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Energy Expenditure of Ecuadorian Students During the COVID-19 Pandemic: Analysis of Group and Individual Responses

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Abstract: This study aimed at determining changes in physical activity (PA) and energy expenditure of Ecuadorian students during the COVID-19 pandemic. A sample of 1033 students completed the short version of the International Physical Activity Questionnaire to estimate energy expenditure in metabolic equivalents of task (MET) in MET·min^{-1}·week^{-1}. Absolute reliability and the smallest worthwhile change (SWC) were computed. Men reduced vigorous-intensity energy expenditure ($p \leq 0.0001$; 95%CI diff.= -410.8, -698.6 MET·min^{-1}·week^{-1}) and moderate-intensity ($p \leq 0.0001$; 95%CI diff.= -283.6, -138.4 MET·min^{-1}·week^{-1}). Walking energy expenditure was higher at the beginning than during the pandemic ($p \leq 0.0001$; 95%CI diff.= -379.6, -303.0 MET·min^{-1}·week^{-1}). Men and women reduced their total energy expenditure ($p \leq 0.0001$; Men CI95% diff.= -1311.7, -894.1 MET·min^{-1}·week^{-1}; Women CI95% diff.= -654.0, 290.0 MET·min^{-1}·week^{-1}). Sitting time was lower at baseline than during the pandemic ($p \leq 0.0001$; 95%CI diff.= 0.48, 0.74 h). The 85.8% of the participants did not change their vigorous energy expenditure, 5.0% increased it, and 9.2% reduced it. The 86.6% of the sample did not change the energy expenditure of moderate intensity, 4.6% increased it, and 8.7% reduced it. Indeed, 84.6% did not change walking energy expenditure, 1.4% increased it, and 14.0% reduced it. The total energy expenditure did not change in 84.2% of the participants, 4.3% increased it, and 11.5% reduced it. The sitting time did not change in 79.3% of the participants, 15.0% increased it, and 5.7% reduced it. In conclusion, the energy expenditure from PA was reduced during the COVID-19 pandemic in Ecuadorian university students. More than 79% of the students maintained their habits, confirming that changing behavior remains challenging. These findings are significant given the deleterious effects of reduced physical activity on cardiometabolic health.

Keywords: Physical activity, Smallest worthwhile change, Hispanics, Metabolism, Sedentary behavior

1. Introduction

Sedentary behavior has been widely described as a factor directly related to the appearance of non-communicable chronic diseases (Arocha Rodulfo, 2019; Izquierdo *et al.,* 2021; Lavie *et al.,* 2019). Even though the phenomenon has been fought for decades, most international organizations point to a progressive increase in sedentary lifestyles in different populations (Bull *et al.,* 2020). Sedentary behavior leads to increased body fat accumulation, overweight and later to obesity; thus, an increase in energy consumption from foods and inadequate energy expenditure from physical activity (PA) (i.e., sedentary behavior) will result in a deleterious energy balance (Blüher, 2019). In addition, the pandemic caused by the severe acute respiratory syndrome (SARS-CoV-2) or COVID-19 generated mandatory confinement, restricting in many cases the possibility of PA and, consequently, exacerbating sedentary behavior (i.e., increasing energy imbalance) in different groups of the population (Stockwell *et al.,* 2021).

College students regularly show highly sedentary behavior, sitting for long periods daily (Castro *et al.,* 2020). Paradoxically, physically active

students can also be considered sedentary due to long hours sitting in front of a screen; therefore, increasing their energy imbalance. Evidence indicates that during the COVID-19 pandemic, sedentary behavior in university students decreased (Rutkowska *et al.,* 2021), even though sitting time increased (Romero-Blanco *et al.,* 2020). However, other studies consistently indicate that sedentary behavior increased during the COVID-19 pandemic, even in previously physically active students (Franco *et al.,* 2021; Gallè *et al.,* 2020; Heller *et al.,* 2023; Luciano *et al.,* 2021).

This scientific evidence points to differences in physical activity (PA) levels; however, these differences are based on group scores (i.e., mean) and do not consider individual responses. Although group responses are essential for establishing public health policies, it does not allow for knowing the influence of the individual's biological variability on the response of the dependent variable of interest (e.g., PA). Individual differences and those of non-responders to intervention (or lack thereof) can be observed when the changes experienced by individuals are above or below their biological variability, respectively (Hopkins, 2004; Moncada Jiménez *et al.,* 2023). Otherwise, the intra-subject differences observed due to the effect of a treatment (or the absence of it) could be due to an inconsistency in the response of the individuals between measurements on the dependent variable (Hopkins, 2004; Moncada Jiménez *et al.,* 2023).

