


Physical activity levels among adolescents in a low socioeconomic school in South Africa using the International Physical Activity Questionnaire (IPAQ), with comparative reflection of COVID-19 restrictions on physical activity

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Background. Physical activity (PA) significantly contributes to adolescents' wellbeing and physical development and is often driven by peer and school involvement. COVID-19 restrictions in South Africa (SA) altered adolescents' lifestyles, especially in low socioeconomic (LSE) areas compared with higher socioeconomic areas.

Objectives. To determine current PA levels and examine the perceived impact of COVID-19 restrictions on PA among adolescents aged 15 - 17 years in an LSE school in SA.

Methods. A descriptive quantitative study with both cross-sectional and retrospective designs was conducted. Convenience sampling targeted Grade 10 adolescents aged 15 - 17 years, from Crestway High School (CHS). On 29 August 2023, 80 participants completed an International Physical Activity Questionnaire (IPAQ) to measure current PA levels and a self-developed COVID-19 Restrictions Questionnaire (SCRQ) to assess the perceived impact of COVID-19 restrictions on PA levels. Researchers cleaned the IPAQ data according to the IPAQ analysis protocol.

Results. After data cleaning, the IPAQ results of 59 participants showed that 10.17% ($n=6$) had low-intensity PA scores, 23.73% ($n=14$) had high-intensity PA scores and 66.10% ($n=39$) had moderate-intensity PA scores. From the 80 participants who completed the SCRQ, 70% ($n=56$) reported an impact of COVID-19 restrictions on PA. The average duration of PA during the restrictions was ~25.71 minutes.

Conclusion. Current PA levels are suboptimal compared with the World Health Organization guidelines of 60 minutes of moderate-to-vigorous PA daily. Adolescents' PA levels were negatively impacted by COVID-19 restrictions, highlighting the need to embed PA education and training sessions within the curriculum.

Keywords. Physical activity, COVID-19 restrictions, low socioeconomic school, adolescents.

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The authors graduated with BSc Physiotherapy from the University of Cape Town. As part of the undergraduate research course, they showed interest in research focusing on physical activity levels among adolescents in a low socioeconomic school in South Africa with comparative reflection of COVID-19 restrictions on physical activity.

Physical activity (PA) is essential for a balanced lifestyle. According to the World Health Organization (WHO),^[1] PA is 'any bodily movement produced by skeletal muscles that requires energy expenditure'. PA positively impacts the overall wellbeing and health of adolescents. Moderate-to-vigorous PA (MVPA) has been shown to boost physical and cardiovascular fitness, aiding in illness prevention and overcoming functional limitations.^[2,3] A systematic review of children and adolescents aged 5 - 17 years found links between reduced PA and obesity, as well as various cardiometabolic indicators, aerobic fitness, muscle strength and bone health.^[3] Research has shown the physical, psychosocial and cognitive benefits of PA for adolescent. These benefits include improved

cardio-pulmonary function, endurance and muscle strength. The WHO recommend 60 minutes of organised daily PA for children and adolescents to help prevent lifestyle-related diseases in adulthood.^[3,4]

When COVID-19 restrictions were implemented to mitigate the spread of the virus, they led to lifestyle changes and the closure of recreation centres.^[5] These restrictions ended public gatherings and contact sports, increasing time spent in isolation at home. Consequently, adolescents' PA levels decreased as many facilities promoting PA were prohibited from operating.^[5] Studies have shown that adolescent PA levels were negatively impacted globally during the COVID-19 pandemic.^[6,7] However, notable limitations include the heterogeneity of the results and insufficient evidence from low-income countries.^[6,7] Yomoda and Kurita^[8] observed a significant decrease in PA levels among older children and adolescents during the COVID-19 pandemic. This decline was exacerbated by the lack of safe environments and sports facilities at low socioeconomic (LSE) schools, hindering adolescents' engagement in PA.^[8]

The decrease in PA during COVID-19 restrictions may be detrimental for adolescents, as PA benefits both physical and mental health.^[4] These negative effects can be magnified in LSE areas, where the population faces social challenges, such as crime and lack of resources.^[9] Furthermore, PA levels among adolescents in LSE schools have been found to be significantly lower compared with high socioeconomic schools.^[10] The current PA levels of adolescents living in LSE areas of South Africa (SA), and the impact of COVID-19 restrictions on their PA, are not sufficiently explored in the literature.

