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Stress and physical fitness among female university students who regularly exercise during the previous two months

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KEYWORDS
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Physical activity;
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ABSTRACT

University students, particularly females, are susceptible to stress affecting their health. Previous evidence suggested that regular exercise promotes good mental and physical health. Female physical therapy students of University of Phayao frequently contend with a challenging academic environment and a lack of daily physical activity. Thus, this study aims to compare stress levels, anthropometric indices, and physical fitness between the groups of female university students who regularly exercise (PE), and those who did not i.e., a non-physical exercise (non-PE) group. One hundred and one female university students, aged between 18-23 years were recruited. The participants were assigned into two groups regarding exercise history over the last two months before participation in this study, including a regular PE group (exercise > 3 days/week, n = 55) and a non-PE group (exercise < 3 days/week, or no exercise, n = 46). All participants were measured for stress levels via the Suan Prung Stress Test-60, including susceptibility to stress, sources of stress, and symptoms of stress. Then, they were assessed for body mass index, waist-to-hip circumference ratio (WHR), and body fat percentage. The grip and leg muscle strength and muscle flexibility were determined. Finally, the participants performed the Queens College step test to measure maximal oxygen consumption (VO_{2max}). Independent t-test or Mann-Whitney U test were used to compare all parameters between the two groups. A *p*-value < 0.05 was considered statistically significant. The results showed that the susceptibility to stress scores and WHR in PE group were significantly lower than non-PE group (*p*-value = 0.01 and 0.03, respectively). In addition, VO_{2max} in PE group were significantly higher than non-PE group (*p*-value = 0.02). The present findings suggested benefit of regular exercises among female physical therapy students who are vulnerable to stress, while they will be health professionals who are directly responsible to health promotion using exercises. The university or faculty may use strategies facilitating the students to engage in regular exercise programs that may promote their health, study outcomes, and awareness to positive exercise effects to be applied for their future patients.

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Introduction

University students, especially health sciences students, are vulnerable to stress from a number of factors such as difficult academic assignments, demanding responsibilities, and a competitive academic environment. Additionally, female university students reported greater stress than males[1]. Stress is defined as an imbalance between a person's expectations and their ability to cope[2] . Stress negatively affects mental health, including psychological functioning, happiness, and life satisfaction[3]. The previous study shows that academic stress leads to depression among students which negatively affecting their academic performance and learning outcomes[4]. Physical inactivity and sedentary behavior are also reported in the student population. These unhealthy lifestyles could lead to decreased physical fitness. Previous study reported that physical activity was positively associated with cardiorespiratory fitness, vital capacity, muscular strength, and flexibility among participants in the fit group of university students[5]. In addition, sedentary lifestyles or a deficiency in physical activity are risk factors for non-communicable diseases, such as hypertension, diabetes mellitus, and cardiovascular disease[6-8].

Physical activity (PA) is any activity which allows the body to expend more energy as a consequence of skeletal muscle contraction[8]. PA also refers to all movements performed during leisure time such as housework, and physical exercise. Regular moderate- to vigorous-intensity PA or physical exercise promotes both good mental and physical health[9,10]. Stress levels and PA are inversely associated. The previous studies revealed that stress was lower in the group with regular PA, particularly for women[11,12]. There is evidence that a decrease in PA leads a decrease in the oxygen transport capacity[13]. Exercise is a stressor on the body, and stress hormones may be reduced while endorphin levels are increased. These suppress pain perception and improve mood[14]. In other research, the impact of PA and exercise on lowering depression and anxiety levels was revealed[15,16].

The physical therapy students of the University of Phayao were the health science students who vulnerable to stress. In addition, most of them are female and had generally sedentary lifestyle. These factors might cause adverse effects on both physical and mental health, while they will be health professionals who are directly responsible to health promotion using exercises. The university or faculty may use strategies facilitating the students to engage in regular exercise programs that may promote their health, study outcomes, and awareness to positive exercise effects to be applied for their future patients. Therefore, the aim of this study was to compare the stress levels, anthropometric indices, and physical fitness between the female university students who reported regular physical exercise in the past 2 months and non-physical exercise group.

