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Morning Versus Evening Physical Activity, Sleep Quality, and Psychological Well-Being Among Healthy Adults in the UAE

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Background and Objective Physical activity is important for maintaining the physical and mental health. Evidence on the optimal time of physical activity (morning vs. evening) is conflicting. This study aimed to evaluate the impact of morning vs. evening physical activity on sleep quality and psychological well-being among healthy adults in the United Arab Emirates (UAE).

Methods A descriptive correlational design was used to achieve the purpose of this study. Data were anonymously collected using a structured online questionnaire comprising a modified version of the International Physical Activity Questionnaire, Pittsburgh Sleep Quality Index (PSQI) questionnaire, and Psychological Well-Being Scale.

Results The majority of the participants (70%) reported performing vigorous physical activity. A total of 269 (76.8%) participants perceived their sleep quality as very good or fairly good. There was a statistically significant difference in participants' PSQI scores by the time of performing vigorous activity. Participants who performed vigorous physical activity in the evening were more likely to have poorer sleep quality compared to those who performed vigorous physical activity in the morning or afternoon. No statistically significant relationship was found between the time of physical activity and psychological well-being.

Conclusions This study revealed that there was a significant relationship between the time of performing vigorous physical activity and sleep quality; i.e., performing vigorous activity in the evening negatively affected the sleep quality. The study further showed that there was no significant relationship between the time of physical activity and psychological well-being among healthy adults living in the UAE.
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Keywords Physical activity; Sleep; Psychological well-being.

INTRODUCTION

Physical activity is widely advocated to be essential for people of all ages in order to improve their health [1,2]. International guidelines recommend that every adult should aim for at least 150 minutes of moderate-intensity physical activity per week [3]. Physical activity has been found to have positive effects on various dimensions of individuals' health, including sleep and psychological well-being [4,5]. Sleep disturbances can affect the overall health, safety, quality of life, memory, mood, immunity, and balance [5,6]. Lack of regular physical activity has been shown to be a predictor of insomnia. Physical activity positively affects the sleep quality, sleep onset latency, total sleep time, and sleep efficiency, and it can decrease insomnia severity [7,8]; thus, it has been utilized as a cost-effective non-pharmacological therapy for insomnia [9].

Most adults experience stress and anxiety during their daily life, which can lead to increased risk of high blood pressure, heart disease, peptic ulcer disease, muscle tension, and headache

[10]. Some studies have shown that physical activity is beneficial for relieving stress and anxiety and for reducing their negative health impacts. People who perform physical activity regularly have better psychological well-being, decreased anxiety, improved self-esteem, and better cognitive functioning [11].

However, the evidence regarding the optimal time to practice physical activity is conflicting. For instance, some evidence shows that morning physical activity may lead to better physiological well-being, productivity, and stress reduction [12]. Some studies have shown that evening physical activity can negatively impact the sleep quality [13]. Other studies have shown that evening exercise, such as stretching activities, helps relieve muscle tension and make individuals feel fully relaxed, and thus it helps to have a good night sleep. On the other hand, several studies have found no clear association between the time of physical exercise and sleep quality [13,14]. Intensity of the physical activity (i.e., vigorous vs. moderate physical activity) has been found to affect the sleep quality. Healthy adults who perform high-intensity activities (e.g., interval training) for less than one hour before bedtime took longer to fall asleep and had poor sleep quality compared to no-exercise control adults [15].

Countries in the Arabian Gulf Region, including the United Arab Emirates (UAE), have a hot and humid weather especially in the summer. Thus, extreme temperatures and humidity may discourage their residents from participating in physical activity, especially during the daytime when the temperature and humidity are higher [16]. Although there is a plethora of studies on individuals' exercise patterns (e.g., type, frequency, and intensity) and how the time of physical activity (morning vs. evening) can influence the sleep quality and psychological well-being among exercisers, this information is especially lacking in the population of the UAE. Thus, this study aimed to examine the association between the time of physical activity (i.e., morning vs. evening physical activity) and sleep quality and psychological well-being among healthy adults in the UAE.

