Weekly physical activity patterns of university students: Are athletes more active than non-athletes?

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Abstract

The aim of the present study was to compare weekly physical activity (PA) and obesity-related markers in athlete and non-athlete university students. One hundred and twenty-six university students (53 males, 20.46 ± 2.04 years old, and 73 females, 19.69 ± 1.32 years old) participated in this study. Participants were fitted with a tri-axial accelerometer (ActiGraph wGT3X-BT, Shalimar, FL, USA) to assess the daily PA. Anthropometric measures of height, weight, BMI and %fat mass were determined with a stadiometer and an electronic scale. The comparison indicated that male and female athletes had a significant lower percentage of body fat than did non-athletes (p value = 0.001; ES = 0.043). Athletes spent significantly more time in light PA than did non-athletes (p value = 0.003; ES = 0.024). Female athletes spent significantly less time in sedentary mode than did non-athletes (p value = 0.040; ES = 0.008). On the other hand, female athletes spent significantly more time in light PA (p value = 0.003; ES = 0.017) and vigorous PA (p value = 0.001; ES = 0.086) than did non-athletes. Despite some statistical differences with minimal effect size, the results of this study suggested proximity between PA levels of athletes and non-athletes, mainly in the case of sedentary behaviour. No significant effects were found in the variances of PA tested in this study.

Keywords: Physical activity, Accelerometer, Athletes, Young adults

Background

The epidemic of excess body weight (overweight) and obesity has attracted scientific interest during the last decades. A population group that has been influenced by this phenomenon is university students (Cocca et al. 2014; Varela-Mato et al. 2012). This group, whose age lies between adolescence and adulthood, presents specific characteristics (e.g. emotional and physiological changes) that influence markers of excess body weight and obesity. In particular, it has been shown that changes in university students’ consumer habits and lifestyle aspects, such as physical activity (PA), might result in increased body mass (Fedewa et al. 2014; Gropper et al. 2012). Therefore, knowledge of PA levels in this population group would contribute to designing intervention programmes targeting excess body weight and obesity, through body mass control.

PA has been well-studied in university students, mainly using self-report measures (e.g. questionnaires), and it has been observed that 22–81% (depending on nationality) of students did not meet the current guidelines for PA levels. In this context, regular participation of students in a sport activity might help increase PA levels and decrease body mass and body fat percentage (BF). However, a series of recent studies on the prevalence of excess body weight and obesity in various sport and age groups has revealed similar rates between athletes and non-athletes (Nikolaidis 2012; Nikolaidis et al. 2015). The above-mentioned studies clearly indicated that regular participation in a sport per se does not result in low rates of body mass and BF, and identified the need for further
research in markers of excess body weight and obesity in
sport groups.

Nevertheless, there is a lack of information about the
differences between athlete and non-athlete uni-
versity students with regards to PA levels and markers
of excess body weight and obesity. In addition, it is not
clear whether there is a sex effect on these differences
and previous studies on PA have relied mostly on subjec-
tive (e.g. questionnaire), rather than on objective, assess-
ment methods (e.g. accelerometer) (Dinger and Behrens
2006; Peterson et al. 2015). Such information would be
important for both researchers and health practitioners.
Researchers focusing on PA and obesity could use such
information as reference data in future studies. Moreover,
the comparison between athletes and non-athletes might
help health practitioners to develop optimal exercise and
nutritional interventions targeting excess body weight and
obesity. Therefore, the aim of the present study was to
examine PA levels and markers of excess body weight and
obesity in female and male athlete and non-athlete uni-
versity students.

Methods
Participants
Participants included 126 Portuguese university students
(53 male with 20.46 ± 2.04 years old and 73 female with
19.69 ± 1.32 years old). Thirty-three (26.19 %) were ama-
teur or professional athletes with a regular practice in
their clubs (3–5 weekly training sessions more one com-
petition per week). The majority lived in rented flats or
in the campus hostels with a small home-to-university
distance. An informed consent form was signed for all
volunteers in this study. A scientific committee from Pol-
ytechnic Institute of Coimbra, Coimbra College of Edu-
cation, approved the ethical standards of this study. The
study followed the ethical recommendations of Declara-
tion of Helsinki for the study in humans.

Procedures
Each participant was individually assessed before to wear
the accelerometer. Anthropometric measures of height,
weight, BMI and %fat mass were determined with a stadi-
ometer (SAGE, precision 0.1 cm, range 0–230 cm) and an
electronic scale (Tanita SC 330 S; precision 100 g, range
0–270 kg). Two measurements were carried out in the
final value resulted from the average.

