



Original Article

Exploring the impact of physical factors on the overweight and obese physical therapy students

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المخلص

أهداف البحث: تعتبر اللياقة البدنية ركيزة أساسية لطلاب العلاج الطبيعي في تعزيز صحتهم الجسدية. الطلاب المصابين بالسمنة وزيادة الوزن قد يكون لهم قدرات بدنية محدودة. لذلك، قمنا بالتحقيق في تأثير زيادة الوزن والسمنة على الحركة، والقوة وخفة الحركة لطلاب العلاج الطبيعي.

طرق البحث: في هذه الدراسة المقطعية المستعرضة، جمعنا البيانات لعينة من ١٣ مشاركاً زائد الوزن و٩ مشاركا مصابا بالسمنة من طلاب العلاج الطبيعي، تتراوح أعمارهم من ١٩ إلى ٢٤ عاماً. قمنا بقياس مرونة العمود الفقري، والطرف العلوي والسفلي تليها قوة الطرف العلوي باستخدام اختبار تعليق ثني الذراع والخفة الحركية باستخدام اختبار سباق العدو ١٠×١١.

النتائج: لم يظهر اختبار "ت" للعينة المستقلة بمقارنة القيم المتوسطة بين المشاركين المصابين بزيادة الوزن والمصابين بالسمنة اختلافاً جزئياً لاختبار سباق العدو ١٠×١١. ولكن، كان هناك نتائج ذات دلالة إحصائية لاختبار تعليق ثني الذراع. أظهر اختبار ارتباط بيرسون ارتباطاً سلبياً معتدلاً بين مؤشر كتلة الجسم وتعليق ثني الذراع، يشير ذلك إلى أن المشاركين مع مؤشر كتلة الجسم الأعلى يميلوا إلى التمسك لوقت أقل أثناء اختبار تعليق ثني الذراع. أظهر تقييم الارتباط ارتباطاً إيجابياً ضعيفاً بين مؤشر كتلة الجسم واختبار سباق العدو ١٠×١١.

الاستنتاجات: في هذه الدراسة، أظهر طلاب الجامعة المصابون بالسمنة ضعفاً في العوامل البدنية خصوصاً قوة الطرف العلوي من الجسم وحركة الأطراف السفلية مقارنة مع المشاركين الذين يعانون من زيادة الوزن. كما أظهر طلاب الجامعة المصابين بالسمنة وزيادة الوزن انخفاضاً في القدرات البدنية والوظيفية.

الكلمات المفتاحية: الخفة الحركية؛ مؤشر كتلة الجسم؛ القدرة البدنية؛ القوة، الشباب

Abstract

Objective: Physical fitness is a fundamental pillar for physical therapy students in promoting their physical health. Obese and overweight students might have limited physical capabilities. Therefore, we investigated the effect of overweight and obesity on the mobility, strength, and agility of physical therapy students.

Methods: In this cross sectional study, we collected data from a sample of 13 overweight and 9 obese physical therapy students, aged between 19 and 24 years. We measured spinal, upper, and lower limb mobility; upper body strength (using the flexed arm hang test), and agility (using the 11 × 10 shuttle sprint test).

Results: The independent sample *t* test comparing the mean values of overweight and obese participants showed no significant difference [$t(20) = 0.16, p > 0.05$] for the 11 × 10 shuttle sprint test. However, there was significant difference [$t(15.2) = 3.79, p < 0.05$] for the flexed arm hang test. The Pearson's correlation test showed a moderate negative correlation between the body mass index and flexed arm hang [$r(20) = -0.62, p < 0.005$], indicating that the participants with higher body mass index tended to hold on for less time during the flexed arm hang test. The correlation assessment showed weak positive correlation between body mass index and the 11 × 10 shuttle sprint test.

Conclusions: In our study, the obese college students tended to have poor physical factors, especially upper body strength and lower limb mobility, compared with the overweight participants. The obese and overweight college students demonstrate lower physical and functional capabilities.