METHODS

Research Design

This study utilized a quantitative non-experimental, descriptive correlational design to evaluate the correlations between physical activity, sleep quality, and psychological well-being among healthy adults.

Sample and Setting

All healthy adults who were current residents (both nationals and non-nationals) of the UAE, aged 18 years or more at the time of data collection, could read and understand English, and were not diagnosed with any chronic illness (e.g., diabetes mellitus, hypertension), insomnia, or mental disorder were eligible to participate in the study. The convenience sampling technique using social media platforms (e.g., Twitter, Facebook, Instagram, and Telegram) that included a link to an anonymous online survey was used to recruit the study participants from all seven Emirates in the UAE.

Data Collection Procedure

Potentially eligible participants were directed to an online study survey that included the data collection instruments and introductory page/disclosure statement. Participants were instructed to read the introductory page to confirm their eligibility for the study (e.g., current residents, no mental disorder, chronic disease, etc.), and if eligible, to indicate their consent to participate in the study before completing the survey. Participants were instructed not to complete the survey if they did not meet any of the above-mentioned eligibility criteria. Data were collected using valid and reliable scales. Demographic data were measured using a questionnaire developed by the researchers for the purpose of the study; it included 13 general questions (e.g., age, gender, height, weight, level of education, etc.). Physical activity was measured using a modified version of the International Physical Activity Questionnaire (IPAQ) scale for healthy adults. The IPAQ has undergone extensive reliability (test-rest reliability indicated good stability, $\alpha > 0.80$) and validity testing (i.e., predictive validity, concurrent validity, convergent validity, criterion validity, and discriminant validity) and found to have acceptable measurement properties for use in many settings and in different languages [17,18]. The IPAQ assesses three levels of the intensity of physical activity and sitting time that people do as part of their daily routine. Low physical activity includes walking for at least 10 minutes. Moderate physical activity includes activities, such as carrying light loads, bicycling at a regular pace, or doubles tennis. Finally, vigorous physical activity includes activities, such as digging, fast cycling, swimming, heavy lifting, or aerobics [18]. To meet the aim of this study, each intensity question was followed by a question assessing the typical time of the day the participant performed this activity as follows: 1) morning (> 8 hr before bed), 2) afternoon (4–8 hr before bed), or 3) evening (< 4 hr before bed). The level and time of exercise variables were combined. Thus, participants were classified in one or more of the following categories: light exercise—morning, afternoon, or evening; moderate exercise—morning, afternoon, or evening; and vigorous exercise—morning, afternoon, or evening.

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) scale for healthy adults [19]. The PSQI is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates "poor" from "good" sleep quality by measuring the following 7 components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction over the last month. The PSQI is composed of 9 items and 2 parts. The first part has 4 open-ended questions, and the second part has 6 Likert questions. The maximum score on the

sleep quality scale is 27, and the minimum number is 9; a total score of "5" or greater indicates poor sleep quality [19]. The PSQI has acceptable measures of internal consistency, test-retest reliability, and validity.

Psychological well-being was measured using the Psychological Well-Being Scale (PWB) questionnaire [20]. The scale consists of 8 statements with which one may agree or disagree. The response options vary from 1 (i.e., strongly disagree) to 7 (i.e., strongly agree) for all 8 items. The possible range of scores is from 8 (lowest PWB possible) to 56 (highest PWB possible). A high score indicates that the person has many psychological resources and strengths [20].

