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Exploring the physical activity level and sleep quality among a cohort of healthy females in Egypt: a cross-sectional survey

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Abstract. – OBJECTIVE: In healthy adults, the short-term effects of sleep disruption include disorders of mood, impaired coping ability, deficits in cognition, and reduced quality of life. Increased physical activity may improve sleep duration and quality. The aim was to investigate the physical activity level and sleep quality and their relationship among a cohort of healthy females in Egypt.

PATIENTS AND METHODS: We conducted a cross-sectional, self-reported survey. 688 healthy young adult females aged 18-45 years without a prior history of chronic disease were recruited for this study. Demographic data as well as physical activity (International Physical Activity Questionnaire) and sleep quality (Pittsburgh Sleep Quality Index) were collected.

RESULTS: 73.5% reported poor sleep quality, which was worse for housewives. 50.4% of participants were either obese or overweight. Approximately 29.7% of the participants were physically inactive. High physical activity levels were associated with higher sleep efficiency compared to moderate physical activity (*p*=0.01). However, high physical activity resulted in poorer sleep quality overall (*p*=0.001).

CONCLUSIONS: The majority of participants reported poor sleep quality and high levels of physical activity, but the relationship between physical activity and sleep quality was not clear. Poor sleep quality in our study is one of, if not the highest, reported in the literature for a similar age range in females.

Key Words:
Physical activity, Sleep quality, Female, Arab, Middle-aged.

Introduction

Sleep has essential restorative functions, accounting for nearly one third of our lifespan[1]. Sleep disorders are common, and the six major types are insomnia, circadian rhythm disorders, sleep apnea, narcolepsy, parasomnias, and restless leg syndrome[2]. Adults with sleep disturbances often complain of difficulty in initiating sleep and then maintaining it, and morning awakening[2]. Women experience more sleep disturbances than men[3], and have a higher prevalence of restless leg syndrome, insomnia, and sleep dissatisfaction[4].

The National Sleep Foundation's "Sleep in America" highlighted that 27% of all women complained of poor sleep quality[5], but this was higher in pregnancy (30%) and the postpartum period (42%)[6]. In healthy adults, the short-term effects of sleep disruption include disorders of mood, increased somatic pain, impaired coping ability, deficits in cognition, memory, and performance, and reduced quality of life. In the long-term, the effects on healthy adults include diabetes type 2, metabolic syndrome, cardiovascular disease, and colorectal cancer[7]. In women, duration of sleep is an independent risk factor for all-cause mortality[8]. There are a variety of factors that interact to cause sleep disturbances, including the ageing process, health factors (e.g., obesity, hypertension, type 2 diabetes, neurological disorders, and non-can-

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cerous gynecological disorders), lifestyle (e.g., smoking, alcohol, and caffeine intake), gender differences, depression, and physical inactivity[7-9].

Medication has been a primary intervention to reduce sleep disturbances and improve sleep quality. However, they are not always effective[2,10]. Among the non-pharmacological approaches, cognitive behavioral therapy and increased physical activity (PA) may improve sleep duration and quality for adults[10,11]. When done regularly, moderate (not intense) exercise improves the quality of sleep[12,13] and is linked to fewer sleep disorders[14]. Walking is an inexpensive, safe, and simple intervention that does not require trained professionals. There is some evidence[15] to suggest that when performed daily, it improves sleep quality, particularly in middle-aged people, whether they are physically active or inactive.

More broadly, there is evidence[16] of a bi-directional relationship between PA and sleep quality, even with objectively measured PA, as well as sleep quality and quantity. In Egypt, the prevalence of sleep disorders has been reported as 13-28% for college students[17], and 33% for elderly people[18].

Patients and Methods

In this cross-sectional study, healthy females were recruited by convenience sampling. Data was collected between December 2017 and April 2018 at Cairo University, Egypt. Approval for this study was granted (P.T.REC/012/001948) by the Ethical Committee of the Physical Therapy Faculty, Cairo University. Subjects were recruited from Cairo University with the following inclusion criteria: females between 18-45 years old and without prior history of chronic disease. Exclusion criteria were the presence of any condition that limited physical activity or movement. Following written consent, subjects were invited to complete the self-administered questionnaires.