The primary objectives of this study were twofold: first, to establish the existing levels of PA among adolescents attending a LSE school in SA, using the International Physical Activity Questionnaire (IPAQ) and second, to assess the perceived impact of COVID-19 restrictions on PA levels in the same group, employing the self-developed COVID-19 Restrictions Questionnaire (SCRQ). The study aimed to investigate PA levels and explore the perceived influence of COVID-19 restrictions on PA among adolescents aged 15 -17 years at the specified LSE school in SA. The hypothesis is that adolescents in LSE schools will, on average, exhibit a moderate intensity PA. Furthermore, we anticipate that PA levels decreased during the 2020 - 2022 COVID-19 restrictions compared with the post-restriction period when restrictions were eased, with a gradual increase in PA from June 2022 to the present.

Methods

The research employed a descriptive quantitative approach, combining cross-sectional and retrospective elements. The cross-sectional aspect used the IPAQ to assess current PA levels among Grade 10 adolescents, while the retrospective component used the SCRQ to understand the perceived impact of COVID-19 restrictions on PA levels within the same demographic.

Participants included 80 Grade 10 adolescents, aged 15 - 17 years, from Crestway High School (CHS) in a low-to-middle socioeconomic (LSE) area, in Cape Town, Western Cape, SA. Retreat is a small, urban community with predominantly Coloured residents, living in both formal and informal dwellings with access to running water and electricity.^[11] Strict inclusion criteria limited the study to this age group and excluded those outside the specified range. A convenience sampling method was employed to recruit participants from a total Grade 10 population of approximately 220, aiming for a 95% confidence interval (CI) and an 8.5% margin of error.

The study used two main measurement instruments. First, the IPAQ-Short Form is designed for individuals between 15 and 69 years of age. This tool has good test-retest reliability ($\alpha < 0.80$) and reasonable predictive, concurrent, convergent, criterion and discriminant validity.^[12] IPAQ data was converted into metabolic equivalents (MET) minutes using coefficients, duration and frequency, and classified as follows:

- Low PA: Total MET-minutes <600 per week
- Moderate PA: $600 \leq$ total MET-minutes < 3000 per week
- High PA: Total MET-minutes \geq 3000 per week

The second instrument was the self-developed COVID-19 Restrictions Questionnaire, designed to assess the perceived impact of COVID-19 restrictions on PA levels. It included six multiple-choice questions covering the frequency, duration and intensity of PA sessions during the 2020 - 2022 COVID-19 restrictions, as well as during the post-restriction period

starting in June 2022. The face validity of the SCRQ was determined during a pilot study.

The research team obtained ethical approval from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (ref. no. HREC 139/23), the Western Cape Education Department (16375E04C00004A-20230328) and the principal of Crestway High School. The SCRQ underwent a pilot study involving nine Grade 9 adolescents (14 - 15 years). Informed consent was obtained by the guardians before the pilot study commenced. A Likert scale questionnaire was used to assess the adolescents' understanding of each SCRQ question. Questions that received a rating of 2 or higher prompted adolescents to identify specific difficulties and suggest alternative phrases. Based on this feedback, two minor refinements were made to the SCRQ, resulting in the final version used in the main study.

Data collection occurred on 29 August 2023, at the school premises. The research team distributed questionnaires to the 80 participants, provided a thorough explanation of the study and addressed all queries as students completed the questionnaires. Data management included secure storage of physical and digital data, with statistical analysis involving extensive cleaning of IPAQ and SCRQ data, followed by descriptive analysis to calculate the mean, standard deviation (SD), range and mode values.

Results

IPAQ

Of the initial sample of 80, data from 59 participants remained after data cleaning.

Exclusions occurred because of unanswered questions or multiple answers selected for single-choice questions. Among these participants, the IPAQ scores were distributed as follows: six individuals (10.17%) were within the low-intensity range, 39 (66.10%) moderate-intensity range and 14 (23.73%) fell within the high-intensity range.

Overall, the total MET value, which represents the cumulative METs of all activities, had an average of 2 428.24. This total MET value exhibited a large SD of 3 330.31, indicating substantial variability in total PA levels among participants. The range for total METs extended from 0 - 12 852, highlighting the diverse activity levels within the sample.

