**RESEARCH ARTICLE:**

# Physical Activity Levels During SARS-Cov2- Pandemic: A Focus on South African Data from the 'Activity and Health During the SARS-Cov-2 Pandemic' (ASAP) Study

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## *Abstract*

*In March 2020, the SARS-CoV2 pandemic emerged in South Africa (SA). Due to the highly contagious nature of this virus, the government employed lockdown restrictions to decrease the rate of infections and deaths. These restrictions prohibited the use of shared exercise facilities, which inadvertently decreased opportunity for physical activity (PA). This article provides a sub-analysis of the SA dataset within the worldwide ASAP study, specifically focusing on physical activity and compliance with the guidelines of the World Health Organisation (WHO) in SA. The study utilised an online cross-sectional questionnaire that evaluated PA volume pre and during restrictions using the Nordic Physical Activity Questionnaire-short (NPAQ-short), and WHO PA guideline compliance using a five-point Likert scale. The results revealed a decrease in overall moderate to vigorous and vigorous PA by 53.5% and 58%, respectively; 30% of the sample reported decreased WHO PA guideline compliance during lockdown when compared to compliance before lockdown. The lockdown measures adopted during the pandemic aided in decreasing the spread of the virus but contributed significantly to the decrease in PA among the healthy population. This decrease may have impacted individuals' health and increased the risk for non-pandemic related health conditions. Hence, PA and the availability and access to remote PA resources need to be considered in planning for future pandemics and natural disasters.*

***Keywords:*** *physical activity; exercise; WHO guidelines; SARS-CoV2*

## Introduction

The health risks, associated with a sedentary lifestyle, have been researched extensively in the fields of physical and mental wellness over the years (Falck *et al*., 2017: 800; Saunders *et al*., 2020: 197). A lack of sufficient exercise increases an individual's risk of developing a variety of physical and mental ailments (Biddle *et al.*, 2017: 134). There is evidence to suggest an association between a lack of physical activity and the prevalence of lifestyle diseases such as hypertension, diabetes mellitus, cerebrovascular accidents and mental health conditions such as anxiety and depression (Biddle *et al.*, 2017: 134; Lear *et al*., 2017: 2643; Paudel *et al*., 2023: 921; Alley *et al*., 2018: 1). As much as the common focus is usually placed on the cardiovascular benefits of regular physical activity (PA) (Lear *et al.,* 2017: 2643; Paudel *et al*., 2023: 921), the advantages result in improved physiological functioning which may contribute to better overall health outcomes (Alley *et al.,* 2018: 1; Heath *et al*., 2012: 272). For example, studies have shown that increased PA volumes not only improve physiological processes, but also aid in the prevention and control of pathological pathways (Ficarra *et al*., 2022: 402; Xie *et al*., 2020: 4). These benefits are not limited to physical wellness, but have a significant positive effect on mental wellness (De Nys *et al* 2022: 1; Vancampfort *et al*., 2017: 1) in those without mental conditions as well as individuals who have existing psychological ailments (Patel *et al*., 2013: 766; Herbert, 2022: 1). The World Health Organisation (WHO),

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recommends a minimum of 150 minutes (min) of moderate PA or 75 min of vigorous PA per week, however, with the high physical and mental demands placed on the average adult, this minimum requirement can be difficult to achieve (Bull *et al*., 2020: 1451).

In March 2020 the first reported positive case of SARS-CoV2 presented in SA (Taylor *et al*., 2021: 50). The country found itself joining several other countries in the fight against this rapidly spreading virus as the global pandemic emerged. This novel virus threatened lives and livelihoods across all walks of life (Taylor *et al*., 2021: 50). Medical resources were strained and in order to prevent further rapid spread of the virus and to decrease mortality rates, political leadership around the world began to implement drastic lockdown and isolation measures as recommended by the WHO guidelines (Haider *et al*., 2020: 1). SA implemented a complete lockdown, where only essential workers and essential service providers were permitted to leave their homes (South African National Department of Health). Law enforcement officers were instructed to ensure that any persons found traveling in public were to produce proof of valid permits for their movement for the stipulated work activities that were permitted during the lockdown period (South African National Department of Health, 2020; Stiegler and Bouchard, 2020: 695). This lockdown period began on 26 March 2020 and allowed for a full return to normal activities on 1 October 2021 (South African National Department of Health, 2020; Stiegler and Bouchard, 2020: 695; Donga *et al.,* 2021: 1).