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Keywords: Agility; Obese; Overweight; Physical fitness; Physical therapy students; Strength

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Introduction

Overweight and obesity constitute a major challenge among college students.^{1,3} The prevalence of both is increasingly evident in different countries, regardless of their socioeconomic status.⁴ Overweight and obesity are determined by the body mass index (BMI). BMI ranges from 25 to 29.9 kg/m² for the overweight and 30 kg/m² or above for the obese.^{3,5} It is a measure of body fat based on height and weight that applies to the adults.⁵ Overweight and obesity are considered as risk factors which reduce physical fitness of young adults.^{6,7} Physical fitness is defined as the capacity of doing physical activities effectively and efficiently.^{8,10} Physical fitness is axial for enjoying a state of health and well being.^{8,10} It is essential particularly for physical therapy (PT) students who need to have adequate physical capabilities to meet the required physical challenges. PT students should have a physical capacity level that exceeds the work demand for successful physical functional performance.¹¹ PT students need to mainly promote physical health of a wide array of patients including heavy weight and paralysed patients, and handicapped and disabled children. Therefore, PT students should have adequate mobility, flexibility, strength, and agility to better serve their patients and clients since overweight and obesity could result in a decline in physical performance and reduction in skill related performance.^{6,7,12} Basic fitness test has been frequently utilised to assess strength and agility using the flexed arm hang test and 11 × 10 m shuttle sprint test, respectively.^{6,7} It is unknown if spinal mobility, upper limb mobility, and lower limb flexibility would vary between PT collegiate students with a BMI classification of overweight or obese. It is also unknown if agility and upper body strength would differ between overweight or obese college students. There is a gap in the body of knowledge regarding how overweight or obesity affects mobility and flexibility of PT students in addition to the uncertainty of its relation with upper body strength and agility necessary to promote physical health. The aim of the study was to determine the relation of BMI of the overweight or obese PT students with the physical factors of mobility, flexibility, strength, and agility. We hypothesised that the BMI of the overweight or obese would not have a significant relationship with the mobility or flexibility of college students. We also hypothesised that being overweight or obese would not have a significant relationship with upper body strength or agility.

Materials and Methods

Study design

The present study was a descriptive cross sectional study conducted between September 2019 and January 2020. The study was operated according to the Saudi regulations of the National Bioethics Committee, guidelines of the Declaration of Helsinki, and United States Code of Federal Regulations. Researchers fully explained the research protocol to the participants and subsequently obtained their informed consent.

The sample size was determined using G* power (version 3; Franz Faul, University of Kiel, Germany). Calculations based on power of 0.8, α error of 0.05, and effect size of 0.8 were used for a priori power analysis. One tailed *t* test was employed to identify the difference between the two independent means.

Participants

Twenty two male participants (13 overweight and 9 obese PT students) from College of Medical Rehabilitation Sciences, Taibah University, KSA, were consecutively recruited using a homogeneous purposive sample.

Inclusion and exclusion criteria

Participants were included if they were classified as overweight or obese, engaged sometimes in regular physical activity, and were willing to participate. Overweight and obesity were identified when BMI was 25–29.9 kg/m² and ≥ 30 kg/m², respectively.³ BMI can be obtained by dividing a person's weight in kilograms by their height in meters squared. Participants were classified as recreationally active if they reported to have engaged in moderate intensity exercises of 30 min for five times/week or engagement in vigorous intensity exercise of 25 min for three times/week. Participants were classified as inactive if they did not meet the threshold set by the American Academy of Sports Medicine.¹⁰ Participants were excluded if they had sustained a recent injury, significant limitation of mobility, or suffer from any neuromuscular disorder.

Procedure

The researcher began by explaining the fundamental research steps and demonstrating the outcome measurements needed to each participant. A data collection form was used to systematically collect participants' demographics including but not limited to age, BMI, and recreational status. Secondly, the researcher have screened every participant for spinal, upper limb, and lower limb mobility and flexibility ensuring that the inclusion criteria are met.^{13,16} All measurements were taken at the university lab at College of Medical Rehabilitation Sciences, Taibah University.

Spinal mobility

Spinal mobility was assessed at the sagittal and frontal planes.^{14,15} Forward spinal mobility was measured from fingertips to floor after instructing every participant to bend forward as far as possible, trying to touch the floor while keeping knees consistently straight. Touching the floor scored as zero distance. Backward bending mobility was measured by having each participant to assume the prone lying position and hands under shoulders, and pushing himself up as far as tolerated while keeping hip and pelvis in contact with the plinth. The researcher measured the perpendicular distance from the sternal notch to the floor. Side bending mobility was measured by having each participant to slide his fingers down the lateral thigh as far as tolerated. The researcher measured the perpendicular distance from finger tips to the floor before and after bending. For example, if the distance before bending was 60 cm and it became 40 cm after bending, the percentage of mobility was calculated using this formula $(60 - 40)/60$, which indicates 33.3% of side bending mobility. Participants have to be barefoot and are closely observed by the researcher to stop them from looking to the sides or shifting the pelvis to the opposite side.

