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Effect of 12-week pilates exercises on sleep quality, stress levels and fatigue in college students

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Abstract

This research aims to determine the effectiveness of 12-week Pilates exercises on sleep quality, stress levels, and fatigue among students. The research method was quasi-experimental with a posttest-only approach and a control group design. The research subjects consisted of 100 male students with an average age of 20.72 ± 0.78 years old, height 170.32 ± 4.15 , weight 56.59 ± 1.42 , and BMI 21.16 ± 1.32 . The research results indicated that the experimental group had a lower average stress level, longer sleep duration, and a lower level of fatigue marked by the three components compared to the control group. Hence, these results have confirmed that the benefits of 12-week Pilates exercises could reduce stress levels, improve sleep quality, and reduce fatigue levels.

Keywords: Sleep quality, pilates, stress level, fatigue

1. Introduction

Sleep is a vital physiological process for maintaining physical and mental health (Jones *et al.*, 2020) ^[11]. Poor sleep quality and quantity can cause serious health problems (Chen *et al.*, 2020a) ^[5]. Recently, some research revealed that 8.3% of Shanghai residents (Wu *et al.*, 2020) ^[20], 42.5% of the labor population in Singapore (Visvalingam *et al.*, 2020) ^[19], and 75% of undergraduate nursing students in the United States surveyed experienced sleep problems such as delayed sleep, difficulty falling asleep, sleep disturbances, and excessive daytime sleepiness (Zhang *et al.*, 2018) ^[23]. Poor sleep quality is commonly associated with health problems such as decreased physical performance and excessive energy intake, which causes obesity, cardiovascular disease, decreased academic performance, increased anxiety, depression, and increased risk of other psychiatric disorders (Park *et al.*, 2021) ^[16].

However, adequate sleep is curative and can reduce fatigue levels, thus allowing individuals to carry out daily activities (Yigitalp & Aydin, 2021) ^[22]. In addition, excessive fatigue can cause cognitive decline, including problems with concentration, memory, and decision-making (Abdali *et al.*, 2020) ^[1]. A study reported that 19.8% and 67.2% of Iranian students experienced moderate to high fatigue, significantly impacting performance and academic performance (Sajadi *et al.*, 2018) ^[17]. Moreover, another health problem experienced by adolescents is high levels of stress. Research revealed that prolonged stress could cause hypertension and increase the risk of coronary heart disease, reproductive system disorders, stroke, and mental disorders, which impacted suicide rates among adolescents and adults (Dar *et al.*, 2019) ^[7]. Therefore, managing stress, keeping the body fit, and sleep quality are vital to exploring safe, effective, and economical methods to overcome these problems.

Physical exercise is a method or strategy that can be used to improve mental and physical health (Oliva-Lozano & Muyor, 2020) ^[15]. Pilates is a form of physical exercise focusing on muscle strengthening, flexibility, and body balance (Amzajerdi *et al.*, 2023) ^[3]. These exercises combine practical movements and ideas from gymnastics, martial arts, yoga, and dance with philosophical ideas based on six fundamental principles: concentration, control, centering, fluid movement, precision, and breathing (Eliks *et al.*, 2019) ^[9]. Some research emphasized that Pilates could provide benefits for mental and physical health, including improving sleep quality (McNeil & Davidson, 2021) ^[13], reducing stress (Fleming *et al.*, 2019)

[10], treating chronic diseases (Ohayon, 2002) [14], and reducing fatigue (Dritsa *et al.*, 2008) [18].

Notably, adolescence is an essential period in human development marked by significant physical, emotional, and social changes. One of the health problems that adolescents often face is sleeping disorders, high levels of stress, and fatigue. These disorders can negatively impact adolescents' academic performance, mental health, and quality of life. Therefore, effective interventions are needed to overcome this problem. Even though the benefits of Pilates exercises are well documented, researchers have not found any studies on the effects of Pilates exercises on sleep quality, stress levels, and fatigue in adolescents in Indonesia. Thus, this research aimed to determine the effectiveness of Pilates exercises on sleep quality, stress levels, and fatigue in adolescents in Indonesia.