During this lockdown period, there were several adjustments to the restriction parameters. These changes were implemented as lockdown levels (Level 5 to Level 1) (South African National Department of Health, 2020; Stiegler and Bouchard, 2020: 695), with modifications being made based on the severity of infection rates and the level of mortality rates as well as the general preparedness of the health care systems in the country (Naidoo and Naidoo 2022: 01). As the infection risks and mortality rates lowered, the lockdown levels were altered from Level 5, most stringent restrictions to Level 1, a return to normal activities with minimal to no restrictions (South African National Department of Health, 2020; Donga *et al.,* 2021: 1; Naidoo and Naidoo, 2022: 01). Access to regular exercise facilities was severely restricted, particularly in the early stages of the more stringent lockdown enforcement (Levels 3 to 5), due to the ease with which the virus could spread from the use of shared exercise equipment and surfaces (South African Government, 2020). The fact that individuals could not comfortably wear masks whilst exercising coupled with an increase in laboured breathing during exercise, meant that they could easily transmit respiratory droplets to other users of exercise establishments and onto equipment and surfaces (South African Government, 2020; You *et al*., 123). The foundation of implementing lockdown measures focused on minimising the spread of SARS-CoV2, however, these measures also had the potential to significantly impact the overall physical and mental wellness of healthy individuals by decreasing PA opportunities (You *et al.,* 2022: 123).

The 'activity and health during the SARS-CoV-2 Pandemic' (ASAP) survey was designed to evaluate the effects on PA engagement during active lockdown periods in several countries (Ammar *et al*., 2020: 1). It aimed to gauge the effect of these lockdown measures on individuals' PA levels, whilst also comparing PA levels preceding SARS-CoV2 to those during the lockdown timeframes to WHO guideline compliance (Wilke *et al* 2021a: 1; Wilke *et al*., 2021b: 1; Wilke *et al*., 2020: 1). This manuscript presents a detailed reporting on the data collected in the South African cohort of the global study.

## Methodology

The original study used an online cross-sectional survey (ASAP) (Wilke *et al*., 2021b: 1) to evaluate the volume and type of PA performed by participants during the SARS-CoV2 lockdowns. The participants were adults older than 18 years of age, living or working in SA during the implementation of lockdown measures in response to the SARS-CoV2 pandemic, and had limited access to public exercise facilities or group exercise interaction. A convenience sampling technique (Etikan *et al*., 2016: 1) was adopted where participants were recruited using DUT Pinboards as well as social media avenues such as Facebook and WhatsApp. The South African sample made up 3.4% (n=456) of the total global sample (n=13503) (Wilke *et al*., 2021b: 1). The components of the survey were planned and compiled by the members of the global research team. These components comprised three sections. The first section was dedicated to; demographic and general characteristics such as age, sex, work mode (remote work, office work, both remote and office work, no work, unspecified), work categories (full-time, part-time, unspecified), the presence of cold and flu symptoms, and the SARS-CoV2 test status where cold and flu symptoms were present; PA type and PA levels; compliance with WHO PA guidelines about the implementation of lockdown measures. The second section was, the Nordic Physical Activity Questionnaire-short (NPAQ-short), which assessed the amount of physical activity in minutes that participants were engaging in during the course of the

lockdown measures and about the amount of physical activity they were engaging in for the same period before the start of lockdown (Wilke *et al*., 2021b: 1).