Reliability statistics make it possible to know whether the observed responses are due to the intervention (or the absence of it), setting aside the possible biological variability of the person, thus allowing the group information to be complimented. For example, the typical error of measurement (TEM) allows knowing the variation that can be expected between measurements if one of the participants is assessed multiple times. The coefficient of variability (CV) is also a relative representation of the TEM and describes the change a person obtains in different tests; the lower the value, the greater the consistency and homogeneity. Furthermore, it is easier to interpret because it is presented in relative (i.e., %) and not absolute (e.g., kg, cm, mmHg) units (Hopkins, 2000; Hopkins *et al.,* 2001). Currently, the smallest worthwhile change (SWC) is promoted, representing the minimum relevant value representing a change in the dependent variable of interest. Generally, the SWC is usually smaller than the TEM (Hopkins, 2000; Hopkins e*t al.,* 2001); thus, regardless of whether a hypothesis test yields statistically significant results (e.g., $p \leq 0.05$), the reliability statistics and the SWC contribute to determining what the truly important change is for a person or a group of people, allowing them to be classified with the higher accuracy. In this sense, it has been determined that values 1.5 to 2 times the TEM ensure a relevant change for a variable of interest (Hopkins, 2000; Moncada Jiménez *et al.,* 2023).

In this context, the purpose of the study was to determine the group and individual responses to the change in energy expenditure from vigorous and moderate intensity PA, walking, total PA, and sitting time of Ecuadorian university students during the COVID-19 pandemic. The problem that led our study was: ¿What is the group and individual change, if any, of the energy expenditure derived from PA in Ecuadorian students during the COVID-19 pandemic?.

2. Method

2.1. Participants

Secondary data analysis was performed from a recently published study (Barreto Andrade et al., 2023). Briefly, the study had a cross-sectional design in which volunteers were 1033 Ecuadorian students (Men=446, Women=587) between the ages of 17 and 65 years. The volunteers provided informed consent to participate in the study and completed an on-line questionnaire.

2.2. Procedures

Students completed online the Spanish version of the International Physical Activity Questionnaire Short Form (IPAQ-SF) (Craig *et al.,* 2003). The IPAQ-SF is used as a comparable and standardized self-report measure of habitual PA of populations from different countries and socio-cultural backgrounds. The IPAQ-SF addresses the number of days and time spent on PA in moderate intensity, vigorous intensity, and walking of at least 10-min duration the last seven days, and also includes time spent sitting on weekdays the previous seven days (Craig *et al.,* 2003). Total PA is obtained by considering PA duration (i.e., minutes per day), frequency (i.e., days per week), and intensity (i.e., walking, moderate or vigorous intensity) (Craig *et al.,* 2003). The information collected estimates the energy expenditure in metabolic equivalent tasks (i.e., MET). A MET measures the energy expenditure required during a PA in relation to the energy expenditure required at rest. This value corresponds to 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$ and can describe the intensity of PA; for example, moderate-intensity PA requires 3-6

METs, while vigorous-intensity PA requires >6 METs (Ainsworth *et al.*, 2011). According to the IPAQ classification algorithm, the energy expenditure (MET·min^{-1}·week^{-1}) for walking is obtained by multiplying 3.3 x walking minutes x days; expenditure on moderate intensity PA is obtained by multiplying 4.0 x minutes of moderate-intensity PA x days; the expenditure on vigorous-intensity PA is obtained by multiplying 8.0 x minutes of moderate-intensity PA x days. Finally, the total energy expenditure is estimated by adding the expenditure in walking, moderate PA, and vigorous PA (Craig *et al.*, 2003).

2.3. Statistical Analysis

Data analysis was performed using the IBM-SPSS software, v. 26 (IBM North America, New York, USA), and the Excel spreadsheet (Microsoft Corp., Washington, USA). Descriptive and inferential statistics from 2-way ANOVA (sex x measurements) were calculated. The least significant difference (LSD) post-hoc analysis was calculated for the main effects and the 95% confidence interval of the mean difference (95% CI Diff.) in case of obtaining statistically significant interactions at $p < 0.05$. Absolute reliability and individual response were also calculated using the TEM, CV(%), and SWC (Hopkins, 2000; Moncada Jiménez *et al.*, 2023). The difference between pre- to post-pandemic scores was first computed. Then, the standard deviation of these differences was obtained. That value was divided by the square root of two to obtain the TEM. The resulting value is displayed in the original units (i.e., MET·min^{-1}·week^{-1} or sitting hours). Subsequently, the CV was calculated, taking the standard deviation of the differences and dividing it by the average of all the data (i.e., before and after the pandemic) and multiplying the result by 100 to express the value in relative terms (i.e., %) (Hopkins, 2000; Moncada Jiménez *et al.*, 2023). The SWC was calculated based on the CV(%) result. For a CV > 5%, the ETM was multiplied by 2.0, but if the CV < 5%, then the ETM was multiplied by 1.5. The calculated value was used as the threshold to determine the percentage of students who improved, worsened, or did not change (Hopkins, 2000; Hopkins, 2004; Moncada Jiménez *et al.*, 2023).

