Investigation of Physical Fitness and Anthropometric Profiles of International and National Physiotherapy and Rehabilitation Students

Gizem ERGEZEN SAHIN[1*], Sabiha Irem SANCAKTAR[2, 3] , Mustafa SAHIN[4]

Abstract

Introduction: Lack of physical activity (PA) increases chronic disease risk and reduces physical fitness (PF), posing a public health concern for young adults, including university students. This study aims to assess PA and PF levels in physiotherapy students and compare national and international students. *Methods and Materials:* A total of 122 healthy physiotherapy students (18-25 years) participated. PA levels were assessed using the International Physical Activity Questionnaire, and PF parameters, including flexibility, muscle endurance, balance, handgrip strength, and maximal performance, were measured. *Results:* Among participants, 57.5% had high, 38.3% moderate, and 4.2% low PA levels. International students performed significantly better in balance and maximal performance tests than national students (p<0.05), while other PF parameters showed no significant differences. *Discussion and Conclusions:* The findings show that there is a general similarity in PF levels between national and international students, but international students are superior in terms of balance and maximal performance. These results may indicate the influence of cultural, socioeconomic and environmental factors on PF.

Keywords: *anthropometry, physical fitness, physiotherapy, student*

Introduction

The World Health Organization's (WHO) definition of the term "physical activity" refers to all bodily movements produced by skeletal muscles that require energy expenditure [1]. According to WHO recommendations, adults should engage in at least 150–300 minutes of moderate-intensity or at least 75–150 minutes of vigorous-intensity aerobic physical activity (PA) per week. The recommended activity pattern is a combination of moderate- and vigorous-intensity activities. Aerobic exercises should be supported by muscle-strengthening exercises involving major muscle groups, performed at moderate or high intensity on at least two days per week [2].

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[1] Corresponding author; Physiotherapy and Rehabilitation Department, Health Science Faculty, Istanbul Medipol University, Istanbul, Türkiye; gergezen@medipol.edu.tr
[2] Physiotherapy and Rehabilitation Department, Graduate School of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye
[3] Physiotherapy and Rehabilitation Department, Health Science Faculty, Istanbul Aydın University, Istanbul, Türkiye
[4] Department of Surgical Medical Sciences, Division of Orthopedics and Traumatology, Faculty of Medicine, Istanbul Medipol University, Istanbul, Türkiye

A decrease in physical activity level leads to declines in health-related physical fitness parameters. This situation negatively affects factors such as cardiovascular capacity, muscle strength and endurance, body composition, and flexibility, thereby increasing the risk of developing various chronic diseases such as cardiovascular diseases, type II diabetes, and certain types of cancer. Physical inactivity and sedentary behaviors contribute to the increase in non-communicable diseases and place a burden on health systems [3]. The negative consequences of reduced physical activity are also reflected in the student population, and a decrease in physical activity may likewise lead to a decline in physical fitness [4].

Physical inactivity and sedentary behaviors are major public health problems, particularly among young adults such as university students who struggle to balance academic, work, and personal responsibilities [5]. Health-related physical fitness is also influenced by many other factors, such as body weight and socioeconomic status [4]. For example, individuals with low socioeconomic status experience lower levels of physical activity due to reduced access to parks and walkable neighborhood environments [4, 6, 7]. In addition, one of the most common negative external factors affecting physical activity in the student population is the lack of leisure time due to academic schedules and social and family obligations [4].

Physical fitness (PF) is a combination of cardiorespiratory fitness, body composition, muscular strength, muscular endurance, flexibility, balance, speed, and explosive power [8]. PF reflects an individual's ability to perform daily PA or physical exercise. However, PF can also indicate a person's current or future health status independently of PA. An increasing body of research has recently shown that PF is strongly associated with students' cognitive and academic performance [9]. Moreover, some studies conducted in different countries have shown that higher PA is associated with cardiorespiratory fitness, speed, and muscular strength [10–13].

In the study by Osipov et al., a standardized questionnaire was used to assess physical activity. The study concluded that participants with higher levels of physical activity had better physical fitness compared to those with lower activity levels [14]. However, some studies have shown that PA or sedentary behavior is not associated with PF [15–18]. Therefore, results should be interpreted with caution due to cultural differences, variations among faculties included in analyses, and differences in educational systems [5]. Because many students feel pressure during participation in academic activities and do not allocate time to physical activities, there is a need to determine the current physical activity and physical fitness status of university students. To our knowledge, there have been no previous studies comparing physical activity levels and physical fitness parameters in national and international physiotherapy students. Therefore, the aim of this study is to identify the current PA and PF levels of university students studying in the department of physiotherapy and rehabilitation and to compare national and international student profiles. The main hypothesis of the study is that there will be statistically significant differences in PA levels and PF parameters between national and international students as a result of the cultural and environmental differences they experience.