Materials and methods

Study design and participants

This retrospective cohort study was carried out during July to August 2022. The population in this study were 193 female physical therapy students from the Department of Physical Therapy, School of Allied Health Science, University of University of Phayao, Northern Thailand. We recruited the number of physical therapy students as much as we can. The inclusion criteria were healthy females aged 18 to 22 years, with no major adverse health conditions such as heart disease, asthma, hypertension, or myopathy. The participation flowchart is shown in Figure 1. After selection, the participants were subdivided according to the exercise history in the past 2 months into two groups, including the regular physical exercise (PE), and a non-physical exercise (non-PE) group. The PE group was fifty-five physical therapy students who performed exercise regularly such as walking, jogging, running, cycling, dancing, yoga, and weight training, for at least 30 minutes/session, 3 days per week over the previous two months prior to participation in this study. The non-PE group was forty-six physical therapy students who performed physical exercise less than 3 days per week or

did not perform any exercise. The participants received an explanation of the objectives and study protocols. All participants volunteered to participate and provided written informed consent before data collection began. The study was reviewed and approved by the Human Ethical Committee at the University of Phayao (protocol code UP-HEC 1.2/036/65 and date of approval, 1 July 2022), prior to data collection.

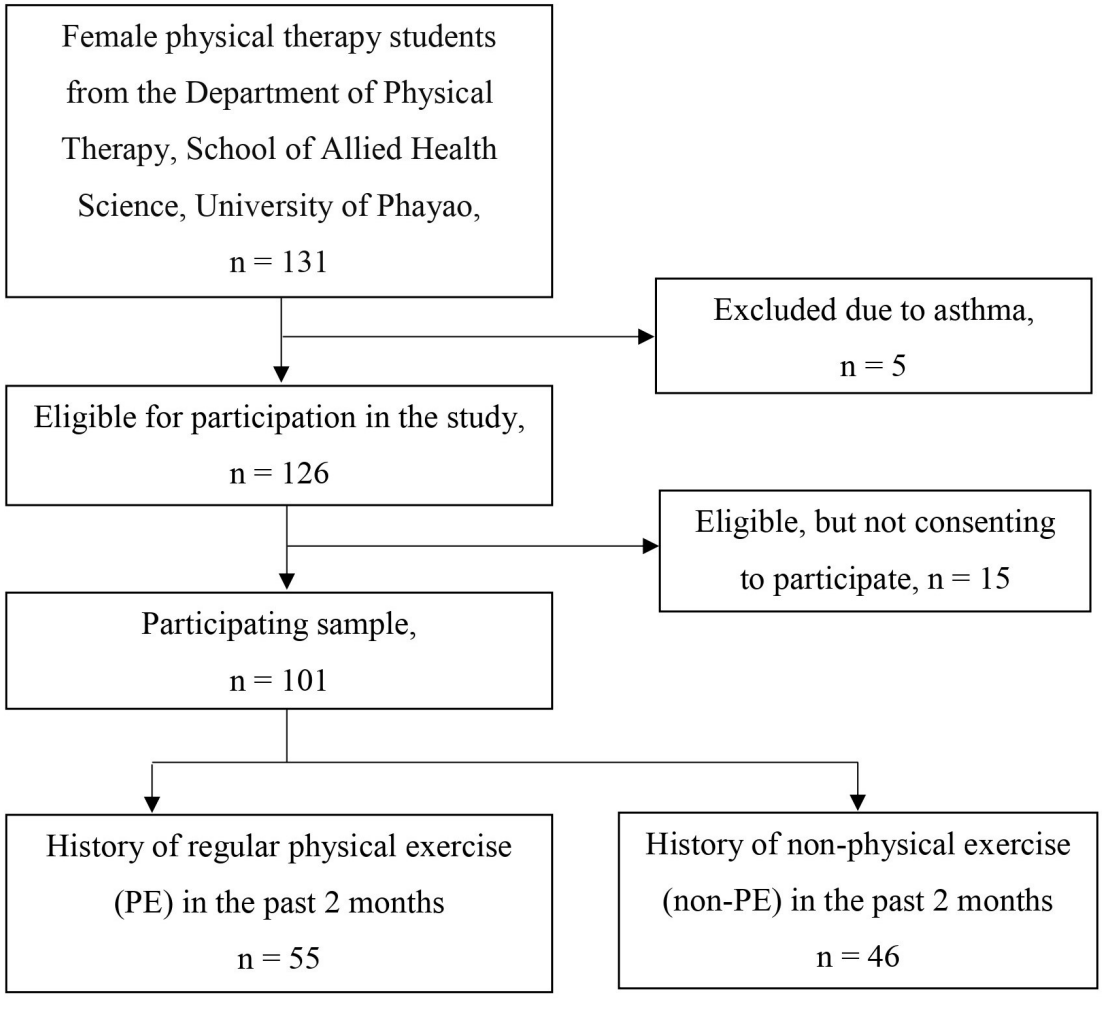


Figure 1 The participation flowchart.

Research protocols

The participants were completed two self-report questionnaires, one for their demographics (including age, underlying diseases, alcohol use, and cigarette smoking) and the participation in any exercise programs (i.e., frequency, duration, and types of exercise), and the other one for their stress levels using the Suan Prung Stress Test-60 (SPST-60). Then, anthropometric indices including body mass index (BMI), waist-to-hip circumference ratio (WHR), and body fat percentage, were measured. The participants were assessed for their muscular strength using grip, and back and leg dynamometers. For assessing their trunk flexibility, the participants were performed modified sit-and-reach test. Finally, the participants performed the Queens College step test for assessing their cardiorespiratory fitness.

Anthropometric indices, muscular fitness, and cardiorespiratory fitness were measured with two blinded assessors. The assessors were two physical therapy students who had received administration training from an experienced physical therapist. The first assessors evaluated BMI, WHR, body fat percentage, and trunk flexibility. The second assessors evaluated grip and leg muscle strength, and Queens College step test. Details of the measurements were explained below.

