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Energy Expenditure and Physical Activity in a University Population in the Coastal Region of Ecuador

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Abstract: Background: Variations in physical activity greatly affect total energy expenditure, and therefore its examination contributes to the prevention of systemic disease. We sought to evaluate energy expenditure and physical activity within a university population from the coastal region of Ecuador. Methods: A descriptive and observational research study was developed to compare 1038 university students. Weight, height, resting metabolic rate and estimated energy needs were estimated. A 24 h recall questionnaire was administered to examine the relationship between total energy expenditure and physical activity. The "IPAQ" (international physical activity questionnaire) was employed to classify the type of physical activity performed and weekly metabolic equivalent (MET) minutes were calculated. Results: Male and female participants showed total energy expenditures of 2571.26 ± 321.26 and 1924.75 ± 112.78 kcal/day, respectively, with resting metabolic rates of 1864.12 ± 206.67 and 1373.96 ± 178.28 kcal/day, respectively. A total of 81.88% of the population reported being sedentary. With regards to time distribution between activities, insignificant time was dedicated to sport and health-related activities. Weekly MET minute expenditure was classified as low in 45.37% of individuals, moderate in 52.2%, and high in 3% of individuals. Conclusions: We conclude that the studied population led a notably sedentary lifestyle, which was contingent on voluntary behavioural states including the avoidance of certain exercises. Such tendencies are harmful to health.

Keywords: physical activity; total energy expenditure; energy profile; university student; nutritional education; wellbeing

1. Introduction

Physical activity (PA) refers to any type of musculoskeletal activity which raises energy expenditure above basal values. It is considered as the component to show the greatest variability relative to total energy expenditure (TEE). Physical activity is determined by both physiological and cultural factors. The latter conditions the behaviour assumed by individuals in daily life routines, in addition to motor activity habits associated with physical exercise for the preservation of good health, physical recreation, or organised sport engagement. In any case, physical activity leads to an energetic cost that elevates metabolism in line with the energy needs of muscular activity. For this reason, a large number of diverse authors consider the determination of total energy expenditure to be essential [1–3].

Systematic and planned engagement in physical activity in the educational context has various benefits which have been roundly discussed in the scientific literature [4–8]. It is considered a protective factor against systemic or non-communicable chronic disease. Furthermore, it contributes to body weight control, favouring muscle tone and physiological capacities such as strength and resistance. It even influences the neurological processes associated with increased concentration in students, having an obvious contribution to their subsequent development and improving their academic performance and emotional control [5].

Nonetheless, despite the aforementioned benefits, institutional concern is notable both nationally and internationally regarding populational trends towards adopting sedentary lifestyles and drastically reducing physical activity whilst, at the same time, observing wide tobacco and alcohol consumption, and following diets which contribute to obesogenic trends. This drives the emergence of immunological disorders [9] and chronic non-communicable disease [10–12], carrying with them increased morbidity and mortality amongst individuals, alongside economic losses for all countries.

The university population is not exempt from these concerns. A number of authors have expressed unease in relation to the situation described above [13–16] and have encouraged educational training to include behavioural changes in this sector, given that universities act as professional training centres. They are, therefore, key to countries achieving their economic and social potential, without dismissing the fact that the political leaders of these countries are also trained within the same sector. Consequently, examination of this aspect is necessary to be able to roll out actions which will contribute towards changing the state of such aspects, particularly in Ecuador where this issue has been well documented [17,18]. In accordance with that which has been previously discussed, the aim of the present work was to evaluate energy expenditure and physical activity in a university population from the province of Manabí, Republic of Ecuador.

2. Materials and Methods

2.1. Design

A descriptive and observational comparison study is presented which examines physical activity patterns in a 24 h cycle within students undertaking degree studies at the Laica "Eloy Alfaro" de Manabí University (ULEAM). This study formed part of the "Dietary Habits, Physical Activity and Health in Populational Groups Coming from the Coastal Region of Ecuador" project.