2. Material and Method

This research employed a quasi-experimental method with a posttest-only approach with a control group design. This method was intended to collect data at a particular time to determine a relationship between the independent variable (Pilates exercise) and the dependent variable (Sleep quality, stress level, and fatigue level). Data collection was carried out in January-March 2024. The researchers only compared the *post-test* data results between the two groups (Experimental and control) after all participants had completed the exercise program for 12 consecutive weeks.

2.1 Participants

The total subjects in this research were 100 male students, consisting of 50 students (Experimental group) and 50 students (Control group). All subjects were collected based on the inclusion criteria, namely being in good health, not smoking, not consuming alcohol, not under the influence of drugs, and not having a history of mental disorders. Unqualified Participants on inclusion criteria would be excluded from this research.

2.2 Measurements and Research Procedures

2.2.1 Anthropometrics

Subject age data was collected using a questionnaire distributed to all subjects during the test. Then, body height was measured using a GEA HT721 digital stature meter: the subject stood upright near a wall, then, set the digital height measuring device at the top of the subject's head. Meanwhile, Omron Karada Scan brand scales measured weight and body mass index (BMI).

2.2.2 Pilates Exercise

Pilates exercise was carried out for 12 consecutive weeks with a frequency of three times a week. In these 12 weeks, the experimental group implemented Pilates exercises three times a week for 1 hour. Each session began with a 15-minute warm-up, followed by 30 minutes of strength training and stretching movements, and ended with a 15-minute cool-down. A trainer supervised the entire series of Pilates exercises, and each exercise started from 07.00 - 08.00 a.m. Meanwhile, the control group was not required to exercise for 12 weeks.

2.2.3 Sleep Duration

Sleep quality could be measured by ascertaining the participant's daily sleep duration. All groups were required to self-report daily sleep duration during the activity. Daily sleep duration was assessed by weighting weekdays and weekend

days with a ratio of 5:2 (i.e., daily sleep duration on weekdays got five points) + (Sleep duration on weekend days got two points), then divided by the number seven. The guidelines for good adolescent sleep duration recommended sleeping 8-10 hours/day. Participants were classified into two groups for each movement behavior: "met guidelines" and "did not meet guidelines" (Paruthi *et al.*, 2016) [24].

2.2.4 Mental Health

Data collection on stress levels among students was measured using the *Perceived Stress Scale* (PSS) questionnaire. This questionnaire was recommended to help someone understand how the situation affected their feelings and stress (Son *et al.*, 2020) [18]. The questionnaire would ask about the subject's feelings and thoughts over the past month. In each case, subjects would be asked to indicate how often they feel or think in a certain way. Each answer would be scored on a scale of 1 to 4. Although some questions were similar, there were differences between them, and the subject had to answer all questions quickly without having to think for a long time. Calculating your stress level index was done by adding up all the scores obtained from ten questions, but for questions 4, 5, 7, and 8, the score changed to 0=4, 1=3, 2=2, 3=1, 4=0. Individual scores on the PSS could range from 0 to 40, with higher scores indicating higher perceived stress. A score of 0-13 would be considered low stress, 14-26 would be moderate stress, and a score of 27-40 would be high stress.

2.2.5 Fatigue

Fatigue data was collected using the multidimensional fatigue inventory (MFI-20) questionnaire. The questionnaire contained 20 items that assessed five dimensions of fatigue: general fatigue, physical fatigue, mental fatigue, decreased activity, and decreased motivation. Each section had a score ranging from 4 to 20. The total score for fatigue level was the sum of the five fatigue components (the total score ranges from 20-100). Higher scores indicated more severe levels of fatigue. However, in this research, the researchers only focused on general, physical, and mental fatigue.

2.2.6 Data Analysis

The research data were displayed in the form of average values and standard deviation. Anthropometric data such as age, weight, height, and BMI were tested using *one-way analysis* or one-way ANOVA to compare the two groups. Then, the stress level questionnaire, sleep duration, and fatigue were analyzed using a *paired t-test* to test the differences between the two groups after treatment. All statistical analyses employed the SPSS version 22 application with a significance level of $p < 0.05$.