SCRQ

Impact of COVID-19 restrictions on PA

When asked about the extent to which the COVID-19 restrictions impacted their PA levels, 33.75% ($n=27$) of 80 participants reported a major impact, signifying a substantial disruption in their PA routines. Conversely, 12.5% ($n=10$) indicated no impact and 20% ($n=16$) acknowledged a minor impact, indicating some degree of disruption. Furthermore, 17.5% ($n=14$) remained neutral and 16.25% ($n=13$) reported a moderate impact.

Pre-pandemic PA behaviours

A substantial portion (32.5%, $n=26$) of participants engaged in PA occasionally prior to COVID-19 restrictions. Others exhibited greater consistency, with 28.75% ($n=23$) reporting frequent engagement and 25% ($n=20$) reporting full commitment. Conversely, a smaller fraction reported rare (7.5%, $n=6$) or non-existent (6.25%, $n=5$) pre-pandemic PA (Table 1).

Impact of COVID-19 restrictions on PA frequency

There was a perceived significant shift in PA with 20% ($n=16$) reporting sometimes and 65% ($n=52$) of adolescents reporting rarely or never participating in PA during COVID-19 restrictions. In contrast, a smaller proportion (15%, $n=12$) demonstrated remarkable resilience, continuing to engage in PA often or always (Table 2).

Perceived PA intensity during and after COVID-19 restrictions

During COVID-19 restrictions, 46.25% ($n=37$) of participants rated the intensity as moderate. Notably, 45% ($n=36$) considered their PA to be of low intensity, while only 8.75% ($n=7$) reported high-intensity activities. Following the easing of COVID-19 restrictions, the participants exhibited varying perceptions of intensity. The results indicate that 38.75% ($n=31$) of participants engaged in activities that they considered to be of high intensity, while 32.5% ($n=26$) selected moderate intensity and 28.75% ($n=23$) selected low intensity (Table 3).

Duration of PA during COVID-19 Restrictions

A significant portion of participants (46.25%, $n=37$) engaged in moderate-duration sessions, typically spanning ~30 minutes. In contrast, 20% ($n=16$) reported very short durations (~10 minutes) and 18.75% ($n=15$) reported short durations (~20 minutes). Some adolescents engaged in longer-duration sessions, with 11.25% ($n=9$) reporting sessions lasting 40 minutes and 3.75% ($n=3$) participating in very long sessions spanning ~50 minutes. The average PA duration during COVID-19 restrictions was 25.71 (10.51) minutes, indicating the variability in the duration of PA during COVID-19.

Discussion

This study embarked on a two-fold exploration to understand the behaviours of adolescents aged 15 - 17 years in an LSE school setting in SA. First, we ascertained their current levels of PA, along with the perceived

impact of COVID-19 restrictions on their PA levels. The results from the IPAQ show low PA levels, relative to WHO recommendations.^[1] Based on the MET-minutes calculation, 66.10% of adolescents had moderate PA levels. Skaal *et al.*^[13] examined PA levels in adolescents in Northwest Province schools using the IPAQ and found that only 35% engaged in high PA levels, highlighting relatively low PA levels among SA adolescents across various socioeconomic statuses.^[13] A cross-sectional study of urban-based SA adolescents (aged 8 – 14 years) reported that 57% participated in moderate levels of PA, while 31% did not meet the recommended international MVPA levels.^[14] These results are comparable with those from studies with similar age groups.^[14]

The results from the SCRQ indicated that COVID-19 restrictions had a perceived negative impact on the PA levels of adolescents in an LSE school in SA. A study by Micklesfield *et al.*^[15] found that 94% of

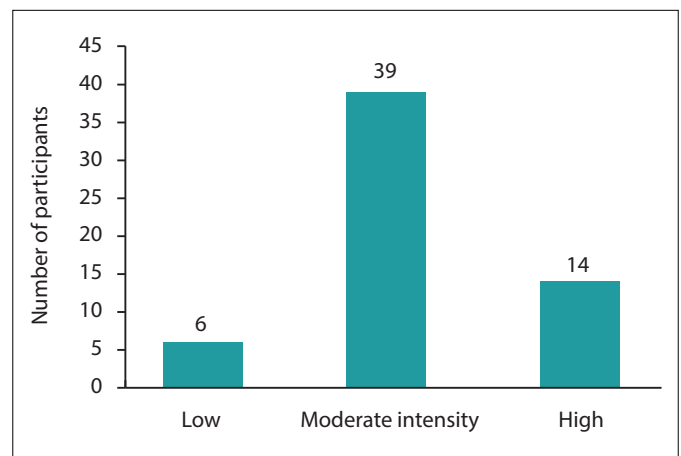


Fig 1. Total metabolic equivalent of tasks in the International Physical Activity Questionnaire.