It was asked to participants their regular activities. It
was considered a sports athlete all the participants that
reported an involvement with a club, with two or more
trainings plus one competition per week. Physical activity
patterns without competition were not included in the
sports athlete group.

After to individually assessment, participants were fit-
ted with a tri-axial accelerometer (ActiGraph wGT3X-BT,
Shalimar, FL, USA). The accelerometer was programmed
to collect 10-s epochs. Participants were instructed to
wear accelerometer by seven consecutive days, 24 h/day.
Sleep time was also included in the time of wearing. Par-
ticipants were only instructed to not use accelerometers
to take shower or to water-based activities. After to fin-
ish the seventh day, participants turned to laboratory to
remove the accelerometer. ActiGraph data were analysed
using Actilife 6.0 software. Ten seconds epochs were col-
lapsed into 60-s epochs that have been the protocol for
the study in young adults. Sixty minutes without activity
(zero counts) was considered nonwear time. This time
was not included in the data treatment.

The Actilife software allowed to extract the total daily
and hourly counts per minute (cpm) of sedentary time
(minutes per day), light PA (minutes per day), moder-
ate PA (minutes per day) and vigorous PA (minutes per
day) and number of steps per day. The cut-off values for
PA classification were: sedentary time ≤100 cpm; light
PA = 100–1951 cpm; moderate PA = 1952–5724 cpm;
and vigorous PA ≥ 5725.

Statistical procedures
Gender (male and female) and relationship with sports
(athlete or not) were classified as factors. The anthropo-
metric variables (weight, height, BMI, %fat mass) and
PA variables (sedentary, light PA, moderate PA, vigoro-
us PA and number of steps) were defined as dependent
variables. The two-way MANOVA was used after vali-
dating normality and homogeneity assumptions. When
the MANOVA detected significant statistical differences
between the two factors, we proceeded to the two-way
ANOVA for each dependent variable, followed by Tukey’s
HSD post hoc test (O’Donoghue 2012). Ultimately, the
statistical procedures used were one-way ANOVA and
Tukey HSD post hoc per factor. Effect size (ES) was pre-
sented as $\eta^2$ and interpreted using the follow criteria: no
effect ($\eta^2 < 0.04$), minimum effect ($0.04 < \eta^2 < 0.25$), mod-
erate effect ($0.25 < \eta^2 < 0.64$) and strong effect ($\eta^2 > 0.64$
(Ferguson 2009). All data sets were tested for each sta-
tistical technique and corresponding assumptions and
performed using SPSS software (version 23.0, Chicago,
Illinois, USA). Statistical significance was set at 5 %.

Results
The two-way MANOVA revealed that the gender ($p$
value = 0.001; $ES = 0.751$; large effect) and the type of
practice ($p$ value = 0.021; $ES = 0.013$; no effect) had sig-
nificant main effects on the anthropometric. There was
significant interaction (Pillai’s Trace = 0.044; $p = 0.001$;
Interaction was found between factors for height ($p$ value = 0.016; $ES = 0.044$; minimum effect) between the gender and the type of practice.

Interaction was found between factors for height ($p$ value = 0.016; $ES = 0.007$; no effect) and %fat mass ($p$ value = 0.001; $ES = 0.012$; no effect). No statistically interactions were found in weight ($p$ value = 0.256; $ES = 0.001$; no effect) and BMI ($p$ value = 0.661; $ES = 0.001$; no effect). Table 1 shows the descriptive statistics about the anthropometric characteristics of students that participated in the study.

The analysis of variance carried out between genders revealed that in sports athletes there were statistical differences in height ($p$ value = 0.001; $ES = 0.332$), weight ($p$ value = 0.001; $ES = 0.129$) and % of fat mass ($p$ value = 0.001; $ES = 0.527$). It was possible to verify that male athletes are taller (6.97 %) and heavier (16.55 %). Women athletes had a greater percentage of fat mass (142.29 %). In the case of non-athletes, the analysis of variance revealed statistical differences between genders in height ($p$ value = 0.001; $ES = 0.401$), weight ($p$ value = 0.001; $ES = 0.172$) and % of fat mass ($p$ value = 0.001; $ES = 0.401$). Similarly with athletes, the male non-athletes are taller (8.16 %) and heavier (18.04 %). Female non-athletes had a greater percentage of fat mass (115.64 %). These results can be observed in Fig. 1.

