

## RESEARCH PAPER (ORIGINAL)

# Relationship between physical activity, muscle strength and body composition in a sample of nursing students

Relação entre atividade física, força muscular e composição corporal numa amostra de estudantes de enfermagem

Relación entre la actividad física, la fuerza muscular y la composición corporal en una muestra de estudiantes de enfermería

Leonel São Romão Preto\*; André Filipe Morais Pinto Novo\*\*; Maria Eugénia Rodrigues Mendes\*\*\*

## Abstract

**Background:** Regular physical activity promotes health and quality of life, and contributes to the prevention of chronic non-communicable diseases.

**Objectives:** To assess the physical activity level (PAL) and its relationship with sociodemographic variables, muscle strength tests, and body composition.

**Methodology:** Analytical cross-sectional study. PAL was assessed using the International Physical Activity Questionnaire (IPAQ), muscle strength using leg press and dynamometry, and body composition using bioelectrical impedance analysis.

**Results:** The sample was mostly composed of female participants (76.7%). The mean age of participants was 21 years. Students ( $n=86$ ) had low (58.1%), moderate (29.1%), and high (12.8%) PALs. An association was found between PAL and gender (.013) and some strength tests, namely right and left handgrip ( $p=.000$ ;  $p=.005$ ) and peak isometric quadriceps strength ( $p=.010$ ). PAL influenced the amount of lean and fat body mass ( $p=.012$ ;  $p=.042$ ).

**Conclusion:** The profile of the more physically active students showed increased muscle strength and mass, and a lower percent body fat. These are relevant indicators of the health of the population under analysis.

**Keywords:** physical activity; muscle strength; body composition; nursing students

## Resumo

**Enquadramento:** A prática regular de atividade física promove a saúde, a qualidade de vida e contribui para a prevenção das doenças crónicas não transmissíveis.

**Objetivos:** Avaliar o nível de atividade física (NAF) e a sua relação com variáveis sociodemográficas, testes de força muscular e composição corporal.

**Metodologia:** Estudo analítico transversal. Avaliámos o NAF pelo Questionário Internacional de Atividade Física (IPAQ), a força por dinamometria e prensa de pernas e a composição corporal por bioimpedância.

**Resultados:** Amostra predominantemente feminina (76,7%), com média de idade de 21 anos. Os estudantes ( $n=86$ ) apresentaram um NAF baixo (58,1%), moderado (29,1%) e alto (12,8%). O NAF relacionou-se com o sexo (0,013) e alguns testes de força; designadamente a força de prensão manual direita e esquerda ( $p=0,000$ ;  $p=0,005$ ) e a força isométrica máxima dos quadríceps ( $p=0,010$ ). O NAF influenciou a quantidade de massa magra e gorda ( $p=0,012$ ;  $p=0,042$ ).

**Conclusão:** Os estudantes fisicamente mais ativos apresentavam um perfil marcado por maior força e massa muscular e menor percentagem de gordura total, indicadores relevantes na saúde da população estudada.

**Palavras-chave:** atividade física; força muscular; composição corporal; estudantes de enfermagem

\* Ph.D., Coordinating Professor, School of Health, Polytechnic Institute of Bragança, 5300-121, Bragança, Portugal [leonelpreto@ipb.pt]. Address for correspondence: Vale Chorrido, Rua Senhor dos Perdidos, Lote 101, 5300-121, Bragança, Portugal. Contribution to the article: data collection, statistical treatment and article writing.

\*\* Ph.D., Adjunct Professor, School of Health, Polytechnic Institute of Bragança, 5300-121, Bragança, Portugal [andre@ipb.pt]. Contribution to the article: research outline, data collection and literature search.

\*\*\* MSc., Adjunct Professor, Department of Nursing Sciences, School of Health, Polytechnic Institute of Bragança, 5300-121, Bragança, Portugal [maria.mendes@ipb.pt]. Contribution to the article: data collection, discussion and final revision.

## Resumen

**Marco contextual:** Practicar actividades físicas con regularidad promueve la salud y la calidad de vida, y contribuye a la prevención de las enfermedades crónicas no transmisibles.

**Objetivos:** Evaluar el nivel de actividad física (NAF) y su relación con las variables sociodemográficas, las pruebas de fuerza muscular y la composición corporal.