Table 1. Pre-pandemic physical activity behaviours and impact of COVID-19 restrictions on physical activity frequency

	Never	Rarely	Sometimes	Often	Always
Question 2: How often did you take part in physical activity before COVID-19 restrictions?	6.25% ($n=5$)	7.5% ($n=6$)	32.5% ($n=26$)	28.75% ($n=23$)	25% ($n=20$)
Question 3: How often did you take part in physical activity when COVID-19 restrictions were active?	20% ($n=16$)	45% ($n=36$)	20% ($n=16$)	11.25% ($n=9$)	3.75% ($n=3$)

Table 2. Descriptive analysis of the International Physical Activity Questionnaire

	Mean	SD	Mode	Min	Max
Moderate METs	1 020.93	1 115.936	0	0	3 640
Vigorous METs	2 151.13	2 265.103	0	0	7 200
Walking METs	1 126.784	1 229.68	4158	0	4 158
Total METs	2 428.236	3 330.312	0	0	12 852

SD = standard deviation; Min = minimum; Max = maximum; METs = metabolic equivalents.

Table 3. Intensity of physical activity during and after COVID-19 restrictions

	Low	Moderate	High
During COVID-19 restrictions	45% ($n=36$)	46.25% ($n=37$)	8.75% ($n=7$)
After COVID-19 restrictions	28.75% ($n=23$)	32.5% ($n=26$)	38.75% ($n=31$)

adolescent participants from LSE areas in SA use walking as a means of transport. Since COVID-19 restrictions resulted in the closure of many schools and facilities, many adolescents would not have needed to go to school and therefore their level of PA may have been negatively affected by the lack of walking.^[5]

The perceived detrimental effects of COVID-19 restrictions on the PA levels among adolescents in LSE schools may have been influenced by increased disparities in income and reduced health outcomes. In SA, social protection (including employment), housing and infrastructure, as well as knowledge and education, are the three main socioeconomic determinants of health that impact overall health.^[16] All three major social determinants of health were negatively impacted by COVID-19 restrictions through job losses, closure of schools and limited access to sports facilities, religious gatherings and outdoor spaces, creating a greater financial burden for South Africans living in LSE areas.^[17]

Our findings showed a substantial change in PA frequency before and during COVID-19 restrictions. Before the pandemic, 86.25% of adolescents engaged in PA sometimes, often or very frequently, while only 13.75% engaged in PA rarely or not at all. During COVID-19 restrictions, there was a marked decline in PA, with more than half of the adolescents rarely engaging in PA. This shift underscores the substantial impact of COVID-19 restrictions on PA participation, as most respondents were forced to curtail their usual exercise routines. This shift in PA during COVID-19 restrictions is supported by a review conducted by Rossi *et al.*,^[18] that showed that the duration and frequency of PA decreased during the COVID-19 pandemic.

The current study also examined PA intensity during and after the easing of COVID-19 restrictions. We found a 30.5% increase in adolescents engaging in high-intensity PA following the easing of restrictions than during COVID-19 restrictions. The SCRQ findings indicate a 16.25% drop in adolescents who engaged in low-intensity PA following the easing of COVID-19 restrictions. This is congruent with a study conducted by Hargreaves *et al.*,^[19] which reported on the changes in PA before, during and after the easing of COVID-19 restrictions. That study found that PA intensity significantly increased from low to high intensity following the easing of COVID-19 restrictions.^[19] This perceived shift in intensity may be attributed to the return to full attendance in school settings and more activity outside the home, e.g., increased walking.^[19] Comparing the SCRQ results from question 5 to the IPAQ results, adolescents show an increase in PA intensity from the easing of COVID-19 restrictions to the present. The percentage of adolescents currently participating in moderate or high PA is 18.58% higher compared with the perceived PA levels following the easing of restrictions. This gradual increase in PA intensity aligns with the findings of Carriedo *et al.*,^[20] suggesting that the return to sports activity after COVID-19 restrictions were eased has led to a gradual improvement in cardiovascular and muscular fitness.