The comparison between male sports athletes and non-athletes revealed statistical differences in height ($p$ value = 0.002; $ES = 0.026$) and % of fat mass ($p$ value = 0.001; $ES = 0.043$). Male non-athletes were taller (1.38 %) and had a greater percentage of fat mass (20.52 %). In the case of analysis of variance carried out in female athletes and non-athletes it were found no statistical differences.

The two-way MANOVA revealed that the gender ($p$ value = 0.005; $ES = 0.019$; no effect). No statistical differences were found on the type of practice ($p$ value = 0.339; $ES = 0.006$; no effect). There was significant interaction

### Table 1 Descriptive anthropometrics characteristics of the studied participants and the comparisons between genders and type of practice

|                         | Athletes (n = 33) | Non-athletes (n = 93) | p value | Effect size |
|-------------------------|------------------|-----------------------|---------|-------------|
| **Women (n = 73)**      |                  |                       |         |             |
| Height (cm)             | 164.33 (6.60)*   | 164.77 (6.59)*        | 0.626   | 0.001       |
| CI (95 %)               | (162.70–165.97)  | (164.15–165.38)       |         |             |
| Effect size             | 0.332 Moderate effect | 0.401 Moderate effect |         |             |
| Weight (kg)             | 60.89 (7.42)*    | 61.41 (10.58)*        | 0.708   | 0.001       |
| CI (95 %)               | (58.35–63.43)    | (60.46–62.36)         |         |             |
| Effect size             | 0.129 Moderate effect | 0.172 Minimum effect  |         |             |
| %fat mass               | 23.26 (6.24)*    | 24.95 (7.63)*         | 0.093   | 0.006       |
| CI (95 %)               | (21.41–25.11)    | (24.26–25.64)         |         |             |
| Effect size             | 0.527 Moderate effect | 0.401 Moderate effect |         |             |
| BMI                     | 22.90 (2.91)     | 22.60 (3.64)          | 0.530   | 0.001       |
| CI (95 %)               | (22.02–23.78)    | (22.27–22.93)         |         |             |
| Effect size             | 0.002 No effect  | 0.001 No effect       |         |             |
| **Men (n = 53)**        |                  |                       |         |             |
| Height (cm)             | 175.79 (6.64)*   | 178.21 (7.89)*        | 0.002   | 0.026       |
| CI (95 %)               | (174.89–176.70)  | (177.00–179.42)       |         |             |
| Effect size             | 0.332 Moderate effect | 0.401 Moderate effect |         |             |
| Weight (kg)             | 70.97 (11.42)*   | 72.49 (8.91)*         | 0.184   | 0.005       |
| CI (95 %)               | (69.62–72.32)    | (70.69–74.30)         |         |             |
| Effect size             | 0.129 Minimum effect | 0.172 Moderate effect |         |             |
| %fat mass               | 9.60 (5.00)*     | 11.57 (3.31)*         | 0.001   | 0.043       |
| CI (95 %)               | (9.03–10.17)     | (10.81–12.33)         |         |             |
| Effect size             | 0.527 Moderate effect | 0.401 Moderate effect |         |             |
| BMI                     | 22.55 (3.09)     | 22.61 (1.62)          | 0.842   | 0.001       |
| CI (95 %)               | (22.21–22.89)    | (22.16–23.06)         |         |             |
| Effect size             | 0.002 No effect  | 0.001 No effect       |         |             |

* Statistically differences between men and women for a p value <0.05
Interaction was found between factors for light PA ($p$ value = 0.001; $ES$ = 0.019; no effect) and vigorous PA ($p$ value = 0.001; $ES$ = 0.025; no effect). No statistically interactions were found in steps ($p$ value = 0.096; $ES$ = 0.003; no effect), time in sedentary mode ($p$ value = 0.080; $ES$ = 0.003; no effect) and moderate ($p$ value = 0.880; $ES$ = 0.001; no effect). Table 2 shows the descriptive statistics about the PA patterns of participants during one week using accelerometer.

The comparison between male and female athletes revealed no statistical differences in number of steps per day, sedentary time, light PA, moderate PA, and vigorous PA. Nevertheless, the comparison between male and female non-athletes revealed statistical differences in number of steps per day ($p$ value = 0.001; $ES$ = 0.096; $ES$ = 0.003; no effect), time in sedentary mode ($p$ value = 0.001; $ES$ = 0.027) and time in vigorous PA ($p$ value = 0.001; $ES$ = 0.071). Male non-athletes walked statistically more steps (16.76 %) and spent statistically more time in moderate PA (32.20 %) and vigorous PA (243.52 %). Percentage of differences in PA levels and also in anthropometric characteristics can be found in Fig. 1.