Suan Prung Stress Test-60

The SPST-60 is a widely accepted measure to indicate stress levels among Thai people[17]. The questionnaire comprises 60 items with the scores ranging from 1 to 5. This questionnaire presents Cronbach's alpha reliability > 0.7 and concurrent validity > 0.27 (statistically significant based on electromyography values at a 95% CI)[18]. The SPST-60 was designed to assess participants' stress levels from the prior six months. The scores of each item were separated into five categories based on the frequency of the event or symptom. The participants were given only one category in each item. In the susceptibility to stress aspect, the scales ranged from 1 = always occurs to 5 = never occurs (scoring rates were reversed for items 4-6). In the sources of stress and the symptoms of stress aspects, the scales ranged from 1 = no stress or never to 5 = very high stress or always occur. SPST-60 has three aspects as following.

Susceptibility to stress

The first aspect of SPST-60 consisted of 12 items. The questionnaire accessed daily activities which could affect stress levels in participated subjects. This section provided power of detecting the probability of susceptibility to stress. In this part, the stress level was quantified by numerical system where 1 means always occur (scored 1), 2 means often (scored 2), 3 means sometimes (scored 3), 4 means rarely (scored 4), and 5 means never (scored 5). The reverse rating systems were applied for items 4-6; smoking, alcohol consumption and taking sleeping pills or antidepressants. Total score was used for interpreting the stress levels ranging from mild (score 0-20), moderate (score 21-26), high (score 27-33), to severe (score > 33).

Sources of stress

This aspect provided data about sources of stress namely work or study, personal issues, family, social problems, environment, and financial issues (24 items in total). Conversely, for the sources of stress aspect, the participants scored 5 for the answer of very high stress, 4 for high, 3 for average, 2 for low, and 1 for no stress. A higher total score means higher stress. Total score was used for interpreting the stress levels from mild (0-36 scores), moderate (27-57 scores), high (58-79 scores), to severe (> 79 scores).

Symptoms of stress

The last aspect illustrated the symptoms of stress in terms of skeletal muscles, parasympathetics and sympathetics nervous systems, emotion, cognition, and the endocrine and immune systems (24 items in total). The participants scored 5 for the answer of always occur, 4 for often, 3 for sometimes, 2 for rarely, and 1 for never. Total score was used for interpreting the stress levels from mild (score 0-17), moderate (score 18-36), high (score 37-57), to severe (score > 57).