**Metodología:** Estudio analítico transversal. El NAF se evaluó a través del Cuestionario Internacional de Actividad Física (IPAQ), la fuerza por dinamometría y prensa de piernas y la composición corporal por bioimpedancia.

**Resultados:** Muestra predominantemente femenina (76,7 %) con una edad media de 21 años. Los estudiantes ( $n=86$ ) tenían un NAF bajo (58,1 %), moderado (29,1 %) y alto (12,8 %). El NAF se relacionó con el sexo ( $p=0,013$ ) y algunas pruebas de fuerza, como la fuerza de presión manual derecha e izquierda ( $p=0,000$ ;  $p=0,005$ ) y la fuerza isométrica máxima de los cuádriceps ( $p=0,010$ ). El NAF influyó en la cantidad de masa magra y grasa ( $p=0,012$ ;  $p=0,042$ ).

**Conclusión:** Los estudiantes físicamente más activos presentaban un perfil marcado por más fuerza y masa muscular y menor porcentaje de grasa total, indicadores relevantes en la salud de la población estudiada.

**Palabras clave:** actividad física; fuerza muscular; composición corporal; estudiantes de enfermería

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## Introduction

Physical inactivity and overweight are leading risk factors for global mortality, being responsible for 6% and 5% of deaths worldwide, respectively (World Health Organization [WHO], 2010). The physical activity level (PAL) also has an impact on the incidence of a group of medical conditions, commonly referred to as chronic non-communicable diseases (NCDs), including cardiovascular diseases, osteoporosis, depression, and type 2 diabetes (Demakakos, Hamer, Stamatakis, & Steptoe, 2010).

Chronic NCDs usually develop in adulthood, but their prevention should be done in other developmental stages, namely during childhood, adolescence, and young adulthood (Pires, Mussi, Cerqueira, Pitanga, & Silva, 2013).

According to WHO (2010), there is conclusive scientific evidence about the benefits of regular physical activity for young adults and older people. With regard to young people, these benefits include increased physical fitness, improved ability to cope with stress, and higher self-esteem. On the contrary, a sedentary lifestyle increases the risk of obesity and comorbidities. A recent study found that higher education students who exercise have better indicators of body composition and respiratory function (Paulo et al., 2015). Despite the available evidence, many young people still have a sedentary lifestyle (Corte-Real, Balaguer, Dias, Corredeira, & Fonseca, 2008) and only a few countries focus on physical activity in their epidemiological studies and public health policies (Pardini et al., 2001). According to Deng and Castelli (2011), university students are a unique subgroup within the research on this topic because, among other reasons, young adults are at a time of transition and lifestyle consolidation, and their PALs is a strong predictor of physical activity and health throughout the life span.

In fact, the admission to higher education and the transition from secondary school to university requires students to adapt to academic, psychosocial, and family changes. The first year of higher education is a crucial stage for increased risk of obesity and reduced level of physical activity among young adults since this transitional period brings about significant changes in eating habits and reduces the amount of time available for sports and leisure activities (Deng & Castelli, 2011; Wengreen & Moncur, 2009).

The few studies on physical activity habits among nursing students point to high levels of sedentarism (Nassar & Shaheen, 2014; Pires et al., 2013; Silva & Neto, 2014). Nursing students, both as students and future professionals, play an important role in health promotion, and their perceptions and physical activity habits may influence their clinical practice (Nassar & Shaheen, 2014). Regular physical activity is a modifiable risk factor for many chronic NCDs and its health benefits are well documented in the literature. Nursing students should adopt these health promotion behaviors in their own lives, and in the lives of the individuals or groups to whom they provide care.

In view of the above, the main objective of this study was to analyze the relationship between the physical activity level and sociodemographic and anthropometric variables, as well as its association with various muscle strength tests and body composition, in a sample of first-year students of a Bachelor of Science in Nursing.

## Background

Physical activity can be defined as any movement, exercise or activity that involves the work of skeletal muscles, resulting in energy expenditure (Caspersen, Powell, & Christenson, 1985). Together with eating habits, sleep, rest, socioenvironmental conditions, and use of psychoactive substances, physical activity has a significant impact on young adults' health (Demakakos et al., 2010; Deng & Castelli, 2011; Nassar & Shaheen, 2014).