The analysis of variance between male athletes and non-athletes revealed that on average, non-athletes were taller, heavier and had a greater percentage of fat mass and BMI. Nevertheless, statistical differences were only found in height and fat mass. Generally, athletes tended to have a lower percentage of fat mass and our results are in line with this idea (Katch et al. 2011; Whyte 2006). Such values can be justified by the greater recurrence of anaerobic and aerobic workouts that occur in the majority of sports, thus consuming more glycogen, carbohydrates and fat (Djelic et al. 2015). Evidence has also found that regular athletes tend to adapt their organism to an increase in energy from fat and to a decrease in energy from carbohydrates (Katch et al. 2011).

The statistical evidence found in the male participants was not confirmed in the female group. No statistical differences were found in anthropometric measures. Moreover, descriptive statistics showed that female

**Discussion**

The aim of this study was to analyse the physical activity (PA) levels of regular athletes or non-athletes. In addition, the anthropometric characteristics were also compared. The main results revealed statistical differences in height and %fat mass between male athletes and non-athletes. Moreover, statistical differences were found in light PA of male participants and sedentary time, light PA and vigorous PA levels in female participants.

A recent study conducted in the Caucasian population in the Mediterranean area has revealed reference values of %FM between 13 and 20 % in men and 26.1 and 34.9 % for women between 20 and 29 years old (Coin et al. 2008). Our results revealed that male athletes (9.03–10.17 %FM), non-athlete men (10.81–12.33 %FM), female athletes (21.41–25.11) and non-athlete women (24.26–25.64) are below the reference values for this type of population.

The analysis of variance between male athletes and non-athletes revealed that on average, non-athletes were taller, heavier and had a greater percentage of fat mass and BMI. Nevertheless, statistical differences were only found in height and fat mass. Generally, athletes tended to have a lower percentage of fat mass and our results are in line with this idea (Katch et al. 2011; Whyte 2006). Such values can be justified by the greater recurrence of anaerobic and aerobic workouts that occur in the majority of sports, thus consuming more glycogen, carbohydrates and fat (Djelic et al. 2015). Evidence has also found that regular athletes tend to adapt their organism to an increase in energy from fat and to a decrease in energy from carbohydrates (Katch et al. 2011).

The statistical evidence found in the male participants was not confirmed in the female group. No statistical differences were found in anthropometric measures. Moreover, descriptive statistics showed that female
non-athletes had a slightly larger fat mass than did athletes. Nevertheless, female athletes also had a slight greater BMI, although both were in line with healthy guidelines (Pescatello et al. 2014).

The absence of differences in fat mass between female athletes and non-athletes can be partially explained by the large amount of sedentary time spent by the athletes. In fact, the statistical differences between athletes and non-athletes in sedentary mode had no effect size, thus following a previous study that revealed that sedentary behaviour predicts some of the total and regional fatness in the female athletic population (Júdice et al. 2014).

Comparisons between male and female participants were also conducted in this study. Results revealed that male athletes and non-athletes were statistically taller, heavier and had a lower percentage of fat mass compared to female participants. These results are in line with previous studies that showed that women tend to be smaller, lighter and have a greater percentage of fat mass. The greater percentage of fat mass and the distribution of the fat by the body may be explained by the following reasons (Blaak 2001): (1) the catecholamine mediated leg free fatty acid release is lower in women compared to in men; (2) the free fatty acid release by the upper body subcutaneous fat depots is higher in men than in women; (3) there are some indications that basal fat oxidation is lower in females compared to males; and (4) postprandial fat storage may be higher in

### Table 2 Descriptive physical activity characteristics of the studied participants and the comparisons between genders and type of practice