Anthropometric indices

The anthropometric indices including BMI, WHR, and body fat percentage were determined. Each participant's weight and height were measured to calculate BMI. Waist circumference was measured midway between the costal margin and the iliac crest at the end of inspiration. Hip circumference was measured as the largest value above the buttocks. Both waist and hip circumference were recorded in centimeters. Then, WHR was calculated by dividing waist circumference by hip circumference[19]. Body fat percentage was measured via the skinfold thickness technique (Lange skinfold caliper, Beta Technology, Santa Cruz, CA, USA) at four sites: the triceps, biceps, subscapular, and suprailiac crest[20].

Grip, and back and leg strength

The hand grip dynamometer was applied to evaluate grip strength (kilograms). Each participant performed the hand grip dynamometers (T.K.K 5001 Grip-A, Takei Scientific Instruments, Niigata, Japan) three times with a 1-minute rest

interval in between. Then relative strength was calculated by dividing the best grip-strength score by the participant's body weight (kilograms)[21]. To assess leg muscle strength, a back and leg dynamometer (T.K.K 5402 Back-D, Takei Scientific Instruments, Niigata, Japan) were used. The participants performed two trials of the back and leg dynamometer with a 1-minute rest interval. The best score of the leg muscle strength test (kilograms) was divided by the participant's body weight (kilograms) to determine relative strength.

Trunk flexibility

Trunk flexibility was assessed using a modified sit-and-reach with a standing trunk flexion meter (T.K.K. 5403 Flexion-D, Takei Scientific Instruments, Niigata, Japan). In this test, a yard stick was placed on top of a 12-inch sit-and-reach box. The most distant point of the fingertips on the yard stick was measured in inches[22].

Queens College step test

For cardiorespiratory fitness, the Queens College step test was used to measure maximal oxygen consumption (VO_2max). After three minutes of the step test, heart rates (beats per minute; bpm) were recorded. Then, the predicted VO_2max (milliliters/kilogram/minute; ml/kg/min) was calculated[23].

Two physical therapy students who had received administration training from an experienced physical therapist administered the tests. The first evaluator assessed BMI, WHR, and step test. Grip and leg muscle strength, and muscle flexibility were tested by the second assessor.

Statistical analysis

Descriptive statistics were used to explain demographic data and findings of the study. All data were tested for normally distributed pattern by the Kolmogorov–Smirnov test. Independent t-test or Mann-Whitney U test were used to compare the differences in SPST-60 scores, anthropometric indices, and physical fitness parameters between the two groups. *Chi* square test was used to examine the differences between categorical variables between both groups. A p-value < 0.05 was considered statistically significant. Following a statistical examination of the differences between the groups, G*Power was used to compute the power of the test of the findings in order to demonstrate the strength of the findings. We assessed the power of the tests of 0.80 as a standard for adequacy.

Results

Demographic characteristics of the PE group and the non-PE group

Table 1 shows demographic characteristics of the participants. The results showed that aerobic exercise was the most popular exercise for both groups (PE group = 76.4%, non-PE group = 30.4%).

Table 1 Demographic characteristics of participants in the regular physical exercise (PE) and non-physical exercise (non-PE) groups

Parameters	Non-PE group (n = 46)	PE group (n = 55)	*p*-value
Age[a]: years[#]	20.04 ± 1.33	19.98 ± 1.39	0.88
Alcohol use[c]: n (%)	5 (10.9)	9 (16.4)	0.43
Cigarette smoking: n (%)	0 (0)	0 (0)	
Underlying disease: n (%)	0 (0)	0 (0)	
Resting heart rate[a]: beat/minute[#]	80.41 ± 17.25	79.64 ± 9.51	0.51
Systolic blood pressure[b]: mm Hg[#]	111.78 ± 15.97	108.65 ± 13.96	0.30
Diastolic blood pressure[b]: mm Hg[#]	72.74 ± 11.93	70.24 ± 11.27	0.28
Type of Exercise			
- Aerobic (jogging, running, cycling)[c]: n (%)	14 (30.4)	42 (76.4)	0.00[*]
- Strengthening (gym weight)[c]: n (%)	1 (2.2)	2 (3.6)	0.67
- Flexible (yoga)[c]: n (%)	2 (4.3)	11 (20.0)	0.02[*]
- No exercise[c]: n (%)	29 (63.0)	0 (0)	<0.01[*]
Duration of exercise[b]: minutes[#]	14.34 ± 20.26	38.27 ± 10.54	<0.01[*]
Frequency of exercise[b]: days/week[#]	0.65 ± 0.89	3.76 ± 0.76	<0.01[*]