In an article by Bull *et al.*,^[21] discussing the WHO 2020 guidelines on PA and sedentary habits, children and adolescents (5 - 17 years) are recommended to engage in an average of 60 minutes of MVPA daily to achieve the numerous benefits associated with PA. Engaging in PA for longer than 60 minutes provides additional health benefits.^[21] The results of this study indicated that during COVID-19 restrictions, the perceived average duration of PA in adolescents was 25.71 minutes and only 3.75% of adolescents engaged in PA for approximately 50 minutes. Furthermore,

45% of the adolescents rated their PA as low intensity during COVID-19 restrictions. The findings show that most adolescents were not meeting the WHO 2020 guidelines for PA and the various health benefits of PA were not being attained. The results obtained are concerning as a lack of PA may lead to an increased risk of obesity and chronic diseases, such as diabetes and cardiovascular disease.^[22]

Studies have shown that adolescents are more likely to engage in short bursts of PA rather than aim for lengthy sessions.^[23] Furthermore, according to Tarp *et al.*,^[24] when the total daily duration and intensity of the PA are the same, longer bouts do not result in greater health benefits than shorter bouts of PA in individuals aged 4 - 18 years old. Therefore, adolescents should be encouraged to engage in numerous short bouts of PA to meet the WHO 2020 guidelines for PA and to achieve the benefits.^[24]

Limitations

The use of two questionnaires, namely the IPAQ and the SCRQ, increased the risk of recall bias. The inclusion of 'don't know/unsure' responses in the IPAQ is not quantifiable and therefore this restricted data analysis. Owing to the small sample size, the results may not be generalisable to the entire population of adolescents in LSE schools in SA. Furthermore, the study was limited to Grade 10 learners at CHS in Retreat, Cape Town, Western Cape.

Conclusion

The observed decrease in PA levels among adolescents holds significance owing to its potential association with heightened sedentary behaviours and health issues, including obesity, diabetes and heart disease. The decrease in PA levels among adolescents in LSE schools may be ascribed to the impact of COVID-19 restrictions on the social determinants of health and various contextual factors, including school closures and limited access to sports facilities and outdoor spaces. The urgent need for developing and implementing strategies and policies to counteract the adverse consequences of these disruptions on the health and well-being of adolescents in LSE schools is evident. This study provides valuable insights into the application of the IPAQ within an LSE school in SA, offering a foundation for informing future policy initiatives and support programmes. The outcomes of this research could play a pivotal role in prioritising interventions to enhance overall PA levels among adolescents in LSE schools. Compulsory moderate-to-high intensity PA 60-minute sessions, scheduling extra time for PA sessions within the curriculum, and education on the value of physical exercise in the community are all suggested cost-effective evidence-based interventions.^[25] The results of this study may also encourage a healthy lifestyle, thereby lowering long-term health risks associated with lower PA in this population.

Recommendations for future research

Further research focusing on objective measures for assessing PA levels of adolescents in LSE schools is required. Collecting qualitative data through focus groups or interviews with adolescents and teachers is recommended. This will develop a more thorough understanding of the barriers and facilitators to adolescents' PA levels in such contexts. Additionally, it may be beneficial to expand the sample size by including more schools from different LSE and high socioeconomic settings, to allow for comparison between adolescents from diverse backgrounds throughout SA.

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Author contributions. ND contributed to the results analysis, executive summary, completion of all appendices and data collection. IW drafted the discussion, assisted with the literature search, edited the content and assisted with the pilot study. LH edited the content, collected data, drafted the methods and assisted with the literature search. DH contributed to data collection, literature search and content editing. RF was responsible for the abstract, data collection and content editing. NN (Supervisor) supervised the research and assisted with data analysis and content editing.

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Data availability statement. The results and data analysed during the current study are available from the corresponding author on reasonable request. The thesis can be found in the UCT undergraduate thesis repository and restrictions or additional information regarding data access can be discussed with the corresponding author.

Conflict of interest. None.

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