Upper limb mobility

Upper limb mobility was assessed using right and left Apley scratch test.¹³ All participants were instructed to stand up straight with feet at shoulders' width. Right Apley scratch is defined as the flexion, abduction, and external rotation of right shoulder in an attempt to touch the fingers tips of the left hand after moving the left shoulder in extension, adduction, and internal rotation. Left Apley scratch test is defined as flexion, abduction and external rotation of left arm in an attempt to touch the right hand after moving the right arm in extension, adduction, and internal rotation. Finger touch or overlap scored as zero distance.

Lower limb mobility

Lower limb mobility was assessed using the straight leg raise test. Lower limb flexibility was measured by having each participant to assume supine lying position and having the pelvis secured to the plinth. The researcher slowly raised the participants' leg as far as tolerated while keeping knees straight using one hand and grasping the ankle with the other hand. The tester measured the degree of lower limb flexibility using the universal goniometer. The researchers identified 90° as the cut off point. The operational definition for the less mobile participants is the ones that scored 90 or less during straight leg raise test while more mobile participants are those who scored 91° and above.

Basic fitness test

Thirdly, all participants were demonstrated with two elements of the basic fitness test (BFT) including the 11 × 10 shuttle sprint and flexed arm hang tests.^{6,7} Sammito et al.¹⁷ mentioned that the elements of the BFT require only few equipment and are considered appropriate and feasible outcome measurements instruments. Participants' agility

was determined using the 11 × 10 m shuttle sprint. All participants were instructed to sprint as fast as possible and negotiated a cone positioned 10 m away.^{6,7} The researcher recorded the time in seconds from the start until all participants had finished five and a half laps in the shortest time possible. We have to acknowledge that the whole test was conducted from standing and running without lying down on the floor and getting up between laps.^{6,7} Upper body strength was determined using the flexed arm hang test. Flexed arm hang in the chin up position is frequently reported in literature and is used to assess arm and shoulder girdle strength.^{18,19} Researchers gave loud verbal encouragement to the participants to hold on with the chin above a horizontal bar as long as tolerated.^{6,7} Rating of perceived exertion was determined once the flexed arm hang test was finished. The rating is well accepted and popular among researchers for reporting the perceived exertion in many different sports.²⁰ The order of mobility, flexibility, and fitness testing was random to avoid any order effect as a threat to internal validity.

Statistical analysis

Participants' characteristics were reported as frequency and percentages while the descriptive data for all study variables were reported as mean ± SD. Shapiro–Wilk test was used to test the normality of data distribution. Levene's test was used to establish equality of error variances. Independent *t* test was the parametric inferential statistics used to detect any difference between groups. Pearson correlation test was calculated for the relationship between participants' outcome measurements and demographics when the parametric inferential statistics was needed.

Independent sample *t* test was also employed for testing equality of means for the flexed arm hang test; 11 × 10 shuttle sprint test; and spinal, upper, and lower mobility between participants who were classified as overweight or obese. Statistical significance was set at alpha level of ≤ 0.05 and 95% confidence interval of the difference. All analyses were conducted using the IBM SPSS 23 (Copyright © IBM Corp. Armonk, NY, USA) software.

Results

Table 1 provides the descriptive statistics and frequencies of the study variables representing the participants' sociodemographic characteristics. Shapiro–Wilk test established normality for the flexed arm hang and 11 × 10 shuttle sprint test outcome measures.

In reference to the 11 × 10 shuttle sprint test, independent sample *t* test comparing the mean scores of overweight participants with those who are obese found no significant difference [$t(20) = 0.16, P > 0.05$]. However, there was a significant difference between the overweight and obese participants when tested for the upper body strength using the flexed arm hang test [$t(15.2) = 3.79, P < 0.05$] (Table 2, Figure 1). Independent sample *t* test showed

Table 1: Participants' sociodemographic characteristics.