The NPAQ-short was chosen as it has been reported as a reliable measure of PA with WHO recommendations (Danquah *et al*., 2018: 1). This section of the survey recorded the participants' involvement in moderate-vigorous PA (MVPA) and vigorous PA (VPA), during leisure and work time. For the NPAQ-short, MVPA is considered any activity resulting in an increased heart rate and increased respiratory rate. VPA is defined as an activity that causes a high increase in heart rate in addition to sweating and breathlessness. The third section of the survey was a five-point Likert scale to evaluate the degree of change in total PA between the pre- and post- lockdown timeframes, with 'pre-lockdown' indicating activity before the onset of lockdown restrictions and 'post-lockdown' relating to activity after the onset of lockdown/during the lockdown period. This scale provided participants with 5 options to quantify the change in PA that ranged from a large decrease to a large increase. Once the questions, ratings and sections were decided on, the survey underwent a focus group assessment. The focus group was made up of a combination of health and physical activity experts as well as members of the general population. The focus group aimed at ensuring that the survey was easily understood. Following the necessary changes, the survey was finalised and was disseminated. The surveys were available to participants in English for four (4) weeks via the SoSci Survey interface. Ethical approval was obtained by the institutional research ethics committee at the Durban University of Technology, Ethical Clearance number IREC 090/20. Participants provided consent via a digital informed consent submission before being included in the study.

The statistical analysis encompassed both descriptive and inferential approaches to assess PA levels and compliance with WHO guidelines. Descriptive statistics, including mean and standard deviation (SD) were used to summarise the data based on its normality, which was evaluated using the Shapiro-Wilk test. The study also reported counts and percentages for categorical variables such as age groups and sex. Inferential statistics included the Chi-square test for categorical variables and the t-test for numerical variables to compare pre-lockdown and post-lockdown PA levels. Additionally, the study employed multinomial logistic regression to model the odds of WHO guideline compliance across four categories (pre- and post-lockdown, pre-lockdown only, post-lockdown only, neither pre- nor post-lockdown) based on the independent variables of sex and age, providing insights into differential impacts of these factors on PA outcomes. Multinomial logistic regression was employed to model the impact of sex and age individually, and combined sex and age on outcome probabilities across three guideline conditions: pre-lockdown only, post-lockdown only, and neither pre-nor post-lockdown.

## Results

As presented in Table 1, a total of 456 adults participated in the South African part of the ASAP survey. The majority of participants (n=257; 56.4%) were women with a mean (standard deviation (SD)) age of 33.3 (13.7). Men accounted for 199 (43.6%) of the total group, the mean age of which was 32.06 (14.8). A small group (n=21; 4.6%) presented with flu-like symptoms. Of these, only one (4.8%) participant tested positive for SARS-CoV2.

**Table 1:** General characteristics (n=456)

| | | |
|---|---|---|
| **Sex % (n)** | | |
| | Women | 56.4 (257) |
| | Men | 43.6 (199) |
| **Mean age (SD)** | | |
| | Women | 33.3 (13.7) |
| | Men | 32.1 (14.8) |
| **Mean age categories (SD)** | | |
| | 18-29 | 22.1 (3.0) |
| | 30-39 | 33.9 (2.9) |
| | 40-49 | 44.7 (2.6) |
| | 50-59 | 53.7 (2.7) |
| | 60-69 | 63.4 (2.6) |
| | 70-79 | 71.0 (1.2) |
| **Work Mode % (n)** | | |
| | Remote (Home office) | 46.3 (211) |
| | Office | 3.7 (17) |
| | No formal employment | 44.3 (202) |
| | Both remote and office | 2.0 (9) |

| | | |
|---|---|---|
| | Unspecified | 3.7 (17) |
| **Work category % (n)** | | |
| | Full-time | 39.7 (181) |
| | Part-time | 8.8 (40) |
| | Unspecified | 1.5 (7) |
| | Did not answer | 50 (228) |

Most of the participants (n=211; 46.3%) reported working from home during lockdown restrictions; nearly half the participants (n=202; 44.3%) reported not working at all, whilst a small number (n=17;3.7%) reported working from an office or outside their home and 9 participants (2%) reported working from home and an office. A small group (n=17; 3.7%) did not provide a response regarding their workload. Half of the total participants (n=228; 50%) did not respond to the work category section of the survey. Of the remaining half (n=181; 39.7%) were working full-time at the time, 40 (8.8%) participants were working part-time. Seven (1.5%) participants did not specify their work category.