WHO emphasizes the role of physical activity, particularly regarding the prevention of chronic NCDs, and puts forward the following recommendations for individuals aged over 18 years: (1) at least 150 minutes of moderate-intensity aerobic physical activity per week, or at least 75 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity; (2) aerobic activity should be performed in bouts of at least 10 minutes duration; (3) for additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate-and

vigorous-intensity activity; (4) muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week (WHO, 2010).

The recognition of physical activity as a determinant of health has led to increased research interest on this topic. An example of this interest is the creation of a group for the validation of the International Physical Activity Questionnaire (IPAQ), initially proposed by WHO in 1998 (Pardini et al., 2001). Several authors have used this instrument to assess nursing students' PAL (Pires et al., 2013; Silva & Neto, 2014).

Therefore, based on the state-of-the-art, it is possible to establish an association between PAL, muscle strength, and body composition (Michelin, Corrente, & Burini, 2010; Reuter, Strein, & Vargas, 2012; Zanovec, Lajjakula, Johnson, & Turri, 2009).

Handgrip strength is an important predictor of overall muscle function and strength, and an indicator of health-related physical fitness (Michelin et al., 2010). A study conducted in Brazil found that individuals who have a good handgrip strength are twice as likely to have high PALs (Michelin et al., 2010).

With regard to body composition, the concept encompasses various methodologies for measuring the amount of muscle mass, bone mass, and fat mass in the human body that can be applied to multiple areas of health-related knowledge.

A study on the association between body composition and lifestyles among university students concluded that physical activity has a significant impact on the amount of bone mass assessed through densitometry (Reuter et al., 2012). Another study reported that university students with high PALs usually have more muscle mass and low body fat (Zanovec et al., 2009). A recent study conducted with Portuguese and Italian university students reported that those who exercised improved their body composition and lung capacity after a supervised training program (Paulo et al., 2015).

## Research hypotheses

We developed this study based on the following research hypotheses:

H1 - PAL is associated with gender; H2 - PAL varies according to Body Mass Index (BMI); H3 - Students with higher PALs have greater pinch strength; H4 - Students with higher PALs have greater handgrip strength; H5 - Students with higher PALs have greater

quadriceps muscle strength; H6 - Students' body composition varies significantly according to PAL categories.

## Methodology

Based on the research objective and hypotheses, we conducted an analytical cross-sectional study, with a quantitative approach. The target population consisted of all students who were admitted to the Bachelor of Science in Nursing of the School of Health of the Polytechnic Institute of Bragança, through the national competition or special regimes for access to higher education, in the school years of 2012/2013, 2013/2014, and 2014/2015 ( $N = 148$ ). We applied a single exclusion criterion related to the presence of musculoskeletal problems and orthopedic surgery of the hand or lower limbs in the previous year, as we considered this to be an obstacle to performing muscle strength tests. However, none of the students reported any of these situations.

Through a nonprobability sampling technique, we obtained a sample composed of 86 students who agreed to voluntarily participate in the study.

We used a sociodemographic questionnaire for analyzing the gender and age variables. We assessed students' PAL using the IPAQ, as proposed by Craig et al. (2003), who divided PALs into three categories: low, moderate, and high. The IPAQ includes questions related to physical activity with intensity levels ranging between mild, moderate, and vigorous, and two questions related to sedentary behaviors. This instrument was validated in several countries, including Portugal. It is widely used in research studies, and recommended by the WHO to assess the physical activity of people aged between 15 and 69 years (Craig et al., 2003; Pardini et al., 2001; Pires et al., 2013).

We used a classic stadiometer to measure students' height.

We assessed muscle strength through three tests: pinch strength (right and left hand), right and left handgrip strength, and quadriceps muscle strength.

We assessed pinch strength through the thumb to index pulp to pulp method using the Baseline® Digital Hydraulic Pinch Gauge.

We assessed handgrip strength through the Jamar® universal dynamometer.