Demographic Characteristics

This section included 15 questions focused on sociodemographic and individual characteristics, including age, occupation, and amount of junk food consumption. Self-reported body weight and height were utilized to determine the Body Mass Index (BMI; kg/m^2), which was then compared against standardized BMI categories (underweight, normal, overweight and obese)[19].

Physical Activity

The long form of the International Physical Activity Questionnaire (IPAQ) is a reliable and valid tool for determining physical activity in adults during the previous seven days[20-22]. It captures data across a wide range of areas, including work, transport, domestic, gardening, and leisure physical activities (PA). Weekly physical activity [Metabolic Equivalent Tasks (METs)-min per week] was calculated as the total of walking (3.3 METs), and moderate (4 METs) as well as vigorous (8 METs) physical activity[23]. A weekly PA of > 3000 MET-minutes/week was considered highly active, and > 600 MET-minutes/week was moderately active[24].

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI) is the most widely used, self-rated assessment of sleep quality as well as sleep disturbances over one month[25]. It has strong validity and reliability and moderate structural validity in a variety of samples, suggesting the tool fulfils its intended utility[26]. The questionnaire consists of nineteen questions to gather informational data for seven sleep component scores. These component scores (quality, latency, duration, efficiency, disturbances, daytime dysfunction, and intake of sleep medications) produce one overall score between zero and 21; a score > five points is related to poor sleep quality[25].

Study Sample Size

This study was one arm of a larger project assessing premenstrual syndrome (PMS) among Egyptian females[27]. Hence, sample size calculation was based on the prevalence of PMS and determined as n=769 using the following calculation: n=z 2× (1 − p)/d 2; n= sample size required, z=confidence level at 95% (standard value of 1.96), p=estimated prevalence of PMS in the study (50%) and d=margin of error at 5% (standard value of 0.05). A total of 768 women were recruited. Any participants with missing data for physical activity or sleep quality index were excluded.

Statistical Analysis

Data were encoded to ensure participant anonymity. Statistical tests were conducted with SPSS Statistics, version 23.0 (RRID: SCR_002865) (IBM Corp., Armonk, NY, USA). Continuous variables, including age, weight, and height, were reported using means and standard

Table I. Demographic characteristics and physical activity levels of study subjects based on their sleep quality.

		Good sleeper (n=182)	Poor sleeper (n= 506)
Occupation	Student	129	290
	Housewife	15	80
	Other	38	136
BMI	Overweight or obese	82	265
	Normal or underweight	100	241
Age	<20 years	23	72
	20-30	129	286
	30-40	26	116
	>40 years	4	32
No. of children	0	4	6
	1	5	19
	2	18	56
	3	7	63
	4	2	22
	5	2	6
	6	2	1
	9	0	2
IPAQ	Inactive	63	141
	Moderately active	57	151
	High active	59	210

deviations. Correlations were performed between PSQI, IPAQ, and BMI. Multiple linear regression models were applied to determine the effect of demographics as well as anthropometrics (including age, occupation, number of children, and BMI) on IPAQ and PSQI. A one-way ANOVA and a Tukey post-hoc test were conducted to compare different PA levels with the PSQI. Multiple linear regression models were also used to find out how PSQI (the dependent variable) and IPAQ (the independent variable) relate to each other.

Results

This study was completed with 688 females. The average age of the participants is 25.6 (7.7). The majority of the participants are single (67.2%), Egyptian (98.4%), students (60.8%). Approximately half of the participants (50.4%) are either obese or overweight (i.e., BMI is above 25). When it comes to sleep, 73.5% stated that they suffer from poor sleep (7.57±3.2), while 26.5% rated as good sleepers (1.7±0.4), as shown in Table I. The incidence among the poor sleeper was highest 9.56±3.8 among housewives with children (84%) and lowest 7.02±2.8 for students (69%) while others category (25.3%) showed similar score to the students with means values 7.7±3.0.