|                          | Athletes (n = 33) | Non-athletes (n = 93) | p value | Effect size |
|--------------------------|-------------------|-----------------------|---------|-------------|
| **Women (n = 73)**       |                   |                       |         |             |
| Number of steps per day  | 9257.86 (4791.81) | 8219.50 (38,578.58)*  | 0.053   | 0.007       |
| CI (95 %)                | (8271.74–10,243.97) | (7849.71–8589.29)     |         | No effect   |
| Effect size              | 0.002 No effect    | 0.019 No effect        |         |             |
| Sedentary time (min/day) | 730.22 (138.22)   | 773.44 (158.18)       | 0.040   | 0.008       |
| CI (95 %)                | (691.64–768.81)   | (758.97–787.91)       |         | No effect   |
| Effect size              | 0.001 No effect    | 0.005 No effect        |         |             |
| Light PA (min/day)       | 314.05 (75.78)    | 281.79 (82.05)        | 0.003   | 0.017       |
| CI (95 %)                | (293.92–334.18)   | (274.24–289.34)       |         | No effect   |
| Effect size              | 0.001 No effect    | 0.001 No effect        |         |             |
| Moderate PA (min/day)    | 47.57 (41.31)     | 42.86 (32.35)*        | 0.297   | 0.002       |
| CI (95 %)                | (39.26–55.88)     | (39.74–45.97)         |         | No effect   |
| Effect size              | 0.003 No effect    | 0.027 No effect        |         |             |
| Vigorous PA (min/day)    | 4.35 (6.72)       | 1.08 (2.79)*          | 0.001   | 0.086       |
| CI (95 %)                | (3.48–5.22)       | (0.75–1.40)           |         | Minimum effect |
| Effect size              | 0.002 No effect    | 0.071 Minimum effect   |         |             |

|                          | Athletes (n = 53) | Non-athletes (n = 93) | p value | Effect size |
|--------------------------|-------------------|-----------------------|---------|-------------|
| Number of steps per day  | 10,228.30 (8723.13) | 9597.47 (5122.31)*    | 0.446   | 0.002       |
| CI (95 %)                | (9255.40–11,201.20) | (8296.01–10,898.92)  |         | No effect   |
| Effect size              | 0.002 No effect    | 0.019 No effect        |         |             |
| Sedentary time (min/day) | 737.94 (202.62)  | 746.52 (165.26)       | 0.677   | 0.001       |
| CI (95 %)                | (713.71–762.17)   | (714.11–778.93)       |         | No effect   |
| Effect size              | 0.001 No effect    | 0.005 No effect        |         |             |
| Light PA (min/day)       | 311.02 (114.74)   | 276.65 (88.00)        | 0.003   | 0.024       |
| CI (95 %)                | (297.51–324.52)   | (258.59–294.72)       |         | No effect   |
| Effect size              | 0.001 No effect    | 0.001 No effect        |         |             |
| Moderate PA (min/day)    | 52.93 (42.61)     | 56.66 (43.33)*        | 0.422   | 0.002       |
| CI (95 %)                | (47.46–58.39)     | (49.35–63.97)         |         | No effect   |
| Effect size              | 0.003 No effect    | 0.027 No effect        |         |             |
| Vigorous PA (min/day)    | 5.17 (8.65)       | 3.71 (6.63)*          | 0.091   | 0.008       |
| CI (95 %)                | (4.15–6.19)       | (2.35–5.07)           |         | No effect   |
| Effect size              | 0.002 No effect    | 0.071 Minimum effect   |         |             |

* Statistically differences between men and women for a p value <0.05
subcutaneous adipose tissue in women compared to in men.

The analysis of variance conducted in male participants revealed that athletes spend statistically more time in light PA than do non-athletes. No statistical differences were found in the remaining PA levels; nevertheless, a slightly greater average amount of time spent in vigorous activity and number of steps walked per day were found in athletes. On the other hand, non-athletes spent more time in sedentary mode and in moderate PA activities.

These pieces of evidence may lead to a thought that an athlete can be highly physically active but also can spend the rest of the day mostly in sedentary mode (Júdice et al. 2014). In fact, a study suggested that time spent in moderate-to-vigorous PA is unrelated with the sedentary patterns of athletes and track their physical activity in line with healthy guidelines. Nevertheless, a gap between male and female non-athletes may suggest some specific behaviour that must be tracked over the course of years. Specific programmes aimed at non-athletes must be applied, mainly to promote the benefits of PA, as well as to engage non-athletes in regular PA activities over the week. In this field, special attention should be given to the female population, with attempts made to develop some activities that correspond to their expectations and aspirations.

Conclusion

The main results of this study suggested that sports training closes the gap between physical activity patterns of male and female athletes. Nevertheless, without competitive practice, an increase of differences between male and female non-athletes can be verified. This may have serious implications over the years. It was also possible to verify that athletes and non-athletes have some similar sedentary and light PA patterns, and thus it would be interesting to track this idea in future studies with the special population of athletes.

Authors’ contributions

FMC: Conceived and designed the experiments. Performed the experiments. FMC and FMLM: Analyzed the data. RSM: Contributed reagents/materials/analysis tools. FMC and PTN: Wrote the paper. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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