We assessed quadriceps muscle strength using a leg press platform to which we attached a load cell (Ergo Meter - Globus) connected to a computer with a specific software (Graph by Globus Ergometer for Windows). We used the following protocol, which is usually used in research studies and fitness classes: the participant should sit with his/her back against a padded support, with arms extended and hands over the trochanter region, knees initially flexed to 110°, feet 10 cm apart on the platform. The test consists in applying maximum pressure for 10 seconds against the platform, after activating the load cell. With regard to muscle work, the test assesses the strength of the extensor mechanism (quadriceps) and, to a lesser extent, the posterior thigh muscle. Immediately after the software is running, a sound was emitted for 10 seconds, during which the participant had to apply a peak isometric pressure against the platform. Data obtained through the load cell were transmitted and automatically recorded in the software. We measured the following variables: mean strength during 10 seconds, peak isometric strength, time elapsed until peak isometric strength was reached.

We assessed body composition through bioelectrical impedance analysis, using the Tanita BC-545 equipment and following its manufacturer's instructions. The validity and reliability of bioelectrical impedance analysis are well documented in the literature (Jackson, Pollock, Graves, & Mahar, 1988) and this method has been used in studies with populations and objectives similar to our study (Yildiz, Ersoy, & Arabaci, 2012). We measured the following

variables: weight, total muscle mass, percent body fat, and total bone mass.

All participants were provided with verbal explanations and demonstrations on the procedures. Data were collected by the same researchers and using the same protocols. All students were assessed in the afternoon, at least 2 hours after their last meal. Assessments were conducted in November and December of each school year, under similar conditions and at the same location within the school (simulation laboratory).

The administration of the School of Health of the Polytechnic Institute of Bragança granted us permission to use the laboratory and implement the study protocol. All participants signed an informed consent form. The results obtained in the various tests were provided to all students who requested this information.

We used the Statistical Package for the Social Sciences (SPSS) software for Windows, version 22.0, for the statistical analysis, and the chi-square test and other non-parametric tests (Mann-Whitney U Test and Kruskal-Wallis Test) for the inferential analysis. We set  $p < .05$  as the level of statistical significance.

## Results

As Table 1 shows, 86 students participated in this study. Most of them were women (76.7%). The participants' age ranged from 18 to 28 years, with a mean age of 21 years. We observed that men were higher ( $p = .000$ ) and heavier ( $p = .001$ ) than women. The mean BMI was 23.2 Kg/m<sup>2</sup>, and no statistically significant gender differences were found ( $p = .321$ ).

Table 1

*Students' characterization according to demographic and anthropometric variables*

	Total	Gender		<i>p</i> <sup>a</sup>
		Male	Female	
<i>n</i> (%)	86 (100.0)	20 (23.3)	66 (76.7)	
Minimum age	18	19	18	
Maximum age	28	28	28	
Age ( <i>M</i> ± <i>SD</i> )	20.9±2.0	21.1±2.2	20.8±1.9	.842
Height ( <i>M</i> ± <i>SD</i> )	1.65±0.08	1.76±0.05	1.62±0.06	.000
Weight ( <i>M</i> ± <i>SD</i> )	63.7±10.7	70.8±11.3	61.5±9.6	.001
BMI ( <i>M</i> ± <i>SD</i> )	23.2±3.2	22.7±3.6	23.4±3.2	.321

*Note.* *M* = Mean; *SD* = Standard deviation; Weight (Kg); Height (m); BMI = Body Mass Index (kg/m<sup>2</sup>).

<sup>a</sup> Mann-Whitney U Test.

With regard to physical activity, 58.1% of the students had a low PAL, 29.1% had a moderate PAL, and 12.8% had a high PAL (Table 2). Gender comparison showed a higher prevalence of low PALs among

female students and high PALs among male students. The results obtained in the chi-square test revealed an association between PAL and gender ( $\chi^2 = 8.749$ ;  $p = .013$ ).

Table 2  
*Students' characterization according to gender and PAL*

	Gender		Total <i>n</i> (%)	Chi-Square Test
	Male <i>n</i> (%)	Female <i>n</i> (%)		
Low PAL	7 (8.1)	43 (50.0)	50 (58.1)	$\chi^2_{(df=2)} = 8.749$ $p = .013$
Moderate PAL	7 (8.1)	18 (20.9)	25 (29.1)	
High PAL	6 (7.0)	5 (5.8)	11 (12.8)	
Total	20 (23.3)	66 (76.7)	86 (100.0)	

Note. PAL= Physical activity level.