Ethical Considerations

The study was approved by the research ethics committee at the Higher Colleges of Technology, UAE (REIC-Jan-2023-6). The study population comprised adults who were aged 18 years or above. The participants were instructed that their participation in the study is completely voluntary and that they have the right to withdraw from the study at any time without providing any reason or justification. Data were collected anonymously, and the participants were not asked for any personal or identifying information (e.g., names, signatures, and addresses). Eligible participants were instructed that completion of the survey will be considered as their consent for participation in the study. A short recording of 2 minutes describing the study (i.e., study aim, methodology, rights of the participants, and data collection procedure) in a simplified language was provided to the participants, and it was posted in the introductory page of the online survey. The confidentiality of participants' information and completed data was observed by saving all data in a secure and password-protected device, with single access by the research team.

Data Analysis

SPSS version 28 (IBM Corp., Armonk, NY, USA) was used for data entry and analysis. Descriptive statistics were performed to summarize the demographic characteristics of participants and the main research variables (i.e., exercise, sleep, and psychological well-being). Frequency and percentages were calculated for categorical variables. Means and standard deviations were calculated for continuous variables. To answer the research question on the relationship between time of physical activity, sleep quality, and psychological well-being, one-way analysis of variance (ANOVA) was performed. For all statistical analyses, a p-value of 0.05 or less was used as a cut-off for statistical significance.

RESULTS

Demographic Data

A total of 350 participants completed the survey. Prior to analysis, all variables were examined for accuracy of data entry, missing values, and meeting the assumptions of the statistical tests performed. A detailed description of sample demographics is shown in Table 1. The mean age of the participants was 29.73 years, and their mean body mass index (BMI) was 25.03 kg/m^2. More than half of the participants were females (64.3%), the majority were Emirati (76%) and had a bachelor's degree (52.6%). Further, less than half of the participants were employed full time (40.6%), and nearly half of them were single (50.6%). The majority of the participants (47.1%) reported that their city of residence was Sharjah city.

Exercise Patterns

Vigorous, moderate, and light physical activity intensities among the study participants are described in Table 2. The intensities were assessed independently to allow the respondents to endorse multiple levels of physical activity. Activity durations were recorded as the number of days per week and the number of minutes per day. A total of 245 (70%) participants reported performing vigorous physical activity. Participants reported performing vigorous physical activity for a mean of 2.19 days per week and 39.55 minutes per day. Among those who reported performing vigorous physical activity, 24.6% reported performing the activity in the evening, 23.7% in the afternoon, and 21.7% in the morning.

A total of 235 (67.1%) participants reported performing moderate physical activity. They performed moderate physical activity for a mean of 1.87 days per week and 42.13 minutes per day. Among those who reported performing moderate physical activity, 20.6% reported performing the activity in the evening, 25.4% in the afternoon, and 21.1% in the morning. The vast majority of the participants (92.0%) reported performing light physical activity for a mean of 4.25 days per week and 56.22 minutes per day. Only a few participants (8.0%) reported not performing light physical activity. Among those who reported performing light physical activity, 29.7% performed the activity in the evening, 23.7% in the afternoon, and the majority performed the activity in the morning (38.6%). Finally, 15% of all participants reported not performing any vigorous or moderate physical activity.

Sleep Quality and Psychological Well-Being

Sleep quality, sleep latency, sleep duration, sleep efficiency, and sleep disturbances were assessed using the PSQI (Table 3). The PSQI had a satisfactory reliability in this study; a Cronbach's α of 0.71.

A total of 269 (76.8%) participants perceived their sleep quality as very good or fairly good. Of all participants, only 13.1% reported having severe difficulty falling asleep. A total of 218 (62.3%) participants reported that they were sleeping more than 7 hours, while 10.6% reported sleeping less than 5 hours. The majority of the participants (74.6%) reported more than 85% of sleep efficiency. More than half of the participants (54.3%) re-

ported having sleep disturbance less than once a week. In terms of the use of medication, the majority of participants reported not using any sleep medications during the past month (62.9%). A noticeable finding of this study was that the vast majority of participants went to bed very late in the evening, mostly between 11 PM and 4 AM with almost 50% going to bed at 12 AM or after. Gender and age were the only demographic variables that were significantly associated with the global PSQI score. Female participants (7.09 ± 3.87, $p < 0.001$) reported a significantly poorer sleep quality compared to male participants (5.74 ± 3.35). Participants who were aged 18–24 years (7.69 ± 3.93, $p < 0.001$) were more likely to report a poorer sleep quality compared to those in the age groups of 25–34 (5.63 ± 3.31) and 35–44 years (5.71 ± 3.38).