For physical activity, according to the IPAQ scoring guidelines, 29.7% of the participants stated that they are inactive with 39.9% being high active and the remaining being moderately active (30.2%).

There is a significant weak negative correlation between PSQI and IPAQ (*rho*=-0.157, $p<0.01$). There is also a significant weak positive correlation between BMI and PSQI ($r=0.119$, $p<0.01$).

One way ANOVA was applied to compare different components of PSQI and PA levels (inactive, moderately active or highly active). Sleep latency ($F=4.61$, $p=0.001$), Sleep efficiency ($F=3.53$, $p=0.01$) and Daytime dysfunction ($F=8.31$, $p=0.001$) are the only components that showed significant differences.

Post-hoc analysis showed for sleep latency, there was a difference between inactive and highly physically active, with highly active have a higher mean for sleep latency ($p=0.001$). For sleep efficiency there was a difference between moderately active and highly active, with highly active have a higher mean for sleep efficiency ($p=0.01$). For sleep disturbance there was a difference between inactive and highly physically active ($p=0.03$), and between moderately active and highly physically active ($p=0.003$). Finally, for daytime dysfunction, there was a difference between inactive and highly physically active ($p=0.002$), also between moderately active and high active ($p=0.001$), in both scenarios high physical activity had a higher mean (Table II).

Finally, the relationship between PSQI (Dependent variable) and IPAQ (Independent variable)

Table II. Post-hoc tests for different physical activity level with PSQI.

Dependent variable PSQI component	Independent variable IPAQ	Post-hoc comparison	Mean Diff	SE	Sig	95% CI Lower Bound	95% CI Upper Bound
PSQI overall Score	Inactive	Moderately active	-0.307	0.30	0.58	-1.03	0.41
		Highly active	-1.025*	0.29	0.001*	-1.70	-0.34
	Moderately active	Inactive	0.307	0.30	0.58	-0.41	1.03
		Highly active	-0.717*	0.29	0.03*	-1.40	-0.03
	Highly active	Inactive	1.02*	0.29	0.001*	0.34	1.70
		Moderately active	0.717*	0.29	0.03*	0.03	1.40
Subjective sleep quality	Inactive	Moderately active	0.062	0.079	0.70	-0.12	0.24
		Highly active	0.061	0.074	0.68	-0.11	0.23
	Moderately active	Inactive	-0.062	0.079	0.70	-0.24	0.12
		Highly active	-0.001	0.074	1.00	-0.17	0.17
	Highly active	Inactive	-0.061	0.074	0.68	-0.23	0.11
		Moderately active	0.001	0.074	1.00	-0.17	0.17
Sleep latency	Inactive	Moderately active	-.0129	0.104	0.42	-0.37	0.11
		Highly active	-0.344*	0.098	0.001*	-0.57	-0.11
	Moderately active	Inactive	0.129	0.104	0.42	-0.11	0.37
		Highly active	-0.214	0.098	0.07	-0.44	0.01
	Highly active	Inactive	0.344*	0.098	0.001*	0.11	0.57
		Moderately active	0.214	0.098	0.07*	-0.01	0.44
Sleep duration	Inactive	Moderately active	0.163	0.112	0.31	-0.10	0.42
		Highly active	0.001	0.105	1.00	-0.24	0.24
	Moderately active	Inactive	-0.163	0.112	0.31	-0.42	0.10
		Highly active	-0.162	0.105	0.27	-0.41	0.08
	Highly active	Inactive	0-.001	0.105	1.00	-0.24	0.24
		Moderately active	0.162	0.105	0.27	-0.08	0.41
Sleep efficiency	Inactive	Moderately active	0.028	0.106	0.96	-0.22	0.27
		Highly active	-0.258*	0.099	0.03*	-0.49	-0.02
	Moderately active	Inactive	-0.028	0.106	0.96	-0.27	0.22
		Highly active	-0.287*	0.099	0.01*	-0.52	-0.05
	Highly active	Inactive	0.258*	0.099	0.03*	0.02	0.49
		Moderately active	0.287*	0.099	0.01*	0.05	0.52
Sleep disturbance	Inactive	Moderately active	0.043	0.062	0.77	-0.10	0.19
		Highly active	-0.149*	0.058	0.03*	-0.28	-0.01
	Moderately active	Inactive	-0.043	0.062	0.77	-0.19	0.10
		Highly active	-0.192*	0.058	0.003*	-0.33	-0.05
	Highly active	Inactive	0.149*	0.058	0.03*	0.01	0.28
		Moderately active	0.192*	0.058	0.003*	0.05	0.33
Use of sleep medication	Inactive	Moderately active	0.052	0.083	0.80	-0.14	0.24
		Highly active	-0.104	0.078	0.37	-0.28	0.07
	Moderately active	Inactive	-0.052	0.083	0.80	-0.24	0.14
		Highly active	-0.157	0.078	0.10	-0.34	0.02
	Highly active	Inactive	0.104	0.078	0.37	-0.07	0.28
		Moderately active	0.157	0.078	0.10	-0.02	0.34
Daytime dysfunction	Inactive	Moderately active	0.033	0.104	0.94	-0.21	0.27
		Highly active	-0.335*	0.097	0.002*	-0.56	-0.10
	Moderately active	Inactive	-0.033	0.104	0.94	-0.27	0.21
		Highly active	-0.369*	0.097	0.001*	-0.59	-0.13
	Highly active	Inactive	0.335*	0.097	0.002*	0.10	0.56
		Moderately active	0.369*	0.097	0.001*	0.13	0.59