3. Results

Both groups' Anthropometric data were presented as average values and standard deviations. The results indicated that the average age, weight, height, and BMI of both groups (Experimental and control) did not show any statistically significant differences (see Table 1).

Table 1: Anthropometric Data

Variable	Total (N=100)	Group		p-value
		Pilates (n=50)	Control (n=50)	
Age (years)	20.72±0.78	20.56±0.34	20.89±1.23	0.218
Weight (kg)	56.59±1.42	57.14±2.12	56.04±0.72	0.342
Height (cm)	170.32±4.15	170.48±5.21	170.17±3.10	0.089
BMI (kg/m ²)	21.16±1.32	21.59±1.63	20.73±1.02	0.107

Table 2 indicates that the experimental group had a lower average stress level, longer sleep duration, and a lower level of fatigue marked by the three components compared to the control group. Thus, the research results confirmed that the benefits of 12-week Pilates exercises could reduce stress levels, improve sleep quality, and reduce fatigue levels.

Table 2: Both Groups' Data on Stress Levels, Sleep Duration, and Fatigue

Variable	Total (N=100)	Group		p-value
		Pilates (n=50)	Control (n=50)	
PSS (Score)	26.06±8.11	24.72±9.14	27.41±7.09	0.001*
Sleep Duration	7.83±1.39	8.62±1.45	7.04±1.34	0.001*
General Fatigue	13.04±4.63	11.53±4.07	14.55±5.19	0.001*
Physical Fatigue	13.13±3.46	10.06±2.87	16.20±4.05	0.001*
Mental Fatigue	11.22±2.19	9.15±1.28	13.29±3.11	0.001*

4. Discussion

This research aimed to determine the effect of Pilates exercises carried out for 12 weeks on students' sleep quality, stress levels, and fatigue levels. After all groups performed treatment, the results indicated that the quality of sleep in the experimental group had a longer duration compared to the control group. In addition, Pilates exercises significantly reduced stress in the experimental group and reduced fatigue compared to the control group. An increased sleep duration could occur due to the relaxing effects and improved hormonal balance of Pilates exercises. Moreover, reducing stress levels might be related to the effects of meditation and concentration on Pilates exercises, which could help adolescents manage their stress. Meanwhile, reducing fatigue could be associated with increasing muscle strength and flexibility, which helps the body manage energy efficiently for daily activities.

Previous research revealed that 12-week Pilates exercises could significantly improve sleep quality among youth, inactive population (Leopoldino *et al.*, 2013) [12]. Another research also conveyed that after 8-week Pilates exercises, subjective sleep quality, daytime dysfunction, and global PSQI scores improved in postpartum primigravida women (Ashrafinia *et al.*, 2014) [4]. Furthermore, another study also reported that there was improved sleep quality in all domains after 12 weeks of Pilates exercises for 110 postmenopausal women (Aibar-Almazán *et al.*, 2019) [2]. Other research evidence also reported that 16-week Pilates exercises could improve PSQI total scores, sleep latency, and use of sleeping medication in older women (Curi *et al.*, 2018) [6]. Thus, this research has confirmed that the Pilates exercise program has become the most effective alternative for the health of the human body and could positively affect muscle mass and basal metabolism.

Therefore, physical activity is a therapeutic behavior that can improve fitness and affect a person's sleep quality (Chen *et al.*, 2020b) [5]. Pilates exercise can reduce the sympathetic nervous system, while parasympathetic nervous system activity can increase; hence, these physiological changes can cause many positive physical and mental effects (Yentür *et al.*, 2021). This research has provided concrete evidence regarding the benefits of Pilates exercises carried out for 12 consecutive weeks, which significantly impacted sleep quality, reduced stress levels, and reduced fatigue.

5. Conclusion

This research has confirmed that Pilates exercise could be an effective intervention to improve sleep duration, reduce stress

levels, and reduce fatigue in adolescents in Indonesia. Therefore, Pilates exercise programs are recommended and can be considered part of the physical education curriculum in high schools up to university level in Indonesia to improve adolescents' physical and mental health.

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7. References

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