Materials and Methods

Type of Study

This research was designed as a descriptive and comparative cross-sectional study. In the study, the physical fitness and anthropometric profiles of national and international physiotherapy and rehabilitation students were evaluated and compared.

Population and Sample of the Study

The study included students aged 18–25 years who were studying at the 3rd-year level in the Department of Physiotherapy and Rehabilitation at Istanbul Medipol University; who had successfully completed the physical activity course; who met the inclusion criteria; who volunteered to participate in the study and signed the informed consent form; who had no physical or mental health problems that would prevent them from performing PA and PF tests; and who were healthy and physically active. Individuals with chronic diseases that prevented physical activity, acute injuries, or serious physical/mental health problems; individuals who were pregnant or had recently given birth; and individuals who were professional athletes or who regularly performed or had performed high-level sports due to not representing the general student population, as well as those who had experienced severe acute lower extremity injuries or head trauma, were excluded from the study.

Data Collection Tools

Demographic Information Form

The age, sex, height, body weight, and nationality of the students participating in the study were recorded. Body weight was measured using a digital scale with a sensitivity of ±0.1 kg, and height was measured barefoot using a portable stadiometer with a measurement range of 14–200 cm and a sensitivity of 0.1 cm. Body mass index (BMI) was calculated using the ratio of body weight in kilograms to the square of height in meters (kg/m^2) [19].

Waist–Hip Ratio

Waist circumference was obtained by wrapping a measuring tape completely around the body just above the umbilicus and recording the measurement in centimeters. Hip circumference was measured by wrapping the tape completely around the widest part of the hips and recording the measurement in centimeters. The waist–hip ratio was calculated by dividing the waist circumference by the hip circumference [20].

Participants' physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ); upper extremity flexibility was evaluated using the back scratch test for both shoulders; general flexibility was assessed with the sit-and-reach test; muscular endurance was evaluated using timed sit-up, push-up, and plank tests; handgrip strength, which also provides

information about general strength, was measured using a hand dynamometer; balance was assessed using the functional reach test; and maximal performance was evaluated using the Harvard step test.

Physical Activity Level

In order to assess physical activity level based on a global standard, the International Physical Activity Questionnaire (IPAQ) and its short form (IPAQ-SF) were developed by a group of experts in 1998. In this study, the IPAQ-SF, consisting of seven questions and whose Turkish validity and reliability were conducted by Öztürk, was used. This form assesses three different types of activity: walking, moderate-intensity physical activities, and vigorous-intensity physical activities, and also includes information on sitting time. Frequency and duration are calculated separately for each type of activity. MET represents oxygen consumption at rest. A score expressed as "MET-min/week" is obtained by multiplying the MET value by the duration and frequency of the activity. Based on this score, participants are classified into three groups: inactive (MET-min/week <600), minimally active (MET-min/week = 600–3000), and very active (MET-min/week >3000) [21].

Shoulder Flexibility

The back scratch test was performed to assess shoulder flexibility. During the test, while the participant was in a standing position, one arm was moved into external rotation over the shoulder, with the palm facing the back and the fingers in extension, attempting to reach the lowest possible point on the back. The other arm was moved into internal rotation, with the palm facing outward and the fingers in extension, attempting to reach the highest possible point on the back. The participant was asked to bring the tips of the middle fingers of both hands as close to each other as possible, and the distance between the fingertips was measured. During the measurement, no external assistance was provided to help the fingertips approach each other. If the middle fingers did not touch, the distance between them was recorded as a negative (–) value in centimeters. If the middle fingers touched end to end, the value was recorded as zero (0). If one middle finger passed beyond the other, the overlapping distance was recorded as a positive (+) value in centimeters [22].

Body Flexibility

The sit-and-reach test was used to evaluate body flexibility. During the test, a measurement box (Baseline) with a length of 35 cm and a width of 45 cm, with the upper surface extending 15 cm beyond the foot support surface, was used. Participants were encouraged to reach forward as far as possible from a long sitting position with their knees extended and the soles of their feet placed against the measurement box. The farthest point reached by the fingertips was recorded in centimeters, and the best result from two trials was recorded as the score [23].