Mean Diff=mean difference; SE=standarad error; Sig=significance level; CI=confidence interval; *Significant difference as $p< 0.05$.

was investigated using multiple linear regression models after controlling for age, occupation, number of children and BMI. The data was tested for normality using P-Plots and the residuals(error) of the regression were found to be approximately normally distributed and the adjusted R-square is equal to 0.115. The results showed that PSQI is significantly affected by IPAQ ($p<0.01$), occupa-

Table III. Multiple linear regression of PSQI with IPAQ.

	Beta	t-value	*p*-value
IPAQ	.191	2.954	.004**
Age	.065	.829	.408
Occupation	-.221	-3.336	.001**
No. of children	.128	1.760	.080***
BMI	.108	1.565	.119

Correlation is significant at 0.01, *** Correlation is significant at 0.10**

tion ($p<0.01$) and weakly affected by number of children ($p<0.10$), as detailed in Table III.

Discussion

In this survey of predominantly Egyptian females between the ages of 18 and 45 years, 73.5% of participants reported poor sleep quality, and this was worse for housewives with children. 29.7% of the participants were physically active. The relationship between physical activity and sleep was not straightforward, with a weak negative correlation. High physical activity levels were associated with higher sleep efficiency compared to moderate physical activity. However, high physical activity resulted in poorer overall sleep quality compared to inactivity and moderate physical activity, specifically in terms of sleep latency, sleep disturbance, and daytime dysfunction. Moderate physical activity did not improve sleep quality compared to being inactive. 50.4% of the participants were overweight or obese, but this did not affect their physical activity.

To the best of our knowledge, the prevalence of poor sleep quality in our study sample of predominantly Egyptian females (73.5%) is one of the highest reported in the literature considering the age range. In the "Sleep in America" poll, poor sleep quality was reported by 27% of all women[5]. However, in Saudi Arabia, the prevalence was 59% for women aged 18 to > 57 years old[28]. In that study, one of the main risk factors for poor sleep was performing physical exercise four or more times per week. This is in broad agreement with our finding that high physical activity (> 3000 MET-min/week) results in poorer sleep quality overall[28].