3. Results

The study included 446 men (Age = 23.8 ± 6.2 years) from the Catholic University of Cuenca (59.4%) and the University of Cuenca (40.6%). A total of 587 women (Age = 22.8 ± 6.0 years) from the Catholic University of Cuenca (64.7%) and the University of Cuenca (35.3%) also participated. The inferential statistics of 2x2 ANOVA show a significant interaction between gender and measurements on vigorous-intensity energy expenditure ($p \leq 0.0001$). In general, men reduced their energy expenditure (Before = 1795.0 ± 1761.2 vs. During = 1240.3 ± 1634.0 MET·min^{-1}·week^{-1}; $p \leq 0.0001$; 95%CI diff. = -410.8, -698.6 MET·min^{-1}·week^{-1}), while women did not significantly reduce it (Before = 1134.0 ± 1507.0 vs. During = 1026.3 ± 1328.2 MET·min^{-1}·week^{-1}; $p = 0.092$; 95%CI diff. = -233.1, 17.7 MET·min^{-1}·week^{-1}).

A significant interaction was found between gender and measurements on moderate-intensity energy expenditure ($p \leq 0.0001$). In general, men reduced their energy expenditure (Before = 712.1 ± 807.2 vs. During = 501.1 ± 639.3 MET·min^{-1}·week^{-1}; $p \leq 0.0001$; CI95% diff. = -283.6, -138.4 MET·min^{-1}·week^{-1}), while women did not reduce it (Before = 585.7 ± 740.9 vs. During = 566.7 ± 714.3 MET·min^{-1}·week^{-1}; $p = 0.557$; 95%CI diff. = -82.2, 44.4 MET·min^{-1}·week^{-1}).

No significant interaction was found between gender and measurements on walking energy expenditure ($p = 0.834$). However, it was found that the initial values were higher than the final ones (628.8 ± 635.5 vs. During = 286.9 ± 487.3 MET·min^{-1}·week^{-1}; $p \leq 0.0001$; CI95% diff. = -379.6, -303.0 MET·min^{-1}·week^{-1}).

A significant interaction was found between gender and measurements on total energy expenditure ($p \leq 0.0001$). Both men and women reduced their energy expenditure (Men Before = 3181.2 ± 2620.6 vs. During = 2078.3 ± 2404.9 MET·min^{-1}·week^{-1}; $p \leq 0.0001$; 95% CI diff. = -1311.7, -894.1 MET·min^{-1}·week^{-1}, Women Before = 2314.0 ± 2307.1 vs. During = 1842.0 ± 2018.4 MET·min^{-1}·week^{-1}, $p \leq 0.0001$, 95%CI diff = -654.0, 290.0 MET·min^{-1}·week^{-1}).

No significant interaction was found between gender and measurements on the number of hours sitting ($p = 0.337$). However, it was found that the initial values were lower than the final ones (4.1 ± 2.1 vs. During = 4.7 ± 2.2 h; $p \leq 0.0001$; 95% CI diff. = 0.48, 0.74 h).

The analysis of the individual response revealed high variability in the dependent variables (Table 1). All variability coefficients were greater than 45%, indicating a high heterogeneity in the individual response. The SWC estimated from the variability and the TEM indicate the minimum values to consider a change in each variable.

Table 1 Summary table of reliability, variability and smallest worthwhile change statistics for the participants (n = 1033).

Physical Activity	SD Diff.	CV (%)	TEM	SWC
Vigorous (MET·min^{-1}·week^{-1})	1563.4	87.1	1105.5	2211.0
Moderate (MET·min^{-1}·week^{-1})	786.9	94.4	556.5	1112.9
Walking (MET·min^{-1}·week^{-1})	621.1	95.9	439.2	878.4
Total (MET·min^{-1}·week^{-1})	2267.6	69.2	1603.4	3206.9
Sitting (h)	2.1	34.1	1.5	3.0

Note: SD Diff.= Standard deviation of the differences; CV (%) = Coefficient of variability; TEM = Typical error of measurement; SWC = Smallest worthwhile change

Table 2 Percentage of students continuing with their physical activity routines (i.e., did not change) during lockdown.

Category	%
Vigorous physical activity	85.8
Moderate physical activity	86.6
Walking	84.6
Total energy expenditure	84.2
Sitting	79.3
Mean=	84.1

Based on the SWC thresholds for vigorous PA, it was found that 85.8% of the participants did not significantly change their energy expenditure, while 5.0% increased it and 9.2% reduced it (Figure 1A). For moderate PA, it was found that 86.6% did not significantly change their energy expenditure, while 4.6% increased it and 8.7% reduced it (Figure 1B). Regarding walking, it was found that 84.6% did not significantly change their energy expenditure, while 1.4% increased it and 14.0% reduced it (Figure 1C). Furthermore, total energy expenditure did not change for 84.2% of the participants, while 4.3% increased it and 11.5% reduced it. Finally, the number of hours sitting did not change in 79.3% of the participants; 15.0% increased sitting time, and 5.7% reduced it (Figure 2A).