Muscular Endurance

Core endurance was measured using timed sit-up, push-up, and plank tests. For the sit-up and push-up tests, the number of repetitions the participant could perform within 1 minute was recorded, while for the plank test, the duration for which the position could be maintained was recorded in seconds.

Sit-up

To measure abdominal muscle endurance, participants were positioned supine in a hook-lying position and were asked to perform trunk flexion by lifting their scapulae off the floor while keeping their arms and elbows in extension [24].

Push-up

Upper body muscular endurance performance was measured using a push-up test involving a trial focused on reaching the maximum number of repetitions. To perform a successful push-up, participants were required to flex their elbows to a 90° angle and lower their bodies while maintaining a straight line with their back and legs, then extend their arms throughout the movement. The aim was to perform as many push-ups as possible. The assessment was terminated if the participant stopped or paused, failed to maintain correct body position, could not fully extend the arms, or failed to achieve 90° elbow flexion in at least two push-ups [25].

Plank

The plank is an effective exercise aimed at increasing body stability and improving muscular endurance. In the plank position, support is taken on the elbows, forearms, and toes, while maintaining the spine in a straight line and preventing the pelvis from dropping. During the plank exercise, students aimed to remain balanced and in a stable position for as long as possible. The duration of maintaining the plank position was recorded in seconds [26].

Handgrip Strength

Handgrip strength was measured using a hydraulic hand dynamometer (Baseline, Irvington, NY). During the measurement, participants were asked to hold the dynamometer at their side and squeeze it as forcefully as possible for 3 seconds, and maximal voluntary contraction was recorded. This procedure was repeated three times for each hand. The average of the three trials for each hand was determined as the maximal voluntary handgrip strength. Maximal grip strength was recorded in kilograms (kg).

Functional Reach Test

This test, developed by Duncan and colleagues, has been validated and shown to be reliable for the clinical assessment of balance [27]. Participants were asked to raise their dominant arm to 90° and

keep it at shoulder level, then reach forward as far as possible by following a measuring tape mounted on the wall, without moving their feet or losing balance. During the test, care was taken to ensure that the heels did not lift off the ground and that the participant did not take a step forward. If the heels lifted or a step forward was taken, the test was repeated. Among three repeated trials, the best measurement was included in the evaluation.

Harvard Step Test

Recovery heart rate after exercise is used to assess maximal performance. This test requires the individual to step up and down on a 50 cm-high step at a rate of 30 steps per minute for five minutes or until exhaustion occurs within this period. At the end of the test, recovery heart rate is measured and used to calculate the Physical Efficiency Index. During the Harvard Step Test, participants stepped up and down at a rate of 30 times per minute. This movement was performed in four stages:

1. One foot is placed on the step.
2. The other foot is placed on the step so that the body is upright and the legs are extended.
3. The foot that first stepped onto the step is lowered.
4. The other foot follows the same movement.

To maintain the rhythm of the movement, a metronome set at 120 beats per minute was used. Participants stepped up and down 30 times per minute by performing one movement at each beat of the metronome. This cycle continued for 5 minutes as long as the participant did not feel fatigued. Immediately after completion of the test, the participant sat on a chair, and heart rate in the resting position was measured from the carotid or radial artery at 1–1.5, 2–2.5, and 3–3.5 minutes. The Harvard Physical Efficiency Index (PEI) was calculated using the following formula [28].

PEI = (Exercise duration (seconds) × 100) / (2 × sum of three half-minute recovery pulse counts)

Data Analysis

All statistical analyses were performed using the IBM SPSS Statistics 24.0 software. Continuous variables were expressed as mean (Mean) ± standard deviation (SD), while categorical variables were expressed as percentages (%). The conformity of the data to a normal distribution was assessed using the Kolmogorov–Smirnov test. For data showing a normal distribution, differences between groups were examined using the independent samples t-test. A p-value of <0.05 was accepted as the level of statistical significance, and all analyses were conducted with a 95% confidence interval.

Ethical Considerations of the Study

Prior to participation, individuals were informed about the study. This study was approved by the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University and was

conducted in accordance with the Declaration of Helsinki. (Decision number: E-10840098-202.3.02-2645; Date: 26/04/2024)

Results

In this study, the PA and PF levels of university students studying in the department of physiotherapy and rehabilitation, as well as the relationships between these parameters, were examined. Of the 174 students, the study was completed with 122 students who met the inclusion criteria and voluntarily agreed to participate. The mean age of the participating students was 20.59 ± 1.99 years, and 62.30% of the participants were male and 37.70% were female. The proportion of Turkish students was 27.05%, while international students constituted 72.95% of the sample. According to the IPAQ scores, the findings indicated that 57.50% of the participants had a high level of PA. This was followed by a moderate level at 38.33% and a low level at 4.17%. The demographic characteristics of the participants are presented in Table 1.