2.2. Participants

The population was comprised of students from the faculties of Science and Education. Of a total of 1832 registered students, 1038 (57%) agreed to participate in the present study. Individual students provided the unit of analysis, with ages being distributed between 19 and 30 years.

2.3. Instruments

The following instruments were used as anthropometric measures of the individuals participating in the present study:

A Tanita InnerScanV Model: BC-545N scale with 0.1 kg accuracy (TANITA Corporation of America, Inc., Arlington Heights, IL, USA) was used to measure weight (w), whilst height (h) was obtained through use of a portable vertical SECA 206 stadiometer with a range of 0–220 cm (Medizinische Waagen und Messsysteme, Hamburg, Germany).

In order to determine total energy expenditure, the 24 h recall survey and the long version of the international physical activity questionnaire (IPAQ) were used to evaluate the type of physical activity (PA) performed throughout the week.

2.4. Procedure

Weight (w, kg) and height (h, m) were taken according to the methodology defined by Marfell-Jones, et'al. [19] for the direct measurement of anthropometric variables.

Variables of energy expenditure included resting metabolic rate (RMR/kcal), estimated according to the method proposed by the FAO [20], in addition to estimated energy requirements (EER/kcal) which were estimated through the equations presented by the Food and Nutrition Board/Institute of Medicine [21] for individuals aged 18 and older.

The method of 24 h recall via an activity diary was used. Diaries were completed for three alternate days of the week in order to estimate daily routines and activity patterns from the prior day. The time spent on these activities and energy cost were also deduced from these diaries. In order to calculate the energy expenditure of each activity (GE), weight (kg) was multiplied by a factor corresponding to the type and quantity of physical activity in which the participant engaged [22]. Total energy expenditure (TEE) was obtained by summing the energy cost of each of the activities performed in the same 24-h period (1440 min). From RMR, TEE and EER values, physical activity level (PAL) was then determined from relevant quotients, as follows: TEE/RMR = actual physical activity level (PAL_a) and EER/RMR = theoretical physical activity level (PAL_t) [20].

Daily activity patterns were also constructed according to the time dedicated to specific activity and grouped in the following way:

1. Academic activities (academic formation).
2. Sleep time (within sedentary activities).
3. Paid work activities.
4. Personal grooming (within personal hygiene).
5. Dressing (within personal hygiene).
6. Domestic and unpaid home maintenance activities which are discretional in nature.
7. Recreational activities (socially desirable tasks taken on voluntarily that fall outside of mandatory activities, for example, fun activities, dancing, going for a walk).
8. Exercise for preserving health (physical workouts, calisthenics, strolls and walks, sporting games for recreation, all performed with a defined purpose).
9. Sport practice (formal organisation in sports teams with training sessions).
10. Dietary activities (feeding practices throughout the day).
11. Movement and transport activities (moving from the home to the place of study or work).
12. Sedentary activities (sitting down to read, write, talk, wait, discretional activities without a physical workout).

In the same way, the international physical activity questionnaire (IPAQ) was administered to determine activity type according to intensity. This distributes activities between the categories of light, moderate and vigorous or high, whilst also describing the frequency of engagement (days a week) and time in minutes of the session duration. Finally, metabolic equivalents (METs) were calculated by multiplying the multiplicative factor corresponding to the PA category with the duration of daily activity sessions and the number of days a week on which the activity was performed [23–25].

Results were recorded in a database created in Microsoft Office Excel 2016. Statistical analysis 130 was conducted using the program SPSS (SPSS Statistics for Windows, version 23.0, SPSS Inc., Chicago, IL, USA). For continuous variables, means ($\overline{X}$) and standard deviations (SD) were calculated, whilst percentages were calculated for categorial variables. Furthermore, normality of the data was examined via the Kolmogorov–Smirnov test. Based on the outcome of this test, either the independent samples *t*-test or Mann–Whitney U test (Z) ($\alpha = 0.05$, two-tailed *p*-value) was employed for comparisons. Associations between variables were determined through Pearson correlations (r) and linear regression.