In addition, figure 2B presents the SWC and the proportion of people who did not change, increase, or decrease the number of hours sitting for sex. The SWC and the proportion of participants who did not change, increase, or decrease energy expenditure in each variable by sex are presented in Figure 3 (A-D).

4. Discussion

Using the individual response methodology, this study determined the group and individual responses to the change in Ecuadorian students' vigorous-PA, moderate-PA, walking, total PA, and sitting time. The main finding was that during the COVID-19 pandemic, men reduced vigorous and moderate-intensity energy expenditure from PA compared to women. Furthermore, all students walked more before the pandemic than during it, and total energy expenditure was also lower for both sexes. In addition, students spent more hours sitting during the pandemic than before it. Finally, over 79% of students maintained their habits during the pandemic (Table 2).

The patterns of vigorous-intensity PA during the pandemic reported in the literature are inconsistent; for example, in students from Spain (Romero-Blanco *et al.,* 2020), the pattern increased during the pandemic, while the men in the present study reduced their PA. Interestingly, Spanish women increased their vigorous-intensity PA, but Ecuadorian women did not change their vigorous-intensity PA habit. The reduction in vigorous-intensity PA found in the present study is consistent with reports in students

from countries such as Italy, Spain, Malaysia, India, Cambodia, and Saudi Arabia (Al-Mhanna *et al.*, 2022; Franco *et al.*, 2021; Gallè *et al.*, 2020; Maugeri *et al.*, 2020; Rodríguez-Larrad *et al.*, 2021; Stockwell *et al.*, 2021).