Note: [#] The data are presented as mean ± SD (95% confidence interval), and the data between regular physical exercise (PE) and non-physical exercise (non-PE) groups were compared using [a] the independent samples *t* test for data with normal distribution, [b] the Mann-Whitney U test for variables with non-normal distribution, and [c] the data are compared using the *Chi* square test. [*] significant difference between group, *p*-value < 0.05.

Stress levels among PE group and non-PE group

The participants' stress levels were assessed via the SPST-60. Table 2 shows the results of the comparison of stress scores between the PE group and the non-PE group. The results showed that the susceptibility to stress scores was significantly lower than non-PE group (*p*-value = 0.01).

Physical fitness tests

Table 2 shows the results of the comparisons of the anthropometric indices and physical fitness tests. The results showed that WHR in PE group were significantly lower than non-PE group (*p*-value = 0.03). In addition, VO_2max in PE group were significantly higher than non-PE group (*p*-value = 0.02).

Table 2 Comparison of SPST-60 scores, anthropometric indices, and physical fitness between the regular physical exercise (PE) and non-physical exercise (non-PE) groups

Parameters	Non-PE group (n = 46)		PE group (n = 55)		*p*-value
	Mean	SD	Mean	SD	
Susceptibility to stress (total 60 scores)[a]	27.72	5.37	25.04	5.14	0.01*
Sources of stress (total 120 scores)[a]	61.57	14.91	57.87	17.37	0.26
Symptom of stress (total 120 scores)[b]	49.33	15.65	46.58	14.69	0.41
BMI[b]: kg/m^2	21.77	5.44	21.70	3.77	0.46
WHR[b]	0.79	0.11	0.76	0.04	0.03*
Body fat[a]: percent	30.11	4.99	29.75	3.68	0.69
Forward back flexibility[b]: inch	7.60	4.74	7.95	4.45	0.45
Relative hand grip strength[a]	0.46	0.10	0.47	0.07	0.56
Relative leg strength[a]	1.10	0.41	1.12	0.28	0.71
VO_2max[b] (ml/kg/min)	39.09	3.29	41.05	4.78	0.02*

Note: The data between regular physical exercise (PE) and non-physical exercise (non-PE) groups were compared using [a] the independent samples *t* test for data with normal distribution and [b] the Mann-Whitney U test for variables with non-normal distribution. * significant difference between group, *p*-value < 0.05.

Discussion

In this study, we compared the stress levels, anthropometric indices, and physical fitness among female university students between the PE group, who reported the exercise history for at least 3 days/week before participating in this study, and the non-PE group, who had the exercised for less than 3 days/week, or not at all. Stress levels were assessed using the SPST-60, a questionnaire for measurement of stress in the Thai population. The results of this study demonstrated that the PE group had a significantly lower stress scores, as well as greater cardiorespiratory fitness and anthropometric indices than the non-PE group. In the present study, the average exercise duration and frequency of the PE group were 38.27 minutes and 3.76 days a week, respectively. These tended to be effective at lowering stress and promoting physical fitness in the PE group. The World Health Organization (WHO) recommends that all adults engage in moderate intensity exercise for 30 minutes a day of physical activity, 4 to 5 days a week, or at least 150 minutes a week to obtain health benefits. The exercise duration and frequency that the participants reported in this study are considerably less than this minimum recommendation[24]. However, the exercise duration and frequency of the PE group in the present study were consistent with the American College of Sports Medicine (ACSM) guidelines, which recommended that a minimal exercise program should consist of at least three 20- to 60-minute exercise sessions each week to develop and maintain cardiovascular fitness and reduce body fat[25].