Table 1. Demographic characteristics of the participants completing the survey

Characteristics	Value (n = 350)
Age (yr)	29.73 ± 9.48 (18–62)
BMI (kg/m^2)	25.03 ± 4.44 (15.24–42.17)
Gender	
Male	125 (35.7)
Female	225 (64.3)
Nationality	
Emirati	266 (76.0)
Non-Emirati	84 (24.0)
Education level	
High school	72 (20.6)
Diploma	38 (10.9)
Bachelor	184 (52.6)
Graduate studies	56 (16.0)
Employment status	
Employed full-time	142 (40.6)
Employed part-time	57 (16.3)
Unemployed	151 (43.1)
Marital status	
Single	177 (50.6)
Married	156 (44.6)
Divorced	12 (3.4)
Separated	2 (0.6)
Widowed	3 (0.9)
Monthly income	
0–5000 AED	192 (54.9)
5001–10000 AED	45 (12.9)
10001–15000 AED	36 (10.3)
15001–20000 AED	49 (14.0)
More than 20000 AED	28 (8.0)
City of residency	
Abu-Dhabi	18 (5.1)
Dubai	16 (4.6)
Sharjah	165 (47.1)
Ajman	7 (2.0)
Ras Al-Khaimah	8 (2.3)
Um Al-Quwain	4 (1.1)
Fujairah	132 (37.7)

Values are presented as mean ± standard deviation (range) or n (%).
BMI, body mass index; AED, United Arab Emirates dirham.

The PWB scale showed satisfactory reliability in this study, with a Cronbach's α of 0.834. Participants in this study had a mean PWB score of 48.5 ± 6.12 indicating excellent psychological well-being.

Time of Vigorous Physical Activity, Psychological Well-Being, and Sleep Quality

Results of the ANOVA test showed that were no between group differences in the psychological well-being by the time of performing vigorous physical activity [$F(3, 345) = 2.54$, $p = 0.56$]. There was a statistically significant difference in participants' PSQI scores by the time of performing vigorous activity [$F(3, 346) = 10.45$, $p < 0.001$]. The Tukey post hoc test showed that participants who performed vigorous physical activity in the evening were more likely to have a poorer sleep quality (7.83 + 4.25) compared to those who performed vigorous physical activity in the morning (6.23 ± 3.59, $p = 0.03$) or afternoon (4.93 ± 3.07, $p < 0.001$) (Table 4).

Time of Moderate Physical Activity, Psychological Well-Being, and Sleep Quality

Results of the ANOVA test showed that there was a statistically significant difference in participants' PSQI scores by the time of performing moderate physical activity [$F(3, 346) = 3.96$, $p < 0.001$]. The Tukey post hoc test showed that participants who performed moderate physical activity in the afternoon (5.51 ± 3.60, $p = 0.00$) were more likely to have better sleep quality compared to those who did not perform any moderate physical activity (7.23 ± 3.11) (Table 4). No between group differences were observed in psychological well-being by the time of performing moderate physical activity.

Time of Light Physical Activity, Psychological Well-Being, and Sleep Quality

Results of the ANOVA test showed no between group differences in psychological well-being by the time of performing light physical activity. There was no statistically significant difference in the PSQI mean scores by the time (i.e., morning, afternoon, evening, none) of performing light physical activity.