Parameter	Mean	±SD	Range
Age (years)	21.9	1.49	(19–24)
Height (meters)	1.71	0.06	(1.57–1.83)
Weight (kg)	88.3	14.9	(65–130)
BMI	30.03	4.3	(25.3–40.6)
Right Apley	2.09	5.4	(0–17)
Left Apley	3.72	6.4	(0–20)
Forward Bending Mobility	5.4	7.1	(0–22)
Backward Bending Mobility	41.0	8.0	(28–54)
Right Side Bending	0.33	0.05	(0.23–0.42)
Left Side Bending	0.31	0.06	(0.21–0.42)
Right SLR Mobility	89.0	17.6	(60–120)
Left SLR Mobility	88.3	15.0	(60–111)
11 × 10 m shuttle sprint test	41.5	6.76	(25–60)
Flexed arm hang test	9.8	11.1	(0–31)

Characteristics	N	%
Participants BMI		
Overweight	13	59.1%
Obese	9	40.9%
Recreational Status		
Inactive	9	40.9%
Active	13	59.1%
Flexed Arm Hang		
Able	14	63.6%
Unable	8	36.4%
Right SLR Mobility		
(Less mobile, more mobile)	(8, 14)	36.4%–63.6%
Left SLR Mobility		
(Less mobile, more mobile)	(7, 15)	31.8%–68.2%

N: number; SD: standard deviation; BMI: body mass index; SLR: straight leg raise

significant difference ($P < 0.05$) for lower limb mobility but there was no significant difference ($P > 0.05$) for upper limb mobility or spinal mobility (Table 2).

Pearson correlation test was calculated for the relation ship between participants' straight leg raise mobility on the

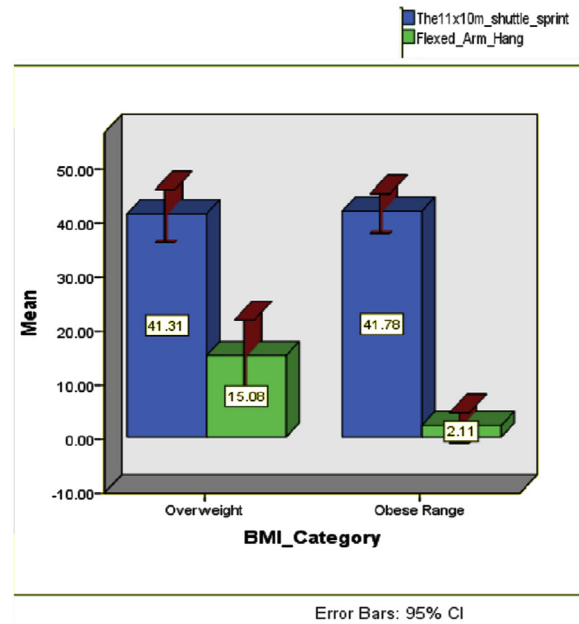


Figure 1: Bar chart showing the outputs of the 11 × 10 shuttle sprint and flexed arm hang tests for overweight and obese college students.

right and left legs. A strong positive correlation was found [$r(20) = 0.94, p < 0.001$], indicating a significant relationship between the two variables. Participants with more mobility on the right leg tended to have more mobility on the left leg. Regarding side bending mobility, a moderate positive correlation was found [$r(20) = 0.71, p < 0.001$]. In reference to the right and left Apley scratch test, there was weak positive correlation [$r(20) = 0.13, p > 0.05$] between right and left upper limb mobility. A moderate negative correlation was found between BMI and flexed arm hang [$r(20) = 0.62,$

Table 2: Independent sample t test for the study variables.

Pair	Variables	N	Mean	±SD	t	df	P value (95% CI)
11 × 10 shuttle sprint	Overweight	13	41.3	8.1	0.16	20	0.87 (-6.73–5.79)
	Obese	9	41.8	4.8			
Flexed arm hang	Overweight	13	15.08	11.5	3.79	15.2	0.002 (5.69–20.25)
	Obese	9	2.11	3.6			
Right side bending mobility	Overweight	13	0.34	0.05	0.68	20	0.51 (-0.03–0.06)
	Obese	9	0.32	0.06			
Left side bending mobility	Overweight	13	0.32	0.32	0.54	20	0.59 (-0.04–0.07)
	Obese	9	0.30	0.30			
Forward bending mobility	Overweight	13	4.54	6.85	0.65	20	0.52 (-8.49–4.46)
	Obese	9	6.55	7.60			
Backward bending mobility	Overweight	13	44.88	9.17	1.99	20	0.06 (-13.29–0.28)
	Obese	9	38.38	6.14			
Right Apley's scratch test	Overweight	13	00	00	1.99	8	0.08 (-11.03–0.81)
	Obese	9	5.11	7.70			
Left Apley's scratch test	Overweight	13	3.92	6.11	0.17	20	0.86 (-5.41–6.36)
	Obese	9	3.44	7.05			
Right SLR	Overweight	13	96.77	16.89	2.88	20	0.009 (5.25–32.73)
	Obese	9	77.77	12.19			
Left SLR	Overweight	13	93.61	15.27	2.15	20	0.04 (0.39–25.50)
	Obese	9	80.66	11.47			

N: number; SD: standard deviation; df: degree of freedom; P: probability; SLR: straight leg raise; CI: confidence interval of the difference

Table 3: Correlation between different study variables.