Table 1. Demographic data of the participants

	Mean	**Standard Deviation**
Age(years)	20,59	1,99
Height (cm)	169,58	10,58
Weight (kg)	69,13	17,44
BMI (kg/m^2)	23,82	4,47
	Groups	**N (%)**
Sex	Male	76 (%62.30)
	Female	46 (%37.70)
Nationality	Turkish	33 (%27.05)
	International	
	● Egypt	31 (%25.41)
	● European	17 (%13.93)
	● Iran	14 (%11.48)
	● Syria	10 (%8.20)
	● Jordan	6 (%4.92)
	● Algeria	6 (%4.92)
	● Palestine	5 (%4.10)
Activity Level	Low-Intensity Physical Activity	5 (%4.17)
	Moderate-Intensity Physical Activity	47 (%38.33)
	High-Intensity Physical Activity	70 (%57.50)

The mean values, standard deviations, and 95% confidence intervals of the demographic characteristics and physical fitness parameters according to ethnicity, as well as the between-group comparisons using the t-test, are presented in Table 2.

No significant differences were found between Turkish and international participants in terms of height, weight, and BMI values ($p>0.05$). In comparisons between Turkish and international students, significant differences were found between the groups in balance (functional reach test) ($p=0.044$) and maximal performance (Harvard step test) ($p=0.006$). The balance performance of international students was found to be higher than that of Turkish students. Similarly, the results of the maximal performance test showed a significant advantage in favor of international students. No

significant differences were observed between the groups in other physical fitness parameters (p>0.05). This finding indicates that the general physical fitness levels of both national and international students studying in the department of physiotherapy and rehabilitation are largely similar (Table 2).

Table 2. Comparison of demographic characteristics and physical fitness parameters by ethnicity

	National Students	**International Students**	**Mean Difference**	**t-test**	**%95 CI**	
	M±SD	**M±SD**		**p**	**Lower**	**Upper**
Age (years)	20,33±0,89	20,69±2,25	-,36330	0,372	-1,165	,438
Height (cm)	169,81±11,19	169,49±10,41	,32380	0,881	-3,963	4,610
Weight (kg)	67,51±14,53	69,72±18,44	-2,20957	0,536	-9,265	4,846
BMI (kg/m^2)	23,30±3,77	24,00±4,70	-,69693	0,447	-2,503	1,109
Waist/Hip	0,76±0,09	0,78±0,17	-,02546	0,424	-,088	,037
IPAQ-SF (MET-min/week)	4680± 3612,4	4370,78± 3129,77	309,21477	0,647	- 1024,865	1643,294
Shoulder flexibility-Right (cm)	1,39±5,31	2,85±7,28	-1,45999	0,296	-4,211	1,291
Shoulder flexibility-Left (cm)	-2,52±6,88	-0,12±8,26	-2,40065	0,140	-5,598	,797
Sit-reach test (cm)	24,58±13,35	25,14±8,98	-,56044	0,791	-4,730	3,609
Muscular endurance						
Sit-ups (reps)	31,9±15,34	36,47±19,64	-4,50221	0,237	-12,005	3,000
Push-ups (reps)	19,18±14,6	20,01±14,52	-,82942	0,780	-6,704	5,045
Plank (sec)	48,21±19,65	54,91±31,16	-6,70360	0,252	-18,227	4,819
Handgrip strength (kg)	28,95±13,97	31,4±20,18	-2,449	0,536	-10,267	5,368
Functional reach (cm)	35,07±11,0	41,44 ±16,38	-6,37131	**0,044***	-12,569	-,173
PEI	44,58 ±17,10	55,79±25,37	-11,2098	**0,006***	-19,20	-3,22

*p<0,05, M: Mean, SD: Standard Deviation, IPAQ-SF: International Physical Activity Questionnaire–Short Form; BMI: Body Mass Index; MET-min/week: Metabolic Equivalent Minutes per Week; PEI: Physical Efficiency Index; CI: Confidence Interval

Discussion

In this study, the comparison of physical fitness parameters between national and international students was aimed, and while many fitness parameters were similar between the groups, significant differences were identified in balance and maximal performance tests. International students were found to have better fitness levels in these parameters compared to national students. These findings indicate that although young individuals studying in the same department and having similar levels of knowledge regarding physical activity, different cultural and environmental factors may influence physical fitness levels.