Table 2. Descriptive results of the International Physical Activity Questionnaire

Question	N	Measurement	Time of day (n = 350)			
			Morning	Afternoon	Evening	None
Vigorous physical activities			76 (21.7)	83 (23.7)	86 (24.6)	105 (30.0)
During last 7 days (days/week)	350	2.19 ± 2.05 (0–7)				
Time spent (min/day)	346	39.55 ± 41.92 (0–180)				
Moderate physical activities			74 (21.1)	89 (25.4)	72 (20.6)	115 (32.9)
During last 7 days (days/week)	348	1.87 ± 1.94 (0–7)				
Time spent (min/day)	339	42.13 ± 55.25 (0–180)				
Light physical activities: walking at least 10 min			135 (38.6)	83 (23.7)	104 (29.7)	28 (8.0)
During last 7 days (days/week)	350	4.25 ± 2.42 (0–7)				
Time spent in walking (min/day)	343	56.22 ± 55.57 (0–300)				

Data are presented as mean ± standard deviation (range) or n (%).

DISCUSSION

This study was conducted to examine the relationship between the time of physical activity (i.e., morning vs. evening), sleep quality, and psychological well-being among healthy adults living in the UAE. Results of this study revealed that there was no significant relationship between the time of performing any level of physical activity (i.e., light, moderate, vigorous) and psychological well-being. On the other hand, this study revealed that participants who reported performing vigorous physical activity in the evening were more likely to have poor sleep quality compared to those who reported performing physical activity in the morning or afternoon.

Findings from this study showed that there was a significant relationship between the time of performing vigorous physical activity and sleep quality (i.e., participants who reported performing vigorous physical activity in the evening had higher overall PSQI scores and thus poorer sleep quality compared to those who performed vigorous physical activity in the morning or afternoon). This finding is consistent with the previous research, which showed that vigorous physical activity in the evening may negatively affect the sleep quality among healthy adults and athletes [14,15]. Exercise is associated with increased stimulation of the sympathetic nervous system and thus the release of stress hormones (i.e. catecholamines) leading to several physiological changes, including increased heart rate, blood flow, muscle tension, and alertness [21,22]. These physiological changes are even more intensified with an increased intensity of physical activity (i.e., vigorous physical activity). Thus, when performed late in the evening, as observed among the study participants (i.e., less than 4 hours before bedtime), vigorous physical activity can disrupt the sleep duration and quality. Further, it has been shown that high intensity exercise can lead to nocturnal hypoglycemia, night sweats, and headaches, which cause individuals to wake up at night [23]. On the other hand, this study finding is contrary to that in several studies and metanalyses, which showed that vigorous evening exercise does not have a negative effect on the sleep quality [15,24]. One plausible explanation for this discrepancy is that participants in this study performed vigorous exercise in the late evening (i.e., less than 4 hours before bedtime) in comparison to those in the other studies who performed vigorous physical activity in the early evening. In addition, the majority of participants included in this study reported a habit of bedtime procrastination (i.e., going to bed late), which could interplay with performing evening vigorous activity and further negatively affect their sleep quality [25].

Females and young participants (i.e., 18–24 years old) reported poorer sleep quality compared to males and participants in the other age groups. Gender variations, particularly, poorer sleep quality and more prevalent insomnia among women is well documented in the literature [26,27]. Several factors have been cited to explain the higher prevalence of sleep disturbances in women. These include hormonal changes, menstruation, pregnancy, women's higher vulnerability to depression and anxiety disorders, restless leg syndrome, and social stress [27]. The current study finding, that participants who were 18–24 years of age had poorer sleep quality compared to older participants, is consistent with that of several previous studies. Excessive use of smartphones and social media, academic stress, excessive caffeine consumption, and bedtime procrastination have been reported among younger adults, including university students in the UAE [28], and it may explain the higher prevalence of poor sleep quality in this age group.