Variables	Right side bending <i>r</i> (p)	Right Apley <i>r</i> (p)	Right SLR <i>r</i> (p)	11 × 10 Sprint test [s] <i>r</i> (p)	Flexed arm hang test <i>r</i> (p)
Left side bending	0.71 (p 0.00)				
Left Apley's scratch test		0.13 (p 0.56)			
Left straight leg raise			0.94 (p 0.00)		
BMI				0.15 (p 0.50)	0.62 (p 0.002)
Flexed arm hang [s]				0.30 (p 0.18)	1

BMI: body mass index; SLR: straight leg raise

$p < 0.005$) indicating that the participants with a higher BMI tended to hold on for less time during the flexed arm hang test (Table 3).

Discussion

Main findings of the study showed significant negative effects of being overweight or obese on upper body strength, agility, and some aspects of mobility which definitely decrease the physical capacity of PT college students to fulfil physical functional work demands. Leyk et al.⁶ and Leyk et al.⁷ stated that overweight is a risk factor that significantly reduces physical performance and further deterioration of performance is expected with the presence of more risk factors. Researchers conducted their study on a group of young soldiers, and the main finding was the decrease in physical fitness. Baceviciene et al.²¹ pointed out the role of the cognitive dimension in health promotion and well being. Authors linked physical inactivity to poor performance and greater psychosocial complaints. Authors have corroborated the importance of having recreationally active individuals in lowering any psychosocial complaints which eventually improve the overall health and quality of life.

Balhareth et al.³ reported that physical inactivity is the main correlate of overweight/obesity in the Gulf States. Authors added that there is a scarcity of information and desperate need to design evidence based health promotion interventions targeting those groups. Authors also emphasised on adopting healthy and sustainable behaviours, thereby encouraging the students to be physically active. Wood et al.²² have emphasised on accommodating different individuals through addressing their physical abilities and designing fitness programmes that have multiple entry points to meet individuals' needs. Healthcare professionals should relentlessly encourage college students to engage in challenging physical activities that match their age and physical capabilities to improve physical well being and the overall quality of life.^{11,23}

A total of 36.4% of overweight/obese college students could not do the flexed arm hang test, and 78% perceived the test as strong exertion, which reflects marked weakness of their upper body. The weakness is classified as deconditioning since participants are healthy but the inactivity and overweight/obesity had reduced their physical capacity. The current findings are in agreement with the findings reported by Clemons et al.¹⁸ who investigated the relationship between the flexed arm hang test and muscular fitness. Researchers studied a group of college students and found that the performance in the flexed arm hang test is related to the

relative isometric strength rather than the absolute strength. The findings are logical since the participants had to hold on and assume the isometric mode of muscle action during the flexed arm hang test.¹⁹ Leyk et al.⁷ pointed out the importance of activating early intervention programmes at schools for the early detection of reduced physical abilities. Researchers conducted a cross sectional study on a sample of young adults and measured their upper body strength by making them perform chin ups on a horizontal bar, and found a marked decrease in their upper body strength.

The overweight college students demonstrated comparable agility to the obese students in the 11 × 10 shuttle sprint: 41.3 and 41.8 s, respectively. The time scored seems to be less than the time reported by Leyk et al.⁶ who studied a group of soldiers and accomplished the test in 43.7 ± 4.2 s. However, the agility test we used was just about running five and a half laps as fast as possible without lying down on stomach, and getting up and sprint between laps. The study results disagree with the results reported by El gohary et al.¹² who had a mean value of 31.9 ± 4.2 s. However, this was expected since the study sample was a group of elite athletes in the adolescence age of 14.9 ± 1.3 years. Research studies have frequently accentuated the role of age strata on the level of physical performance as fitness tends to deteriorate with age.⁶ Many researchers mentioned that BMI is not directly related to physical performance. Pierce et al.²⁴ conducted a study on a group of army soldiers testing military relevant tasks. Investigators found that although BMI can predict certain physical fitness elements, it is not directly associated with physical performance.