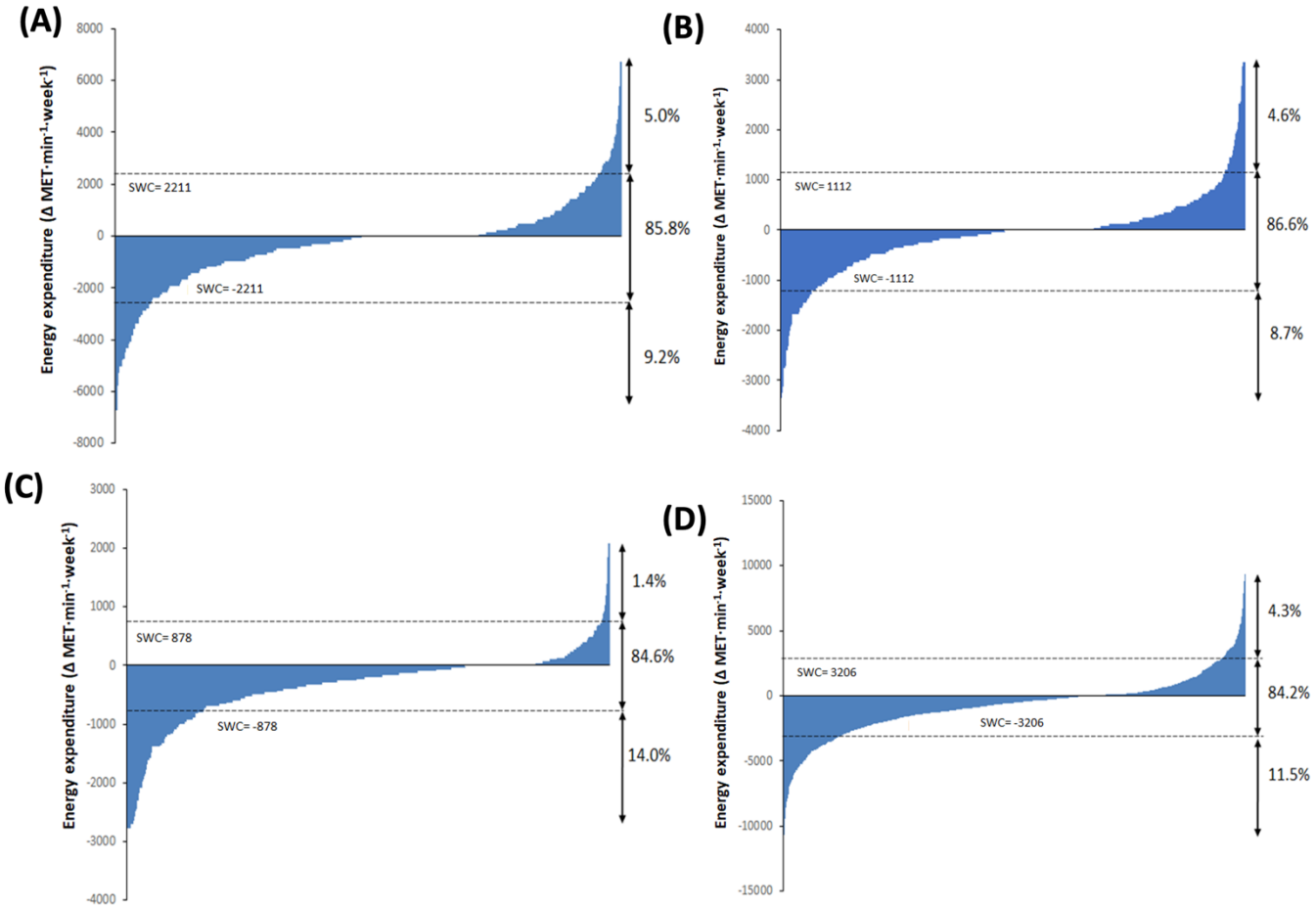

Figure 1 Difference in energy expenditure (MET·min^{-1}·week^{-1}) for vigorous (A), moderate (B), walking (C) and total (D) physical activity for all participants. The smallest worthwhile change (± SWC) is shown with dashed lines. Values within the threshold indicate no change, values above the threshold represent a positive change (i.e., increase in energy expenditure) and values below the threshold a negative change (i.e., reduction in energy expenditure).

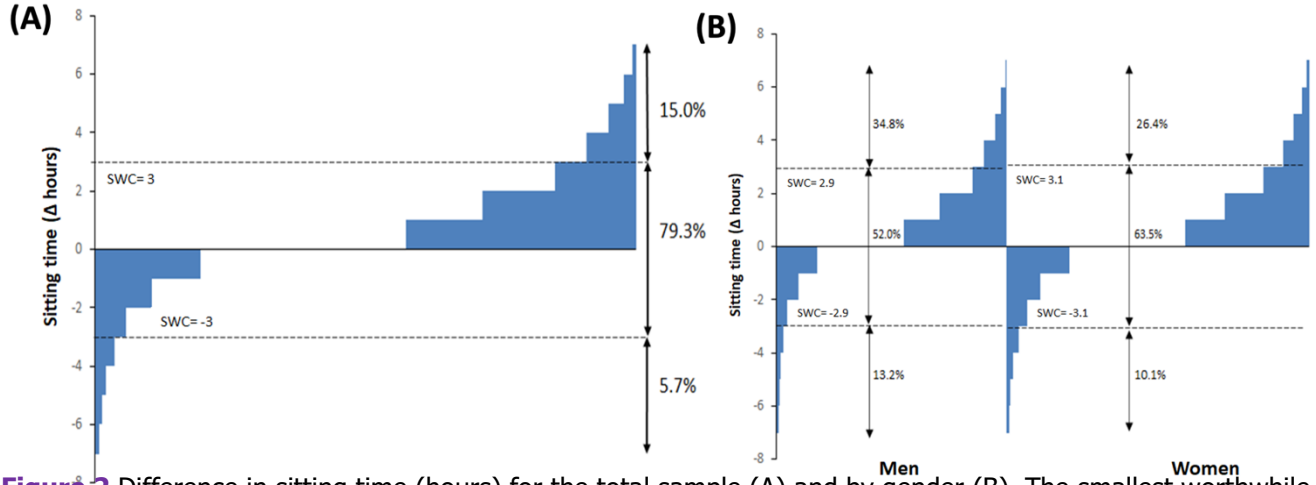

Figure 2 Difference in sitting time (hours) for the total sample (A) and by gender (B). The smallest worthwhile change (± SWC) is shown with dashed lines. Values within the threshold indicate no change, values above the threshold represent a negative change (i.e., more hours sitting), and values below the threshold a positive change (i.e., fewer hours sitting).