Benefits of physical activity on the physical and mental health and quality of life have been well established in the literature. Although the majority of the study participants reported being physically active, a noticeable minority (i.e., 15%) reported not performing any moderate or vigorous physical activity; thus, not meeting the international recommendations for physical activity in adults. Efforts to promote community awareness of the benefits of physical activity on the physical and psychological health should be advocated more. Such efforts may include school

Table 3. Pittsburgh Sleep Quality Index (PSQI) descriptives

Items	Value (n = 350)
Sleep quality	
Very good	83 (23.7)
Fairly good	186 (53.1)
Fairly bad	59 (18.9)
Very bad	22 (6.3)
Sleep onset latency	
No difficulty	64 (18.3)
Slight difficulty	120 (34.3)
Moderate difficulty	120 (34.3)
Severe difficulty	46 (13.1)
Sleep duration	
More than 7 hours	218 (62.3)
5 to 7 hours	95 (27.1)
Less than 5 hours	37 (10.6)
Sleep efficiency	
> 85%	261 (74.6)
75%–84%	37 (10.6)
65%–74%	27 (7.7)
< 65%	25 (7.1)
Sleep disturbance	
Not during in the past month	28 (8.0)
Less than once a week	190 (54.3)
Once or twice a week	127 (36.3)
Three or more times a week	5 (1.4)
Use of medication	
Not during in the past month	220 (62.9)
Less than once a week	86 (24.6)
Once or twice a week	18 (5.1)
Three or more times a week	26 (7.4)
Daytime dysfunction	
Not during in the past month	110 (31.4)
Less than once a week	100 (37.1)
Once or twice a week	88 (25.1)
Three or more times a week	22 (6.3)

Values are presented as n (%).

and youth programs, workplace policies, and facilities (e.g., gyms and showers) to promote employees' participation in physical activity, and community-wide awareness campaigns (e.g., mass media campaigns). In a country like the UAE known for its extremely hot and humid weather, access to indoor places for physical activity (e.g., recreation centers and gyms with free or reduced membership cost) is paramount. Further, this study has shown that there was a negative relationship between evening physical activity and sleep quality; thus, it would be necessary that such awareness campaigns involve an educational message on the importance of avoiding vigorous physical activity for 1 hour or less before sleep time.

Poor sleep quality was prevalent among a significant proportion of participants involved in our study (i.e., 32.3% poor sleepers). It is therefore crucial to design interventions aimed to raise awareness among the Emirati population, especially among young Emirati nationals (18–24 years), on the importance of getting enough night time sleep, sleep hygiene, and avoiding bed-time procrastination. No significant relationship was observed between the time of physical activity and psychological well-being in this study. This result is not congruent with the majority of other relevant studies, which reported a positive association between enhanced psychological well-being and physical exercise [11,29]. This difference could be explained by the limited variation in the psychological well-being among the study participants, as an overwhelming majority of them reported excellent phycological well-being (i.e., a mean psychological well-being score of 48.5).

Limitation

There are several methodological limitations to this study that should be considered in future research. First, as convenience sampling was used, the study sample might not be representative of the population of healthy adults living in the UAE, which may threaten the generalizability of the study results. Second, as with all self-report methods of data collection, response set bias is a possibility (e.g., inaccurate recall of physical activity intensities and types, sleep quality, and the possibility of having a primary sleep disorder, such as sleep apnea, etc.), which may threaten the internal validity of the study. Third, this study was a cross-sectional study, and no information on the temporal association between the time of physical activity and sleep quality and psychological well-being was available. Thus, this study cannot provide evidence of the cause-and-effect relationship between the time of physical activity and sleep quality or psychological well-being. Thus, to overcome the methodological limitations of the current study, it is recommended that future research should recruit a large random sample of healthy adults living in the UAE. More objective methods of measuring the sleep quality (e.g., actigraphy) should be utilized in future research to provide more support to the findings of the study. Finally, to make causal inferences on the relationship between the time of physical activity, sleep quality, and psychological well-being, a future longitudinal study is needed.