No clear association was found between students' physical activity and age, weight, or BMI (Table 3).

Height was the only variable that showed significant differences according to PAL categories ( $p = .003$ ).

Table 3  
*Mean scores for age, height, weight, and BMI according to the PAL*

	Total Sample ( <i>M</i> ± <i>SD</i> )	PAL			<i>p</i> -value <sup>a</sup>
		Low ( <i>M</i> ± <i>SD</i> )	Moderate ( <i>M</i> ± <i>SD</i> )	High ( <i>M</i> ± <i>SD</i> )	
Age	20.9±2.0	20.7±1.9	20.7±2.1	22.1±1.7	.082
Height	1.65±0.08	1.63±0.08	1.68±0.09	1.71±0.06	.003
Weight	63.7±10.7	62.6±11.2	64.0±10.8	67.5±7.7	.151
BMI	23.2±3.1	23.5±3.1	22.7±3.3	23.1±2.9	.522

Note. Age - in years; Height - in meters; Weight - in kilograms; BMI - in Kg/m<sup>2</sup>.

<sup>a</sup>Kruskal-Wallis Test.

Table 4 shows the mean scores obtained in the handgrip and pinch strength tests, of both right and left hands, classified according to students' PAL. We also observed that right ( $p = .000$ ) and left ( $p = .005$ )

handgrip strength increased as the PAL increased. With regard to the variation of the mean scores for pinch strength according to the PAL, we found no statistically relevant results.

Table 4  
*Scores for handgrip and pinch strength, classified by PAL*

	Total Sample ( <i>M</i> ± <i>SD</i> )	PAL			<i>p</i> -value <sup>a</sup>
		Low ( <i>M</i> ± <i>SD</i> )	Moderate ( <i>M</i> ± <i>SD</i> )	High ( <i>M</i> ± <i>SD</i> )	
Right handgrip strength <sup>b</sup>	32.3±10.0	29.7±8.4	32.8±9.5	43.3±11.2	.000
Left handgrip strength <sup>b</sup>	29.4±9.3	27.0±7.7	30.0±8.7	38.9±11.6	.005
Right-hand pinch strength <sup>b</sup>	7.2±2.3	6.8±2.1	7.3±2.2	8.9±3.1	.060
Left-hand pinch strength <sup>b</sup>	6.7±2.0	6.5±1.8	6.5±1.8	8.3±2.9	.099

<sup>a</sup>Kruskal-Wallis Test.

<sup>b</sup>Using kilogram-force (Kgf) as unit of measurement.

During the 10-second test, individuals with low, moderate and high PALs had an isometric quadriceps strength of 1558.1N, 1729.5N, and 1896.7N, respectively. However, this increase in mean quadriceps strength was not statistically significant ( $p = .226$ ; Table 5).

We also observed a significant increase ( $p = .010$ ) in the peak isometric quadriceps strength, according to the PALs. Additionally, as the PAL increased, the time elapsed until reaching peak quadriceps strength decreased ( $p = .017$ ).

Table 5  
Scores for quadriceps strength, classified by PAL

	Total sample ( $M \pm SD$ )	PAL			p-value <sup>a</sup>
		Low ( $M \pm SD$ )	Moderate ( $M \pm SD$ )	High ( $M \pm SD$ )	
Mean isometric strength <sup>b</sup>	1651.3 ± 725.1	1558.1 ± 728.3	1729.5 ± 770.8	1896.7 ± 564.6	.226
Peak isometric strength <sup>b</sup>	2080.8 ± 761.2	1924.4 ± 728.4	2116.8 ± 784.0	2709.7 ± 538.9	.010
Time elapsed until peak strength <sup>c</sup>	5.5 ± 2.8	6.2 ± 2.8	5.1 ± 3.0	3.6 ± 1.5	.017

<sup>a</sup>Kruskal-Wallis Test.

<sup>b</sup>Using as Newton (N) as unit of measurement.

<sup>c</sup>Using second (s) as unit of measurement.

Figure 1 shows that students with low PAL had an average total muscle mass of 43.9 Kg; students with moderate PAL had 46.1 Kg, and students with high PAL had 50.8 Kg. Total muscle mass showed a statistically significant difference in the categories of PAL ( $p = .012$ ).