Our results showed that the PE group had significantly lower outcomes in susceptibility to stress scores than the non-PE group (*p*-value = 0.01, actual power of test = 0.81). These findings tended to show that frequent physical activity was one of the most efficient ways to reduce stress in female university students. Our results corroborated those of a previous study, which found that an aerobic exercise program lasting eight weeks (1 hour/ session, 3 sessions/ week) led to a lower stress score in the experimental group compared to the control group[26]. In addition, de Camargo et al[11] reported that the lower the weekly

frequency of physical activity was, the greater the chances of experiencing stress were, especially for women[11]. Our results were also confirmed the findings in the previous studies that stated the relationships between low physical activity or sedentary lifestyles and high stress levels[12,27]. Nonetheless, stress level is affected by a number of factors which should be considered, including the amount of stress, the duration of its influence, genetic components, and patient history[28].

The results showed that the PE group had a lower mean WHR compared to the non-PE group (*p*-value = 0.03, actual power of test = 0.80). Moreover, the mean VO_2max was higher in the PE group than in the non-PE group (*p*-value = 0.02, actual power of test = 0.80). However, there were no significant differences in BMI or body fat percentage. As previously mentioned, the PE group exercised according to the ACSM recommendations (20–60 minutes per session, three days per week), which can improve and maintain cardiovascular fitness and reduce body fat[25]. As a result, the PE group improved their cardiovascular fitness and reduced their body fat in comparison to the non-PE group. According to our survey data, we found that aerobic exercise, such as jogging, running, and cycling, were the most popular activities in the PE group (76.4%). Regular aerobic exercise has been proven to help maintain the cardiovascular, locomotor, and nervous systems' working capacities[29,30]. Adequate cardiovascular fitness levels can lower obesity rates and total and central body fat[31,32]. Our results were consistent with a study of Milovan et al[37] who found a significant difference in VO_2max between the aerobic exercise training group and the control group among female college students. WHR is an anthropometric predictor of visceral or abdominal obesity while BMI and body fat percentage indicate overall obesity[33]. Additionally, it was discovered that WHR was linked to a higher chance of cardiovascular conditions like myocardial infarction[34]. According to reports, aerobic exercise with a moderate to high intensity has the best potential to decrease visceral fatty tissue[35]. The current research found a significant difference in WHR between the PE and non-PE groups, though not in BMI or body fat percentage. Our study was inconsistent with the previous study which discovered a significant decrease in body fat percentage, fat mass and visceral fat compared to the control group[36]. The PE group in the present study may have exercised at a lower intensity than those in the previous studies (57-90% HRmax). This might not significantly affect the PE group's BMI or body fat percentage compared to the non-PE group. Accordingly, we did not measure individual exercise intensity, which could have impacted the study findings. The present findings did not reveal any significant differences in muscle strength or flexibility. These may be due to the fact that the majority of participants in both groups engaged in aerobic activity, which appears to have had little impact on muscle characteristics. Nonetheless, some data suggests that aerobic exercise of moderate to high intensity led to mild declines in muscle strength[37]. Although the results of this study revealed the significant differences of WHR and VO_2max between the both groups, the results could be confounded by many factors, such as lifestyle, eating, health and personal behaviors of participants.

Our study had some limitations. First, aside from demographic traits, no known variables that influence stress levels have been identified. Second, the group arrangement was done according to the interview data which could affect the findings of the study. Finally, the SPST-60 was used for assessed the stress levels during the past six months, but the specific duration and length of exposure to chronic stress for each participant were not identified. All limitations should be considered when developing further studies. In addition, the different levels found in this study should be compared with clinical significance and standard measurement errors (SEM) of the raters and clinical significance (MDC).

Conclusion

Female university students who engaged in regular physical exercise had better control over their stress levels, WHR, and cardiorespiratory fitness than the non-physical exercise group. Therefore, it is important to encourage female

university students to engage in regular physical exercise. However, a number of factors, including individuals' personal behaviors, eating habits, and lifestyles, should be taken into consideration.

Take home messages

Regular physical exercise lasting at least 30 minutes, three days a week, for two months could control over stress levels, waist to hip circumference, and cardiorespiratory fitness.

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