Conclusion

This is the first study in the UAE to study the impact of morning vs. evening physical activity on sleep quality and psychological well-being among healthy adults. This study revealed that there was a significant relationship between the time of performing vigorous physical activity and sleep quality; i.e., performing

Table 4. Differences in PSQI scores by time of moderate and vigorous physical activity

PSQI†	Time of moderate physical activity					
	Morning[a] (n = 74)	Afternoon[b] (n = 89)	Evening[c] (n = 72)	None[d] (n = 115)	p-value	Comparison
Global	6.61 ± 4.00	5.51 ± 3.60	6.97 ± 4.20	7.23 ± 3.11	0.008	d > b*
Comp. 1	1.15 ± 0.96	0.80 ± 0.74	1.11 ± 0.81	1.17 ± 0.71	0.006	a > b, d > b*
Comp. 2	1.35 ± 0.98	1.16 ± 0.97	1.49 ± 0.90	1.63 ± 0.84	0.003	d > b*
Comp. 3	0.58 ± 0.99	0.69 ± 1.00	0.65 ± 0.98	0.84 ± 1.00	0.351	-
Comp. 4	0.59 ± 0.99	0.30 ± 0.71	0.65 ± 0.13	0.42 ± 0.07	0.055	-
Comp. 5	1.24 ± 0.61	1.08 ± 0.64	1.38 ± 0.61	1.50 ± 0.59	<0.001	d > a, c >b, d > b*
Comp. 6	0.64 ± 1.00	0.49 ± 0.85	0.58 ± 0.88	0.58 ± 0.85	0.785	-
Comp. 7	1.05 ± 0.87	0.99 ± 0.91	1.11 ± 0.92	1.10 ± 0.90	0.811	-
	Time of vigorous physical activity					
	Morning[a] (n = 76)	Afternoon[b] (n = 83)	Evening[c] (n = 86)	None[d] (n = 105)	p-value	Comparison
Global	6.24 ± 3.50	4.94 ± 3.00	7.84 ± 4.20	7.19 ± 3.40	<0.001	c > a, b; d > b*
Comp. 1	0.99 ± 0.84	0.77 ± 0.65	1.19 ± 0.84	1.23 ± 0.81	<0.001	b < c, d*
Comp. 2	1.41 ± 0.89	0.88 ± 0.87	1.71 ± 0.95	1.63 ± 0.81	<0.001	a > b; b < c, d*
Comp. 3	0.53 ± 0.93	0.54 ± 0.94	0.80 ± 1.10	0.90 ± 1.00	0.030	-
Comp. 4	0.42 ± 0.80	0.22 ± 0.62	0.80 ± 1.10	0.45 ± 0.86	<0.001	c > a, b, d*
Comp. 5	1.28 ± 0.64	1.07 ± 0.65	1.44 ± 0.62	1.42 ± 0.56	<0.001	b < c, d*
Comp. 6	0.59 ± 0.88	0.51 ± 0.84	0.60 ± 0.91	0.58 ± 0.92	0.890	-
Comp. 7	1.03 ± 0.93	0.95 ± 0.77	1.29 ± 0.93	0.99 ± 0.92	0.056	-

Scores are presented as mean ± standard deviation.
*Tukey post-hoc test; †PSQI components: Comp. 1, subjective sleep quality; Comp. 2, sleep latency; Comp. 3, sleep duration; Comp. 4, sleep efficiency; Comp. 5, sleep disturbances; Comp. 6, use of sleeping medications; Comp. 7, daytime dysfunction.
PSQI, Pittsburg Sleep Quality Index.

vigorous activity in the evening negatively affected the sleep quality. The study further showed that there was no significant relationship between the time of physical activity and psychological well-being among healthy adults living in the UAE. Poor sleep quality was prevalent among study participants, especially females and younger ones.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Author Contributions

Conceptualization: all authors. Data curation: all authors. Formal analysis: Rana F. Obeidat. Investigation: all authors. Methodology: all authors. Project administration: all authors. Writing—original draft: all authors. Writing—review & editing: Rana F. Obeidat.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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