The study utilised participants' self-reported MVPA and VPA provided in minutes per week (min/week) as a tool for the determination of PA levels. These measures were documented separately as MVPA and VPA levels during leisure and occupational time, respectively. Table 2 reflects a summary of the findings.

**Table 2:** Physical activity levels pre - and post-lockdown restrictions

| | **Leisure time PA** | | **Work time PA** | | **Total** | |
|---|---|---|---|---|---|---|
| | ***MVPA (min/week)*** | ***VPA (min/week)*** | ***MVPA (min/week)*** | ***VPA (min/week)*** | ***MVPA (min/week)*** | ***VPA (min/week)*** |
| **Pre-lockdown** | 216.2 (415.3) | 105.9 (248.6) | 141.0 (404.1) | 53.2 (130.6) | 357.2 (639.8) | 159.0 (325.6) |
| **During lockdown** | 113.1 (289.9) | 42.8 (125.4) | 53.10 (134.2) | 24.0 (87.8) | 116.2 (349.4) | 66.8 (190.1) |
| **Difference (Pre-Post)** | -103.1 (278.6) * | -63.1 (200.9) * | -87.9 (384.7) * | -29.2 (131.1) * | -191.0 (547.2) * | -92.3 (295.1) * |
| **% change** | 47.7 | 59.6 | 62.3 | 54.9 | 53.5 | 58.0 |

Mean (SD). MVPA = moderate-to-vigorous physical activity, VPA = vigorous physical activity, min = minutes. *=p<0.05

As shown in Table 2, the mean in min/week (SD) values for MVPA and VPA during participants' leisure-time PA were 216.2 (415.3) and 105.9 (248.6), respectively before lockdown was implemented. These values decreased by 47.7% for MVPA and 59.6% for VPA during the implementation of SARS-CoV2 lockdown restrictions. PA during work time was recorded as 141.0 (404.1) for MVPA and 53.2 (130.6) for VPA before lockdown. During the lockdown period, there was a 62.3% decrease in MVPA and a 54.9% decrease in VPA. The results for total PA, indicated a 53.5% reduction for MVPA, whereas VPA reduced by 58.0%. Overall, the largest decrease (62.3%) was seen in the MVPA - work-time category. A significant change (p=<0.001) in PA was noted across all categories (leisure-time PA, work time PA, and total PA) in the comparison of MVPA and VPA measurements before and during the implementation of lockdown restrictions.

Prior to the implementation of lockdown measures the highest volumes of total MVPA and VPA were reported in men (409.6 min/week and 198.4 min/week, respectively) who made up 43.6% of the total sample size. Men reported reductions across all categories of PA levels during the various lockdown categories, with MVPA decreasing by 54.9%, 65.6%, and 58.7% for the leisure time PA, work time PA, and total PA categories, respectively. Leisure time and work time VPA in men showed a decrease of 66.2% and 65.1%, whereas, the total VPA in men decreased by 65.8%. A similar pattern was observed in women who made up 56.4% of the sample, however, the overall percentage changes reported in women were less than those reported in men., i.e. women recorded a 39.6%, 59.6% and 48.3% decrease in leisure time PA, work time PA and total MVPA, respectively. In the VPA category, women reported reductions of 52.0% and 41.5% for leisure time and work time, respectively, and a decrease of 48.7% for total VPA. The levels for MVPA and VPA were statistically significant, p=0.004 and p=<0.001 respectively, between sex categories before the introduction of lockdown measures. Figure 1 illustrates the total PA levels for both MVPA and VPA categorised according to sex-age groups.