In order to guarantee the uniformity of measurements and data quality, in-depth training was carried out with all collaborators who participated in fieldwork. Specifically, a workshop was developed which addressed both anthropometric and questionnaire measurement, in addition to organising paired work tasks. Field diagnostics started by conducting an analysis of variance in order to check the extent of technical errors resulting from anthropometric measurement and control over data collection. The latter was improved through simple random sampling with a reference level of 20%. Whenever doubts arose regarding data quality, including when TEE confidence limits were exceeded (following calculation of arithmetic average ± 1.96 × the standard deviation), data were resubmitted to evaluation.

The entire data collection process was carried out within the setting of the ULEAN during timetabled teaching activities and under constant supervision of the authors of the present work and collaborators. At the same time, the purpose of the research was explained to participants, whilst also committing to protect confidentiality and data anonymity. Following this, participants agreed to participate voluntarily and signed an informed consent form in accordance with the principles of the Declaration of Helsinki and the bioethical considerations laid out by the university itself.

3. Results

A total of 1038 university students participated in the present study, of which 237 (23%) were male and 801 (77%) were female. Average age was reported to be 21.25 ± 3.53 years.

The distribution of RMR, TEE, EER, PAL_t and PAL_a values are presented in Table 1. These values demonstrate statistically significant gender differences for all studied parameters, with the exception of the variable describing age.

Table 1. Descriptive statistics and hypothesis testing in relation to weight, energy consumption and physical activity level values of the sample, stratified according to gender.

Variables	Males	Females	Hypothesis Test	
	$\overline{X}$ ± SD	$\overline{X}$ ± SD	t $^{(1)}$–Z $^{(2)}$	*p*-Value
Age	20.01 ± 3.03	21.38 ± 4.98	−0.24 $^{(2)}$	0.81
Weight (w, kg)	65.82 ± 13.73	59.88 ± 12.03	−3.58 $^{(1)}$	0.001 **
Height (h, m)	1.67 ± 0.07	1.56 ± 0.06	−13.94 $^{(2)}$	0.001 **
Resting Metabolic Rate (RMR)	1864.12 ± 206.67	1373.96 ± 178.28	−13.85 $^{(1)}$	0.001 **
Actual Physical Activity Level (PALa)	1.38 ± 0.01	1.40 ± 0.27	−7.24 $^{(2)}$	0.001 **
Estimated Energy Requirements (EER)	2419.60 ± 165.71	1899.34 ± 182.56	−22.57 $^{(2)}$	0.001 **
Total Energy Expenditure (TEE)	2571.26 ± 582.3	1924.75 ± 437.59	−4.63 $^{(2)}$	0.001 **

Notes: hypothesis testing: student's t: $^{(1)}$; Mann–Whitney U test (Z): $^{(2)}$ 0.05 > *p* > 0.01; (**)

TEE was statistically different from EER within the male population ($Z_{EER\text{-}TEEmasc}$ = 25.659; *p*-value = 0.02, <0.05), however, this was not the case within the female population (Z = 21.50; *p*-value = 0.23, >0.05). PAL_a was seen to behave in the same as PAL_t in the male population (Z = 0.04; *p*-value = 0.00, <0.05) and in the female population (Z = 7.03; *p*-value = 0.18, >0.05).

Table 2 presents the distribution of the sample studied according to PAL_a and shows that the majority of individuals, irrespective of gender, are sedentary. Concretely, 81.88% of the total sample were sedentary. Furthermore, the highly active category does not include any females, with significant differences emerging in all cases.

When considering the distribution of time dedicated to each of the activity groups (Table 3), it is shown that sleep dominates (31%), followed by academic activities (28%) and, next, sedentary activities (11%). The remaining activities all take up less than 6% of the time available to students in a 24 h cycle. This includes activities dedicated to sport and exercise for the preservation of health.