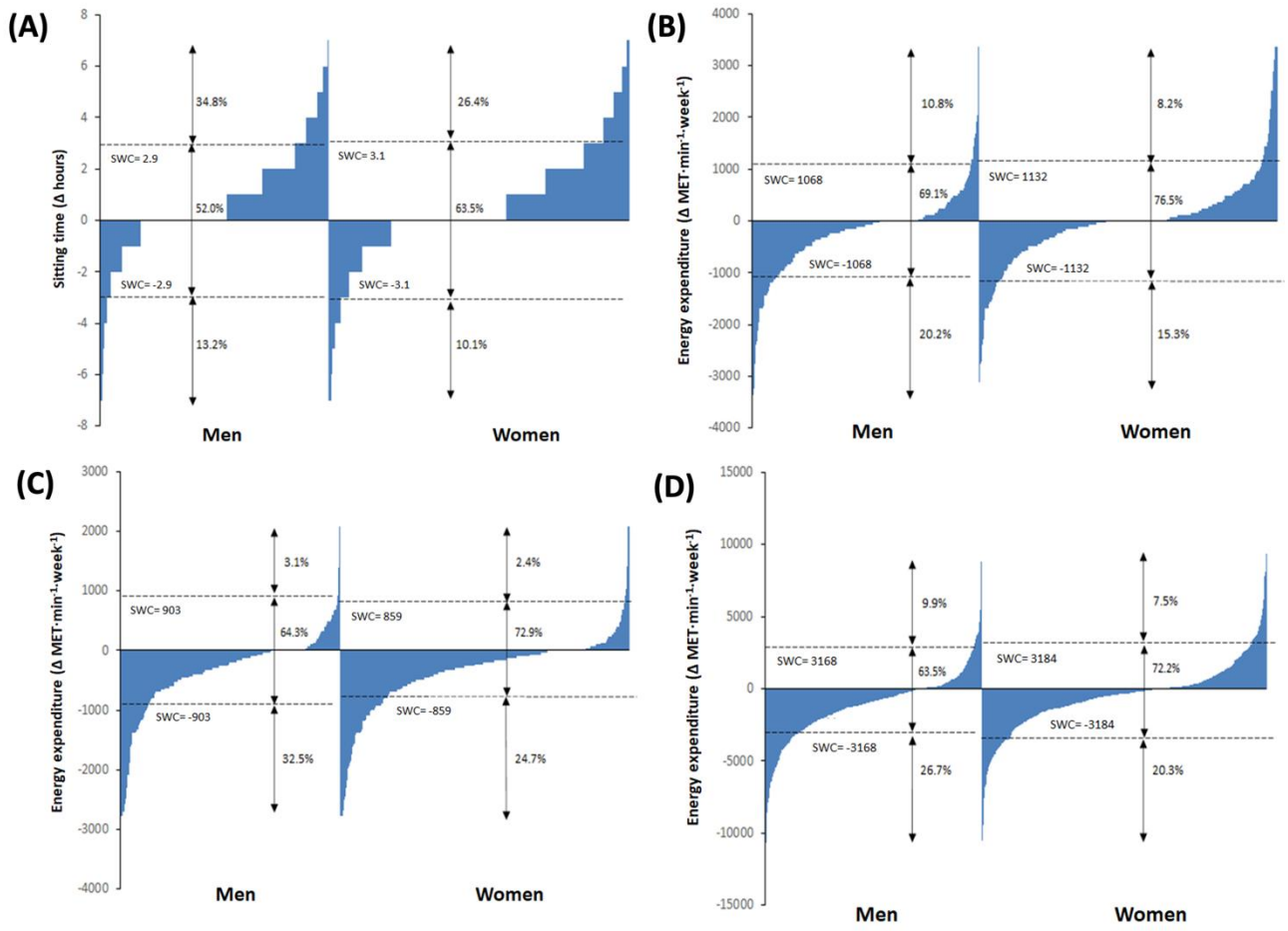

Figure 3 Difference in energy expenditure (MET·min-1·week-1) for vigorous (A), moderate (B), walking (C), and total (D) physical activity by gender. The smallest worthwhile change (± SWC) is shown with dashed lines. Values within the threshold indicate no change, values above the threshold represent a positive change (i.e., increase in energy expenditure), and values below the threshold a negative change (i.e., reduction in energy expenditure).

The moderate-intensity PA patterns reported in students from Spain (Romero-Blanco *et al.,* 2020) increased during the pandemic, while the men in the present study decreased it, which is a similar finding reported in the literature in Italian (Gallè *et al.,* 2020; Maugeri et al., 2020) and Spanish (Rodríguez-Larrad *et al.,* 2021) students. Interestingly, Spanish women increased their moderate-intensity PA, but Ecuadorian women did not change their moderate-intensity PA habit, a finding similar to that reported in Italian adults (Franco *et al.,* 2021).

A reduction in energy expenditure derived from walking was found in Italian adults (Franco *et al.,* 2021), which coincides with the findings reported in the present study. This finding can partially be explained by the measures adopted by government authorities, which imposed a strict confinement policy at the beginning of the pandemic, effectively reducing mobilization and, consequently, the amount of time spent walking.

A recent systematic literature review indicates that PA during the pandemic is reduced compared to initial values (Stockwell *et al.,* 2021). For example, in students from Italy and the USA, a significant reduction in PA was found during the pandemic (Maugeri *et al.,* 2020; Wilson *et al.,* 2021), which is partially consistent with the findings of the present study. Unlike the Ecuadorian students in the present study, the total amount of weekly PA was significantly increased in a sample of students from Poland (Rutkowska *et al.,* 2021). The reasons why the students changed or not the amount of weekly PA could be due to possible educational campaigns, motivation, anxiety, availability of material resources, space to exercise, personality, fear of getting sick, and even the sex of the person (Maugeri *et al.,* 2020; Rodríguez-Larrad *et al.,* 2021; Rutkowska *et al.,* 2021). For example, in Spain, it was found that women responded better than men to PA during confinement.