Participants with low PAL had a total fat mass of 26.4%, participants with moderate PAL had 24.6%, and those with high PAL had 20.7%, with significant differences between groups ( $p = .042$ ).

PAL did not affect the amount of bone mass ( $p = .280$ ).

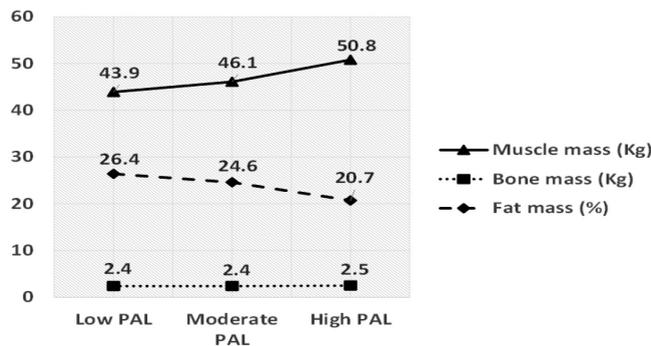


Figure 1. Mean scores for muscle mass, bone mass, and fat mass, classified by PAL.

## Discussion

As in previous studies conducted with nursing students (Nassar & Shaheen, 2014; Pires et al., 2013; Silva & Neto, 2014), most participants of this study had a low PAL. Gresse, Steenkamp, and Pietersen (2015) compared Health Sciences students to students from other areas and found no significant differences regarding risky behaviors,

such as alcohol consumption, dietary habits, or PAL. However, Silva and Neto (2014) concluded that physical inactivity was more prevalent among Nursing bachelor students than among students from other health-related areas (Dentistry, Pharmacy, Biology, and Nutrition). Nassar and Shaheen (2014) suggested that Nursing students' low PAL could be explained by the theoretical and clinical demands of the curricula.

With regard to the first research hypothesis, we found an association between PAL and gender. Several studies have reported that young women have lower PALs (Choi, Chang, & Choi, 2015; Corte-Real et al., 2008; Deng & Castelli, 2011). Intervention programs should take into account that the motivation for physical activity seems to differ according to gender with young men doing physical exercise more often with the purpose of increasing muscle strength, whereas young women mainly aim to reduce body weight and fat mass (Choi et al., 2015).

With regard to the second research hypothesis, we found no association between PAL and BMI. In 2002, the American College Health Association (ACHA) initiated a pilot program (Healthy Campus 2010) with the purpose of improving students' quality of life and health. One of its main purposes was to increase PALs and reduce the number of overweight and obese students. In this program's monitoring report, Deng and Castelli (2011) report that, although higher education is the last educational opportunity to implement interventions aimed at promoting physical activity and reducing BMI, the prevalence of overweight tends to increase.

The results of our study suggest that PAL can have a greater impact on the isometric strength of large muscle groups than on the intrinsic muscles of the hand responsible for the thumb to index pinch movements. In fact, with regard to the third research hypothesis, no evident association was found between students' PAL and right- or left-hand pinch strength. As regards the fourth research hypothesis, we observed that handgrip strength mean scores varied significantly according to PAL, which is a similar result to that reported by Michelin et al. (2010) in a study conducted with 708 adults. Although the association between physical activity and handgrip strength is well documented for other age groups, we found no consistent studies with university students to which we could compare the results obtained in this study. Vigorous-intensity physical activity requires major muscle groups, such as the quadriceps, to provide the strength and stability required to exercise. Pettersson, Nordström, and Lorentzon (1999) concluded that young adults who engaged in sports activities had more isokinetic strength of the quadriceps than young adults with low PAL. In our study, we only found an association between physical activity and quadriceps strength in peak isometric strength and

time elapsed until peak strength. Thus, and regarding the fifth research hypothesis, our results suggest that more active students have a greater capacity to achieve peak strength in less time.

As for the sixth research hypothesis, the results suggest that physical activity promotes an overall increase in muscle mass. A Brazilian study compared Physical Education students and Medicine students, all with high PALs and concluded that the former had higher mean lean mass scores than the latter (Reuter et al., 2012).