Energy expenditure for each physical activity is presented in Table 3. Statistically significant gender differences again emerge in relation to activities pertaining to sleep, academic study, paid work, domestic tasks, health preservation exercises and sport. Activities accounting for the greatest energy expenditure coincide with those to which most time was dedicated.

Table 2. Distribution of physical activity levels according to gender, stratified according to activity patterns shown in daily routine.

PALa	Gender				Total		Hypothesis Testing (Comparisons)	
	Male		Female				Z	*p*-Value
	n	%	n	%	n	%		
PA = 1.00, when 1.0 ≤ PAL < 1.4 (sedentary)	171	72.15	679	84.76	850	81.88	−1.38	0.001 **
PA = 1.13, when 1.4 ≤ PAL < 1.6 (barely active)	29	12.2	81	10.11	110	10.59	−2.04	0.001 **
PA = 1.26, when 1.6 ≤ PAL < 1.9 (active)	23	9.70	41	5.11	64	6.16	−1.81	0.001 **
PA = 1.42, when 1.9 ≤ PAL < 2.5 (highly active)	14	13.48	0	0.00	14	1.34	−0.25	0.001 **

Note: PA: Classified according to ranges corresponding to the participant's PAL [20,26]; 0.05 > p > 0.01; (**) 0.01

Table 3. Time dedicated to activities of daily living within a 1440 min (24 h) cycle and energy expenditure (kcal/24 h) according to physical activity (GE-PA).

Variable	Academic Activities	Sleep	Paid Work	Personal Grooming	Dressing	Domestic Activities	Recreation	Health Exercises	Sport	Feeding	Transport	Sedentary Pursuits	Total
Time (min)	399.8 ± 129.3	453.1 ± 60.5	77.5 ± 8.1	22.5 ± 3.4	20.1 ± 5.1	49.2 ± 8.8	80.2 ± 6.8	29.1 ± 2.8	8.0 ± 2.6	67.1 ± 34.2	71.1 ± 62.2	162.3 ± 34.9	1440
GE-PA (kcal)	551.7 ± 42.7	625.2 ± 103.3	146.2 ± 18.1	31.3 ± 3.3	27.8 ± 8.3	90.3 ± 11.1	111.6 ± 16.7	73.5 ± 2.4	37.1 ± 14.0	92.6 ± 27.1	98.2 ± 15.8	250.6 ± 71.8	2135 ± 237
Male													
Time (min)	407.6 ± 131.9	459.6 ± 51.9	102.3 ± 85.6	22.5 ± 12.4	19.1 ± 10.1	10.2 ± 6.8	78.5 ± 65.4	53.8 ± 30.7	12.0 ± 8.8	62.1 ± 31.8	63.5 ± 4.9	148.8 ± 36.6	1440
EE/PA (kcal)	587.9 ± 44.6	666.3 ± 128.5	194.4 ± 22.7	33.4 ± 26.9	29.6 ± 9.3	96.3 ± 7.5	118.9 ± 18.2	141.8 ± 43.2	110.6 ± 83.9	98.7 ± 31.0	104.6 ± 24.4	267.0 ± 73.0	2571 ± 321
Female													
Time (min)	396.7 ± 128.3	450.4 ± 63.6	52.8 ± 78.9	22.8 ± 13.9	20.5 ± 16.8	88.1 ± 6.9	81.8 ± 67.5	5.8 ± 3.0	4.0 ± 2.6	69.2 ± 4.9	74.4 ± 8.6	173.6 ± 36.1	1440
EE/PA (kcal)	511.3 ± 39.9	580.6 ± 91.2	98.0 ± 12.4	29.3 ± 21.2	26.4 ± 15.8	113.6 ± 13.1	105.5 ± 15.6	14.4 ± 4.2	34.3 ± 3.4	89.2 ± 25.5	95.8 ± 14.0	226.3 ± 62.7	1924 ± 112
Test Statistics for Gender Difference in Energy Expenditure and Physical Activity													
M–W U	−2.29	−3.8	−0.6	−1.46	−1.1	−10.25	−1.29	−16.58	−2.57	−1.64	−0.68	−1.48	–
p-value	0.02 *	0.04 *	0.04 *	0.14	0.27	0.03 *	0.08	0.001 ***	0.01 *	0.11	0.09	0.14	–

Note 1: EE/PA, Energy expenditure/Physical activity (kcal); M–W U, Mann–Whitney U (Z). Note 2: *, $p < 0.05$; ***, $p < 0.001$.