The inadequacy of physical activities as related to age, behaviour, and occupation seems to limit physical capacity. A total of 59.1% participants labelled themselves as recreationally active as they engage in activities like walking and jogging. However, it seems that such activities do not have the adequate intensity necessary to promote physical fitness considering their age and the needed activity level.^{10,11} This applies for the PT students who have the main goal of promoting physical health of different individuals. Therefore, PT students should be physically fit and in good shape to have the functional capacity that exceeds the work demand to better conduct themselves and serve their patients.¹¹ The American Academy of Sports Medicine and recent research studies are encouraging to engage in moderate to vigorous intensity activities like fast running and sprinting to have better physical capacity and fitness.¹⁰ Smetaniuk et al.¹¹ conducted a study on a sample of master of physical therapy students aiming to explore their level of physical activity and sedentary behaviour. Researchers found alarming results with 74% of the

participants not meeting the recommended physical activity guidelines. Researchers raised the concerns given the intrinsic role of physical therapists in prescribing exercises with competencies, meeting the physical activity guidelines themselves, and avoiding sedentary behaviour to demonstrate better capabilities in promoting individuals' physical health.

Mobility assessment showed significant difference between overweight and obese students in lower limb mobility, measured by straight leg raising test, on both the right and left sides. The obese participants showed less lower limb mobility and flexibility on both sides compared to the overweight participants. Mobility assessment was insignificant for spinal mobility and upper limb mobility. The findings of the current study are in harmony with the findings of El gohary et al.¹³ that pointed out symmetrical mobility of upper limbs. It is good to mention that the authors had college students with healthy body weight as participants. The findings are also in agreement with the results reported by El gohary et al.^{14,15} that did not find any significant difference in the participants' side bending mobility. El gohary et al.^{14,15} studied a group of PT college students who mostly had healthy weight with a BMI of 21.9 ± 4.2 . The sample in the current study was a group of overweight/obese students. Most research works warn against overweight/obesity especially in the abdominal area.²⁵ Central obesity is more likely to negatively affect spinal mobility than appendicular mobility.

The correlation assessment showed moderate negative correlation between BMI and flexed arm hang indicating that college students with higher BMI are more likely to hold on for less time during the flexed arm hang test. The increase in BMI is associated with physical inactivity and deconditioning, which decrease physical fitness.^{6,7,10,11,18} Pierce et al. stated that BMI predicts selected physical fitness attributes.²⁴ Baceviciene et al. emphasised the role of self perception of physical activity in decreasing psychosomatic health problems. Therefore, healthcare professionals should encourage people to adopt a healthy life style and be more active to enjoy adequate physical fitness.²¹ The correlation assessment showed weak positive correlation between BMI and the 11 × 10 shuttle sprint test. The small sample size limits the interpretation of the weak correlation coefficient.

In essence, academic institutions and universities should design evidence based health promotion fitness programmes that are sustainable, easily accessible, and affordable to ensure that college students are enjoying good health, being recreationally active, and maintaining healthy body weight.¹¹ The fitness programme should be comprehensive enough to include the basic fitness elements of agility, strength, and endurance after having individuals enjoying adequate, if not distinguished, mobility, flexibility, balance, and coordination. Early intervention and screening programs must be activated to address students' physical health especially among those student groups which are going to definitely encounter certain physical requirements while conducting their work. PT students have specific needs, therefore; they should make their physical fitness a priority not only to have the physical capacity to carry out different physical activities but also to be a role model in promoting physical well being among others.

Conclusions

It can be concluded that college students who are classified as overweight or obese have difficulties with the basic fitness test outcomes, especially upper arm strength. Further, this affects the obese participants more than the overweight. Obese/overweight college students tend to demonstrate lower physical functional capabilities. Obese participants also tend to have decreased lower limb flexibility compared with the overweight participants.

Recommendations

There are several limitations within this study, including the small sample size and inclusion of only male participants. Moreover, there was a large variation in the level of physical activity and nature of other activities adopted by the participants. The author recommends conducting future studies with larger samples, including female participants, and stratifying them according to their level of physical activity for multiple outcome measurements.

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Conflict of interest

The author has no conflicts of interest to declare.

Ethical approval

The study protocol was approved by the ethical research committee of College of Medical Rehabilitation Sciences, Taibah University (CMR PT 2019 11, dated January 9, 2019). The study was operated according to the Saudi regulations of the National Bioethics Committee, guidelines of the Declaration of Helsinki, and United States Code of Federal Regulations.

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