The participants in our study showed a lower percentage of total fat related to increased PALs, which is in line with other studies conducted with secondary or higher education students (Reuter et al., 2012; Yildiz et al., 2012). A high percentage of fat mass, particularly in the abdominal region, was an indicator of cardiovascular risk and its control required a balanced diet and increased physical exercise (Paulo et al., 2015; Zanovec et al., 2009).

This research has a few limitations, so we recommend caution regarding a generalization of the results to other populations. The first limitation was the nonprobability sampling method. Another limitation was the fact that we assessed students' body composition through a doubly indirect methodology, rather than through more accurate methods, such as dual-energy X-ray absorptiometry (DEXA). Despite these limitations, and taking into account the limited research conducted in Portugal on this issue, this study may contribute to a better understanding of the physical activity patterns among nursing students.

## Conclusion

Based on the objectives of the study, and taking into account the analysis of the results, we concluded that low PAL was the most common pattern of PAL, and that this pattern was especially predominant among female participants. We found an association between PAL and muscle strength tests that require peak isometric contraction in major muscle groups. We further concluded that the profile of individuals with high PALs is characterized by a body composition with increased muscle mass and lower percent body fat. Taking into account that amount of fat (especially body trunk fat) predisposes for the development of multiple health disorders, regular physical activity

emerges as a key variable in health promotion and prevention of chronic NCDs.

The high prevalence of low levels of PALs among first-year nursing students points to the need to encourage physical activity during leisure time. The results concerning the association between physical activity and muscle strength tests, and taking into account the analyzed age group (young adults), suggest that intervention programs should emphasize medium- and high-impact aerobic exercise involving major muscle groups in activities such as athletics, swimming, and football, among others. At the academic level, university campuses usually have equipment and facilities adequate for sports activities. The correct management of physical activity, together with behavioral changes, can contribute to increasingly active lifestyles among students.

At the level of research, further studies can contribute to a better understanding of the topic under analysis. Therefore, we suggest that longitudinal studies should be conducted to compare the results obtained by the students throughout the different years of the Bachelor of Science in Nursing.