Outcomes pertaining to energy expenditure obtained following administration of the IPAQ are presented in Table 4. An overall average of 1111.74 ± 110.06 MET minutes a week is observed.

Table 4. Energy expenditure as weekly metabolic equivalent (MET) minutes according to international physical activity questionnaire (IPAQ) scores.

Metabolic Equivalents (MET)	Work-Related Physical Activity	Housework, Maintaining the Home and Caring for Family	Physical Activity through Recreation, Sport and Leisure Time	Transport-Related Physical Activity	Total MET Minutes
MET min/week	245.88 ± 82.64	216.05 ± 115.81	415.04 ± 138.25	234.76 ± 97.49	1111.74 ± 110.06
			Male		
MET min/week	317.66 ± 78.48	33.76 ± 12.28	641.44 ± 116.47	209.62 ± 99.60	1202.47 ± 105.97
			Female		
Total/MET min/week	174.14 ± 73.24	290.83 ± 86.74	366.60 ± 130.85	245.36 ± 97.48	1076.93 ± 99.64

According to gender, males achieved higher physical activity values in relation to work activities and physical activity through recreation, sport and leisure time. On the other hand, females achieved higher scores in the categories pertaining to housework and physical activity through transport.

As laid out by the classification criteria for physical activity levels defined in the IPAQ, within the studied sample 45.3% of students belonged to the low physical activity category. The majority, 52.02%, belonged to the moderate category and only 3% belonged to the category of high physical activity. When examining according to gender, a higher percentage of females were found in the low condition, with higher percentages of males in the other two categories (Table 5).

Table 5. Sample distribution according to physical activity levels as determined by the criteria established in the international physical activity questionnaire (IPAQ).

Gender	Physical Activity Level						Total
	Low	%	Moderate	%	High	%	
Males	67.00	28.27%	153.00	64.65%	17.00	7%	237.00
Females	404.00	50.43%	387.00	48.31%	10.00	1%	801.00
Total	471.00	45.37%	540.00	52.02%	27.00	3%	1038.00

4. Discussion

Height (h) and weight (w) are anthropometric variables of great interest in human populations. Both are found to be associated with nutritional state and physical development. According to data provided by the Economic Commission for Latin America and the Caribbean (ECLAC) in 2000 [27], average height in Ecuador was 1.65 for men and 1.55 m in women. Later reports corresponding to the period 2011–2013 [28] established similar height values of 1.66 m and 1.54 m, respectively. These values are lower than the averages obtained for the population studied in the present study Similarly, with regards to weight, ECLAC reported values of 59.99 kg and 50.45 kg in men and women, respectively. Again, in 2011–2013, Freire et al. [28] reported higher values, with averages of 69.6 kg in men and 60.4 kg in women. Results obtained in the present research work are similar to those previously presented.

The situation described here points to slight changes in height over a 20-year period within the Manabi population. This cannot be said for weight, which saw an increase of around 10 kg in females up until the time of the present study. In contrast, values presented by Freire et al. [28] for the male population showed a similar increase up until 2013, although values presented in the present study indicate a slight decrease in this trend.

Comparing the results obtained for height and weight with those from other populations, lower values are reported here than those previously found in Spanish university students. Only in the case of females from Ecuador has weight been seen to slightly exceed that of their peers [29], with similar patterns seen in Chilean university students [30].

