dissatisfied	9.04	3.33	
	Neutral	10.16	2.87	
	Satisfied	8.69	3.23	
	Very satisfied	10.77	1.74	
Do you feel lonely or socially isolated?	Always	8.70	2.96	0.264
	Often	8.95	2.63	
	Sometimes	9.34	3.36	
	Rarely	8.61	3.70	
	Never	10.50	2.18	
Factors limit participation in social activities				
Health problems	Yes	9.1	3.57	0.907
	No	9.55	2.4	
Transportation issues	Yes	8.7	2.7	0.062
	No	9.54	3.36	
Financial difficulties	Yes	9.28	2.86	0.943
	No	9.26	3.33	
Lack of interest	Yes	10.44	2.77	*0.0001

	No	8.67	3.22	
No one to go with	Yes	8.38	2.9	*0.016
	No	9.55	3.22	

* Significant P-value

3.6. Correlations Between Sleep Quality, Physical Activity, and SAP Scores:

Spearman's correlation analysis demonstrated significant associations among sleep quality, physical activity and participation in social activities. PSQI scores showed negative correlation with PASE scores (ρ = -0.471, P-value < 0.001) and with SAP scores (ρ = -0.320, P-value < 0.001), indicating that poor sleep quality was associated with low physical activity level and decreased social participation. In contrast, PASE scores were positively correlated with SAP scores (ρ = 0.477, P-value < 0.001), suggesting that elder with higher physical activity were associated with more social activities engagement. These results corroborate the increasing amount of research indicating a connection between lifestyle behaviours [7,11]. Because exercise encourages deeper sleep, lowers sleep latency, and improves total sleep efficiency, it has been repeatedly linked to better sleep quality [6]. Additionally, regular exercise may lessen anxiety and tension, which are frequent causes of sleep problems [32].

Social interaction may also affect the quality of sleep through behavioural and psychological mechanisms. Older persons who retain active social networks typically have lower levels of depression and loneliness, which are significant predictors of sleep disruptions. Furthermore, many social activities include mobility, which could tangentially raise levels of physical activity [33]. This study's favourable association between social interaction and physical exercise indicates that these behaviours frequently take place at the same time. Walking groups, leisure clubs, and community fitness programs are examples of group-based physical activities that can improve social interaction and physical activity. It has been demonstrated that these therapies enhance older individuals' psychological well-being and quality of life [34].

3.7. Healthy Aging Implications

The results emphasize the need for coordinated health promotion programs that simultaneously emphasize social interaction, physical activity, and sleep. Examples of community-based interventions that may improve many aspects of older people's well-being include walking groups, social organizations, and leisure pursuits. Healthcare professionals should prioritize sleep hygiene instruction and encourage regular exercise as part of typical geriatric treatment. Policies that enhance community infrastructure, transit accessibility, and social support services may promote active and socially engaged aging [1,35]. Educational initiatives aimed at senior citizens and caregivers are also advised in order to increase awareness of the value of social connections, the advantages of an active lifestyle, and the quality of sleep. Senior citizens' health and well-being can be significantly improved by connecting these tactics.

Finding a causal relationship between physical activity, social engagement, and sleep quality is limited by the cross-sectional design. Firstly, instead of identifying cause-and-effect relations, the study identifies associations. Secondly, the research's statistical ability to identify smaller relationships between social engagement, physical activity, and sleep quality may have been influenced by the small sample size. It might have limited the degree to which the results can be applied to the larger population of older populations and decreased the accuracy of the estimated relationships. Similarly, the study sampling method may include selection bias and limit the representativeness of the study finding against the population. Participants for the study were recruited from a certain geographic region (Sulaimani city), and their characteristics may not fully represent the senior citizens in other locations. Thirdly, the study data were self-reported and collected through participant interviews, which may be prone to recall bias and social desirability bias.

Likewise, participants may have overestimated or underestimated their levels of physical activity, sleep quality, or social engagement. Finally, potential confounding variables were not fully controlled, such as mental health status, nutritional and environmental factors, which may affect the study results. Despite these limitations, the study still provides robust information about the regional older adult's health status, and it is a contribution to understanding the interrelationship between key health determinants of older adults.

4. Conclusions

In conclusion, the study findings indicate that sleep quality, physical activity, and social engagement are significantly interconnected among older adults. Poor sleep quality was common and was associated with low levels of physical activity and reduced social engagement, while greater physical activity was positively associated with higher levels of social participation. These findings highlight the multidimensional nature of healthy ageing and the interrelated role of behavioural and social health factors. The study emphasises the importance of integrated interventions that address sleep health, encourage physical activity, and promote social participation among older adults. The strategies may contribute to enhancing overall well-being and life quality in this age group. Further longitudinal research and more representative sampling methods are recommended to clarify causal relationships and to support the development of targeted, evidence-based strategies for healthy ageing.

Contributorship Statement:

Conceptualization: Z.M, P.S; Data Collection: P.S., Z.M., Data Analysis: R.H.; Writing—Original Draft Preparation, Review and Editing: Z.M, R.H, Supervision: Z.M.

Conflict of Interest Statement:

The authors declare that this paper has no conflict of interest.

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Ethical Approval

This study was approved by the [Ethical Committee of Sulaimani Polytechnic University], under approval number [2/256] on [21/10/2025]. All procedures performed were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

AI Use Statement:

The authors assert that no AI-assisted technologies were utilised in the generation of data, analysis, or interpretation.

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