On the other hand, it was reported that there was no association between vigorous physical activity and sleep quality or duration[29]. However, we found that it was associated with improved sleep efficiency. Moderate-vigorous intensity physical activity, particularly in the afternoon, has been reported to reduce sleep efficiency[30], but the current study did not collect data on the time of day for physical activity. We did not find a benefit of moderate physical activity compared to inactivity. This contrasts with the reported beneficial effects of regular moderate-intensity exercise on sleep quality[13]. However, other trials[31,32] have reported little, if any, improvements in sleep quality or objective measurements of sleep following exercise training. In the current study, the age range was 18-45 years (26±8 years), but we did not find that age was a factor in influencing the relationship between physical activity and sleep quality. One reason may be that 81% of our participants were in the age range of 20-40 years. In this regard, it has been reported[33] that the benefits of physical activity are most robust in middle-aged and elderly adults. Furthermore, the benefits of physical activity in adolescents and young adults are debatable[32].

It is essential not to ignore the housewife's job role, which has its own stresses. In our study, 84% of housewives had poor quality of sleep, and this is higher than reported by Mindell et al[34] who found that 72% of mothers in the Middle East had poor sleep based on the PSQI, compared to predominantly Asian (55%) and predominantly Caucasian (58%) countries/regions[35]. Furthermore, the number of children, especially younger children, affects the paternal quality of sleep; for example, each child < 2 years old is associated with 13 minutes less paternal sleep per day[36]. This agrees with our findings, as 31.6% of poor sleepers had between 1-4 children, while 17.6% of good sleepers had the same number of children.

University life is stressful. This was noted as poor quality of sleep (69%) amongst students, which was higher than what was previously reported as Egypt (28%)[17] and the United Arab Emirates (31%)[37]. More broadly, the prevalence is double that reported by Pengpid and Peltzer[29] in a study of 18211 undergraduate students, from across 26 countries. However, in our sample, the mean age was 5 years higher and 33% had one or more children; these factors may explain the higher prevalence of poor sleep quality[34,36].

In the WHO's STEPS survey, the prevalence of physical inactivity in Egyptian females aged 15-69 years was 28%[38], and this did not change according to the current findings of 29.7% reported as being physically inactive. However, the prevalence of inactivity in other Arab countries exceeds 40%, and as much as 68% in Saudi Arabia, and is higher in females compared to males[39]. While physical (e.g., hot weather and an unfriendly built environment) and social barriers (e.g., preference for social gatherings as leisure activities and lack of social support) are common themes that drive physical activity in the Arab regions, the lower physical inactivity amongst Egyptian women is positive and the reasons for this should be explored further.

Half of the people in our sample were overweight or obese. This is less than what was said before, when 74% of people were considered overweight or obese[38]. The fact that almost two-thirds of the people in the current sample were moderately or very active may explain why this number went down.

Strengths and Limitations

This study addresses the gap in knowledge about sleep quality among women in Egypt. It also looks at the link between how well you sleep and how active you are, which is still up for debate and needs more research.

Ideally, we would have utilized cluster sampling to ensure fair representation of all age groups and occupations. However, we were limited by our ability to recruit participants. The PSQI and IPAQ questionnaires represent valid and reliable instruments for assessing sleep quality and PA level, respectively. However, there is the risk of biased answers or misinterpretation by participants. Alternatively, objective methods of measuring physical activity and sleep could be recommended for future research.

Conclusions

In this survey, 73.5% of participants reported poor sleep quality, which is one of the highest reported in the literature for a similar age range. Sleep quality was worst for housewives with children. Although two-thirds of the participants were physically active, the relationship with sleep was not straightforward. The only significant association was between high physical activity levels and higher sleep efficiency. One positive finding was that a third of the participants were physically inactive, which is relatively low compared to other Arab countries. We suggest that the reasons should be explored further.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Authors' Contributions

D.M.K., S.A.T., and S.H.E. designed the study. A.H.B., N.A., H.Z., and W.K.A. assisted with the design of the study and collected the data. N.A, D.M.K., S.H.E., and W.K.A. analysed the data. D.M.K. and S.A.T. wrote the first draft of the manuscript. E.R., S.H.E., W.K.A. and D.M.K. revised the manuscript critically for intellectual content. All authors reviewed the manuscript and approved the final submitted version.

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Availability of Data

The data collected and analyzed in the present study are available from the corresponding author upon request.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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