It is worth considering that height is controlled by individual genetics and subsequent hormonal changes occurring throughout the growth period [31,32], and influenced by environmental factors such as nutritional feeding habits. In contrast, weight refers to body mass and reflects the standard reaction of each individual. Weights show greater variability in relation to phenotype plasticity and is dependent on nutritional energy balance [33–35].

Nutritional energy balance has two components, total energy expenditure (TEE) and dietary energy intake [33]. Only the former was considered in the present work, with regards to the way in which varying expenditures impact the state of continuous energy expenditure within the organism. This was considered from both PA engagement and RMR. The post-prandial thermogenic effect was excluded due to the fact that it is non-continuous in nature, with an approximate cost of 10% TEE, and modified by variations in diet composition, consumption frequency and individual feeding timetables [36]. In accordance with the calculations performed, the 24 h energy profile for the studied population shows a different relationship depending on gender, with a profile of 72%-RMR/28%-PA in males and 71%-RMR/29%-PA in females. These proportions depict a sedentary adult population [2,20].

It should be highlighted that estimates of TEE according to the different physical activities performed, achieved a general value of 2135.9 kcal/day. This is similar to standard values accepted as meeting basic needs for dietary energy in Ecuador, for instance, the value of 2141 kcal/day per capita of monthly consumption as an indicator of poverty [20,37]. Furthermore, dietary energy consumption values reported by Freire et al. [28] for the population of the Montubia region, a region included within the present sample, are lower than the aforementioned values. This suggests a negative energy balance conditioned by low nutritional energy ingestion. The physiological response to such a state will ultimately lead to a reduction in weight.

Nonetheless, the existence of a significant correlation between weight and TEE ($r = 0.567$; p-value = 0.001; <0.00) shows the way in which mechanisms act to protect body mass and, particularly, energy reserves. This is associated with sedentary behavioural patterns. Thus, in consideration of the mentioned association and statistical trends towards an increase in TEE in line with weight increases, a prediction equation of: $y = 553.646 + 22.37(x)$ is proposed. In this way, it can be seen how the conservation of body mass is favoured in adults [38] subjected to therapeutic nutritional interventions.

The RMR of research participants was higher in both genders than that reported for the Ecuadorian population by CEPAL. CEPAL reported 1594.8 kcal for males and 1223.7 kcal for females [27], with this representing a difference of 269.32 kcal and 150.26 kcal, respectively, relative to the present study. In contrast, EER was similar to that expressed by standard organisms for sedentary lifestyles or lifestyles with low levels of physical activity (2550 kcal in males and 1900 Kcal in females) in individuals aged between 18 and 30 years [27,39]. These data show lower values than those declared by Spanish university students within the same age range [29]. It should be considered that RMR, together with TEE, is one of the components used for determining PAL. According to equations presented by the World Health Organization (WHO), the calculation of RMR considers the variable of P (kg). Weight, in its variable condition, exerts a marked influence on obtained results, explaining differences of approximately 500 kcal between genders.

PAL produced both actual and theoretical mean values which classify the studied population as sedentary [20,39]. This is a similar situation to that reported by university students from practically all continents [9,16,29,40,41], including those from the mountain region of Ecuador [42]. In the present study, it is notable that PAL was higher in females than in males and does not fit with trends presented by Rangel Caballero et al. [9] in Latin American students. Likewise, it serves to mention that there was no statistically significant association with weight ($r = -0.011$; p-value = 0.83; >0.05), despite this indicator being a risk factor for health [43].

Furthermore, the extent of sedentary behaviour in university students has been pointed to as a concern by other authors [17,44] who attribute its cause to voluntary behavioural states characterised by the absence of engagement in certain exercises or planned and oriented musculoskeletal movements. In the present study it was even uncovered that the time dedicated to planned physical activities for health reasons or sport, represents two percent and has a negligible energy cost contribution towards total energy expenditure.