The sitting time increased significantly during the pandemic in students in Italy, with an average difference of 40.64 min (Franco *et al.,* 2021). In the present study, the mean difference was 120 min in sitting time, which coincides with findings in Spanish students (M= 106.76 min) (Romero-Blanco *et al.,* 2020). In contrast, in adults from Poland, sitting energy expenditure was reduced during the pandemic (Rutkowska e*t al.,* 2021).

A novel contribution of the present study is the report of the individual response, which complements the traditional group conclusions. The variability in the responses for the dependent variables was greater than 45%, which made it possible to estimate the possible significant change and the proportion of students who improved, maintained, or worsened their response in each variable. Thus, the main finding was that more than 79% of students did not change their habits during the pandemic. This confirms the challenge of changing an acquired habit, despite exceptional circumstances such as confinement due to the pandemic. This information is valuable for people responsible for developing PA and health policies since they can develop strategies that impact those who maintain negative PA habits (i.e., high sedentary lifestyle).

6. Conclusion

This study determined group and individual responses to PA during the COVID-19 lockdown in Ecuadorian students. International literature on the topic points to significant reductions in PA patterns in different populations. In general, the energy expenditure derived from PA was reduced during the COVID-19 pandemic in Ecuadorian university students. However, based on the SWC from the data collected, almost 80% of students maintained their habits during the pandemic. The lack of PA (i.e., sedentary behavior) from a significant number of students will lead to an accumulation of body fat, leading to overweight and obesity and, consequently, increasing the risk for cardiometabolic disease. Therefore, creative strategies must be implemented to increase students' daily PA and maintain adherence throughout life.

References

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Jr., Tudor-Locke, C., Greer, J. L., Vezina, J., Whitt-Glover, M. C., & Leon, A. S. (2011). 2011 Compendium of Physical Activities: a second update of codes and MET values. *Medicine & Science in Sports & Exercise, 43*(8), 1575-1581. CrossRef

Al-Mhanna, S. B., Wan Ghazali, W. S., Mohamed, M., Mohamed, R. N., Mirza, M. B., Basheer, S. N., Arora, S., Afolabi, H. A., Mutalub, Y. B., Goni, M. D., & Sheikh, A. M. (2022). The Impact of COVID-19 on Physical Activity Patterns of Dental Students: A Multinational Survey. *Healthcare (Basel)*, *10*(11). CrossRef PMC Full Text

Arocha Rodulfo, J. I. (2019). Sedentary lifestyle a disease from xxi century. *Clínica e Investigación en Arteriosclerosis, 31*(5), 233-240. CrossRef

Barreto Andrade, J. A., Aldas Arcos, H., Cobos Bermeo, N., & Bravo Navarro, W. (2023). Physical activity level in Ecuadorian university students before and during confinement. *Retos*, *49*, 49, 97–104. CrossRef

Blüher, M. (2019). Obesity: global epidemiology and pathogenesis. *Nature Reviews Endocrinology*, *15*(5), 288-298. CrossRef

Bull, F.C., Al-Ansari, S.S., Biddle, S., Borodulin, K., Buman, M.P., Cardon, G., Carty, C., Chaput, J.P., Chastin, S., Chou, R. and Dempsey, P.C., (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, *54*(24), 1451-1462. CrossRef PMC Full Text

Castro, O., Bennie, J., Vergeer, I., Bosselut, G., & Biddle, S. J. H. (2020). How Sedentary Are University Students? A Systematic Review and Meta-Analysis. *Prevention Science, 21*(3), 332-343. CrossRef

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35*(8), 1381-1395. CrossRef

Franco, I., Bianco, A., Bonfiglio, C., Sorino, P., Mirizzi, A., Campanella, A., Buongiorno, C., Liuzzi, R., & Osella, A. R. (2021). Decreased levels of physical activity: results from a cross-sectional study in southern Italy during the COVID-19 lockdown. J*ournal of Sports Medicine and Physical Fitness*, *61*(2), 294-300. CrossRef

Gallè, F., Sabella, E. A., Ferracuti, S., De Giglio, O., Caggiano, G., Protano, C., Valeriani, F., Parisi, E. A., Valerio, G., Liguori, G., Montagna, M. T., Romano Spica, V., Da Molin, G., Orsi, G. B., & Napoli, C. (2020). Sedentary Behaviors and Physical Activity of Italian Undergraduate Students during Lockdown at the Time of CoViD-19 Pandemic. *I International Journal of Environmental Research and Public Health, 17*(17). CrossRef PMC Full Text

Heller, S., Kalo, K., Werner, A. M., Eisenbarth, L., Reichel, J. L., Mülder, L. M., Schäfer, M., Letzel, S., Simon, P., Rigotti, T., & Dietz, P. (2023). Sedentary time of university students before and during the COVID-19 pandemic: Risk groups and pre-pandemic predictors using cross-sectional and longitudinal data. *Frontier in Public Health*, *11*, 1138442. CrossRef PMC Full Text

Hopkins, W. G. (2000). Measures of reliability in sports medicine and science. *Sports Med*icine, *30*(1), 1-15. CrossRef

Hopkins, W. G. (2004). How to interpret changes in an athletic performance test. *Sportscience*, *8*, 1-7.