Economically stable countries fail to reach even the minimum level of physical activity recommended by the World Health Organization to maintain health and energy balance [29, 30]. A decrease in physical activity level leads to a reduction in physical fitness, which is reflected in an unhealthy student population. Health-related physical fitness is also influenced by many other factors, such as body weight and socioeconomic status. The physical activity level of individuals with low socioeconomic status is likely to be adversely affected due to limited access to living

environments and safe neighborhoods [7, 29]. In addition, another of the most common negative external factors affecting physical activity in the student population is the lack of leisure time due to academic schedules and social and family obligations [31].

Based on findings from the literature, university students demonstrate a satisfactory level of physical activity and physical fitness. The systematic review by Kljajević et al. showed that university students have moderate levels of physical fitness and physical activity [4]. However, results may vary largely due to cultural differences and factors related to educational systems in different countries. Results obtained from students in faculties of sports indicate that physical activity has a positive effect on the development and maintenance of physical fitness and activity levels [4]. The results of our study are consistent with the literature, showing that students in the physiotherapy and rehabilitation department in our university sample have moderate to high levels of physical activity. All students in the department had taken a physical activity course and successfully completed coursework covering the benefits of physical activity and physical fitness parameters.

Factors such as economic development, socioeconomic status, urban/rural context, availability of facilities, cultural habits, and parents' education level influence the determination of physical fitness levels across countries [18].

The literature indicates that despite a sedentary lifestyle and lack of physical activity in Middle Eastern and Arabic-speaking countries, daily tasks and activities may support certain physical fitness parameters such as flexibility and balance. In particular, it has been reported that women may have advantages in certain physical fitness parameters due to factors such as household activities and local traditions, despite low levels of physical activity [32]. Murtagh et al. reported that physical activity in Arab countries is generally of low to moderate intensity, which supports long-term cardiovascular endurance [33]. Merom et al. stated that men have higher participation rates in physical activity compared to women, leading to better outcomes in both cardiovascular endurance and physical fitness parameters [34].

The restriction of women's physical activity levels due to the influence of conservative cultures may create an advantage in terms of physical fitness for male participants [32]. In our study, the high number of international male participants and the lack of assessment of cultural factors may have prevented the physical fitness parameters from fully reflecting the true situation. However, the fact that international students may have better socioeconomic conditions could explain their superiority in physical fitness parameters. Borraccino et al. demonstrated that individuals with higher socioeconomic levels tend to have better physical fitness levels [35]. Another possible explanation is that students studying abroad may be more inclined to engage in physical activity as a way to express themselves physically in a different environment or as a strategy for coping with stress.

In addition, the literature indicates that factors such as parental education level may influence physical activity habits [36]. The lack of assessment of family education levels in our study can be

considered a limitation. Another limitation is potential sampling bias due to an unbalanced design with a higher number of male students in the sample. The imbalance in nationality and gender distribution observed in the sample reflects the current student profile in our university's Physiotherapy and Rehabilitation department; as the international student population is higher than the national student population, and male students are higher than female students in our institution. This specific demographic structure reflected in the study sample limits the generalizability of the findings to all physiotherapy students. In particular, it is thought that the numerical superiority of male students may have positively influenced physical activity and physical fitness scores due to the fact that men biologically have a higher potential for strength and physical performance compared to female students. Therefore, future studies conducted in groups with more balanced gender and nationality distributions will offer a broader perspective to the literature.

Conclusions

The results of our study, in line with the literature, indicate that cultural and economic factors play an important role in physical fitness parameters. The better outcomes observed in the physical fitness parameters of international students may be attributed to daily lifestyle habits, economic conditions, types of physical activity, and gender distribution. However, the similarity in physical activity levels suggests that awareness gained through education is effective in both groups. This highlights the need for further studies with larger samples in which cultural, economic, and environmental factors are examined in detail.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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Author Contribution

Concept: GES., MS.; Design: GES., MS; Supervision/Consultation: GES., MS.; Resources: GES.; Data Collection and/or Processing: GES.; Analysis and/or Interpretation: GES., MS.; Literature Review: GES., SİS.; Manuscript Writing: GES., SİS.; Critical Review: GES., MS.