It serves to point out that students' daily sleep regimes were of prime importance, followed by academic activities as another prime function. Next come sedentary activities, which include sitting down to read and writing on social networks or using them for entertainment purposes. With the use of smartphones and other electronic devices, such activities can be exercised at any time, even in intervening rest periods from the aforementioned activities.

In addition, physical activity outcomes from the IPAQ were lower than those obtained in students from Argentina [14] and Bucaramanga—Colombia [45], although values were higher than those presented in reports on Hindu students (706 MET-mins/weeks) [14] and similar to those on degree students from the University of Pamplona in Colombia [15].

According to the distribution of MET minute contributions, 37% was dedicated to recreational and leisure-time physical activity and sport, followed by 22% dedicated to work-related activities, 21% pertaining to activities linked to transport, and 20% corresponding to home maintenance and family care. These results coincide with those reported in the study by Pérez-Ugido and their team in Argentina [14].

The number of sedentary individuals in the studied population according to the IPAQ was lower than that suggested by the PAL and indicates that fewer students pertain to the condition of low physical activity than that reported in a similar study conducted in the mountain region of Ecuador [42] or that stated by Rangel et al. [9] in South American students. However, it was higher than that revealed by students from Bucaramanga—Colombia [16].

With regards to engagement in physical exercise, the OMS recommend that adults aged between 18 and 64 years engage in at least 150 min a week of moderate aerobic activity or 75 min of vigorous aerobic activity, or an equivalent combination of both in order to avoid malaise [46]. In the studied population, estimated weekly time was 184.75 min, with a daily average of 29.05 min dedicated to health enhancing activity and 7.9 min to sport. There was little diversity seen in relation to the types of activities performed, with activities being limited to running, walking, strength training and playing football.

It was found that the majority of students who played sports tended to be the same students who performed health-enhancing exercises, with 329 min/week being invested in this. Nonetheless, 43.45% of the male population were undertaking the degree courses of Physical Education and Sport Pedagogy, and Physical Education, Sport and Recreation in the Faculty of Educational Sciences. Their professional training includes practical modules which demand a high level of motor skills and form part of their daily regimen. In the case of females, the situation is alarming with females only dedicating 9.8 min a day to both activities.

In comparing the results obtained for life routines and activity patterns with the evaluation of physical activity types via the IPAQ, notable inconsistencies emerged with regards to the individuals evaluated as sedentary. There is a 36% difference in comparison with evaluations conducted by Santillán Obregón in Business Administration and Medicine students from the mountain region of Ecuador [42].

As a limitation, it should be mentioned that a difference exists between the number of participants as a function of gender, given that the study considered all individuals enrolled on pedagogical degree courses and those within the branch of health sciences, such as nursing. It is normal to find more women enrolled on these courses. This fact urges the development of future related studies in which a more homogenous gender distribution could be found.

In this sense, as strengths of the present study it serves to mention the sample size and the comparisons conducted between employed diagnostic techniques for the determination of energy expenditure and physical activity. The contribution of these data will enable educational intervention programs to be planned in the university context.

5. Conclusions

In accordance with the discussion presented above, the following conclusions can be made.

Changes in the anthropological conditions of the studied population have been seen over the last 20 years. Although these changes were not significant with regards to height, a large increase in body weight was observed.

The studied population was characterised by a largely sedentary lifestyle caused by voluntary behavioural states which are void of specific exercises or planned and oriented musculoskeletal movements, this being a harmful trend for health.

Activity patterns within a 24 h cycle were characterised by a predominant amount of sleep, followed by academic activities and, finally, sedentary activities. The latter are developed in a spontaneous and discretional way without physical excitation and void of a primordial aim. They are marked by a strong tendency towards connecting with social networks and other actions associated with the use of electronic devices, which penetrate other types of activities.

Research participants were not under the influence of educational intervention programs which involve behavioural changes linked to physical activity. Evidently, this has a negative impact on motor skill development which would otherwise favour health and quality of life. This is further mediated by the absence of the subject of Physical Education from their pre-professional study plans.

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