Hopkins, W. G., Schabort, E. J., & Hawley, J. A. (2001). Reliability of power in physical performance tests. *Sports Medicine 31*(3), 211-234. CrossRef

Izquierdo, M., Merchant, R.A., Morley, J.E., Anker, S.D., Aprahamian, I., Arai, H., Aubertin-Leheudre, M., Bernabei, R., Cadore, E.L., Cesari, M. and Chen, L.K., (2021). International Exercise Recommendations in Older Adults (ICFSR): Expert Consensus Guidelines. *Journal of Nutrition, Health and Aging*, *25*(7), 824-853. CrossRef

Lavie, C. J., Ozemek, C., Carbone, S., Katzmarzyk, P. T., & Blair, S. N. (2019). Sedentary Behavior, Exercise, and Cardiovascular Health. *Circulation Research*, *124*(5), 799-815. CrossRef

Luciano, F., Cenacchi, V., Vegro, V., & Pavei, G. (2021). COVID-19 lockdown: Physical activity, sedentary behaviour and sleep in Italian medicine students. *European Journal of Sport Science*, *21*(10), 1459-1468. CrossRef

Maugeri, G., Castrogiovanni, P., Battaglia, G., Pippi, R., D'Agata, V., Palma, A., Di Rosa, M., & Musumeci, G. (2020). The impact of physical activity on psychological health during Covid-19 pandemic in Italy. *Heliyon*, *6*(6), e04315. CrossRef PMC Full Text

Moncada Jiménez, J., Carazo Vargas, P., Hernández Elizondo, J., Castillo Hernández, I., & Araya Vargas, G. (2023). Methodology and advanced statistics in Human Movement Sciences.

Rodríguez-Larrad, A., Mañas, A., Labayen, I., González-Gross, M., Espin, A., Aznar, S., Serrano-Sánchez, J. A., Vera-Garcia, F. J., González-Lamuño, D., Ara, I., Carrasco-Páez, L., Castro-Piñero, J., Gómez-Cabrera, M. C., Márquez, S., Tur, J. A., Gusi, N., Benito, P. J., Moliner-Urdiales, D., Ruiz, J. R., . . . Irazusta, J. (2021). Impact of COVID-19 Confinement on Physical Activity and Sedentary Behaviour in Spanish University Students: Role of Gender. *International Journal of Environmental Research and Public Health*, *18*(2). CrossRef

Romero-Blanco, C., Rodríguez-Almagro, J., Onieva-Zafra, M. D., Parra-Fernández, M. L., Prado-Laguna, M. D. C., & Hernández-Martínez, A. (2020). Physical Activity and Sedentary Lifestyle in University Students: Changes during Confinement Due to the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, *17*(18). CrossRef

Rutkowska, A., Kacperak, K., Rutkowski, S., Cacciante, L., Kiper, P., & Szczegielniak, J. (2021). The impact of isolation due to COVID-19 on physical activity levels in adult students. *Sustainability*, *13*(2), 446. CrossRef

Stockwell, S., Trott, M., Tully, M., Shin, J., Barnett, Y., Butler, L., McDermott, D., Schuch, F., & Smith, L. (2021). Changes in physical activity and sedentary behaviours from before to during the COVID-19 pandemic lockdown: a systematic review. *BMJ Open Sport & Exercise Medicine*, *7*(1), e000960. CrossRef

Wilson, O. W. A., Holland, K. E., Elliott, L. D., Duffey, M., & Bopp, M. (2021). The Impact of the COVID-19 Pandemic on US College Students' Physical Activity and Mental Health. *Journal of Physical Activity and Health, 18*(3), 272-278. CrossRef

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Informed Consent
The participants offered an implicit informed consent by completing the on-line survey.

Ethics Approval
This study relies on secondary data, which exempts it from the need for institutional ethics committee review.

Author Contributions
Jorge Antonio Barreto-Andrade: Conceptualization, supervision, methodology; Helder Guillermo Aldas-Arcos: methodology, validation, review and editing; Nelson Albino Cobos-Bermeo: methodology, validation; Wilson Hernando Bravo-Navarro: methodology, validation; José Moncada-Jiménez: statistical analysis, writing original draft, review and editing. All the authors read and approved the final version of the manuscript.

Conflict of Interest
The authors declare that there was no conflict of interest.

Does this article pass screening for similarity?
Yes