## References

- Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, 100(2), 126-131.
- Choi, J. Y., Chang, A. K., & Choi, E. J. (2015). Sex differences in social cognitive factors and physical activity in Korean college students. *Journal of Physical Therapy Science*, 27(6), 1659-1664. doi:10.1589/jpts.27.1659
- Corte-Real, N., Balaguer, I., Dias, C., Corredeira, R., & Fonseca, A. (2008). Atividade física, prática desportiva, consumo de alimentos, de tabaco e de álcool dos adolescentes portugueses. *Revista Portuguesa de Saúde Pública*, 26(2), 17-25. Retrieved from <https://www.ensp.unl.pt/dispositivos-de-apoio/cdi/cdi/sector-de-publicacoes/revista/2000-2008/pdfs/tpsp-2-2008/02.pdf>
- Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., ... Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, 35(8), 1381-1395. doi:10.1249/01.MSS.0000078924.61453.FB
- Demakakos, P., Hamer, M., Stamatakis, E., & Steptoe, A. (2010). Low-intensity physical activity is associated with reduced risk of incident type 2 diabetes in older adults: Evidence from the English Longitudinal Study of Ageing. *Diabetologia*, 53(9), 1877-1885. doi:10.1007/s00125-010-1785-x
- Deng, X., & Castelli, D. (2011). University students meeting the recommended standards of physical activity and body mass index. *Journal of Research*, 6(1), 21-26. Retrieved from <http://files.eric.ed.gov/fulltext/EJ936016.pdf>
- Gresse, A., Steenkamp, L., & Pietersen, J. (2015). Eating, drinking and physical activity in faculty of health science students compared to other students at a South African university. *South African Journal of Clinical Nutrition*, 28(4), 154-159.
- Jackson, A. S., Pollock, M. L., Graves, J. E., & Mahar, M. T. (1988). Reliability and validity of bioelectrical impedance in determining body composition. *Journal of Applied Physiology*, 64(2), 529-534.
- Michelin, E., Corrente, J., & Burini, R. (2010). Associação dos níveis de atividade física com indicadores socioeconômicos, de obesidade e de aptidão física em adultos. *Revista Brasileira de Atividade Física e Saúde*, 15(1), 35-41. Retrieved from <https://periodicos.ufpel.edu.br/ojs2/index.php/RBAFS/article/viewFile/694/694>
- Nassar, O., & Shaheen, A. (2014). Health-promoting behaviours of university nursing students in Jordan. *Health*, 6, 2756-2763. doi:10.4236/health.2014.619315
- Pardini, R., Matsudo, S., Araújo, T., Matsudo, V., Andrade, E., Braggion, G., ... Raso, V. (2001). Validação do questionário internacional de nível de atividade física (IPAQ- versão 6): Estudo piloto em adultos jovens brasileiros. *Revista Brasileira de Ciência e Movimento*, 9(3), 45-51.
- Paulo, R., Petrica, J., Martins, J., Pichetto, F., Faure-Rolland, F., & Magno, F. (2015). Estudo da relação entre a atividade física e a função respiratória: Análise da composição corporal e dos valores espirométricos de alunos portugueses e italianos. *Motricidade*, 11(1), 3-13. doi:10.6063/motricidade.2797
- Pettersson, U., Nordström, P., & Lorentzon, R. (1999). A comparison of bone mineral density and muscle strength in young male adults with different exercise level. *Calcified Tissue International*, 64(6), 490-498. Retrieved from [http://download.springer.com/static/pdf/930/art%253A10.1007%252Fs002239900639.pdf?originUrl=http%3A%2F%2Flink.springer.com%2Farticle%2F10.1007%2Fs002239900639&token2=exp=1468248348~acl=%2Fstatic%2Fpdf%2F930%2Fart%25253A10.1007%252Fs002239900639.pdf%3ForiginUrl%3Dhttp%253A%252F%252Flink.springer.com%252Farticle%252F10.1007%252Fs002239900639\\*~hmac=bd82dcd52d4eb1cc1211320802af3308d97cf3642194ee8457c7943902cc0ab3](http://download.springer.com/static/pdf/930/art%253A10.1007%252Fs002239900639.pdf?originUrl=http%3A%2F%2Flink.springer.com%2Farticle%2F10.1007%2Fs002239900639&token2=exp=1468248348~acl=%2Fstatic%2Fpdf%2F930%2Fart%25253A10.1007%252Fs002239900639.pdf%3ForiginUrl%3Dhttp%253A%252F%252Flink.springer.com%252Farticle%252F10.1007%252Fs002239900639*~hmac=bd82dcd52d4eb1cc1211320802af3308d97cf3642194ee8457c7943902cc0ab3)
- Pires, C., Mussi, F., Cerqueira, B., Pitanga, F., & Silva, D. (2013). Prática de atividade física entre estudantes de graduação em enfermagem. *Acta Paulista de Enfermagem*, 26(5), 436-443. doi:10.1590/S0103-21002013000500006
- Reuter, C., Strein, C., & Vargas, D. (2012). Massa óssea e composição corporal em estudantes universitários. *Revista da Associação Médica Brasileira*, 58(3), 328-334. doi:10.1590/S0104-42302012000300013
- Silva, O., & Neto, C. (2014). Associação entre níveis de atividade física e transtorno mental comum em estudantes

- universitários. *Motricidade*, 10(1), 49-59. doi:10.6063/motricidade.10(1).2125
- Wengreen, H., & Moncur, C. (2009). Change in diet, physical activity, and body weight among young-adults during the transition from high school to college. *Nutrition Journal*, 8(2). doi: 10.1186/1475-2891-8-32
- World Health Organization. (2010). *Global Recommendations on physical activity for health*. Geneva, Switzerland: Author. Retrieved from [http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf)
- Yildiz, H., Ersoy, A., & Arabaci, R. (2012). Investigation into physical activities, body compositions and nutritional habits of youth between 14-18 ages. *European Journal of Educational Studies*, 4(2), 239-248. Retrieved from [http://ozelacademy.com/ejes4-2%208\).pdf](http://ozelacademy.com/ejes4-2%208).pdf)
- Zanovec, M., Lajjakula, A., Johnson, L., & Turri, G. (2009). Physical activity is associated with percent body fat and body composition but not body mass index in white and black college students. *International Journal of Exercise Science*, 2(3), 175-185. Retrieved from <http://digitalcommons.wku.edu/cgi/viewcontent.cgi?article=1065&context=ijes>