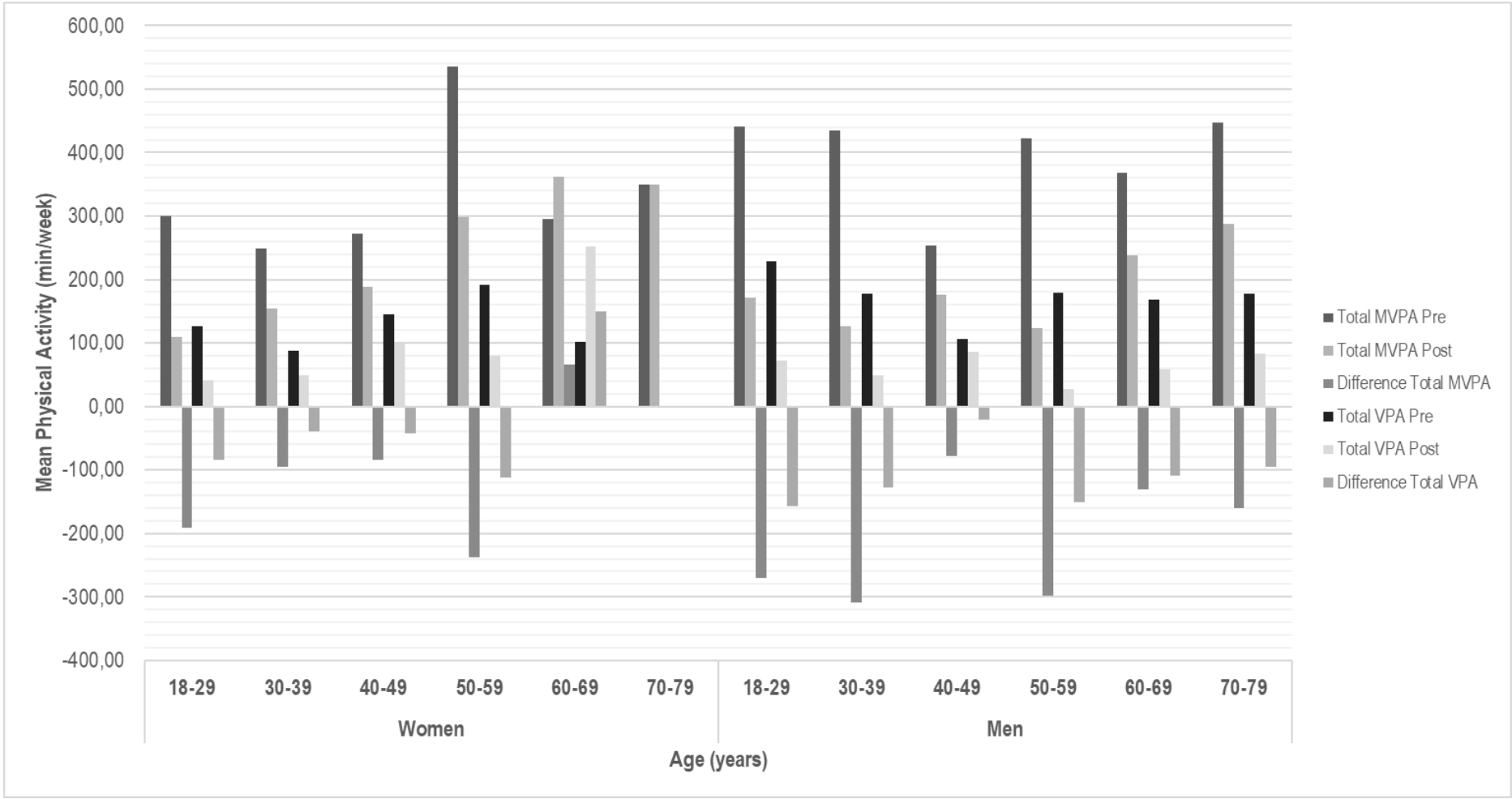


**Figure 1:** Total physical activity levels by sex-age groups

The findings comparing sex and age categories for total MVPA and VPA volume revealed that women aged between 50-59 years had the highest MVPA (536.0 min/week) and VPA (191.5 min/week) levels pre-lockdown, whereas women aged between 40-49 and 30-39 reported the lowest MVPA (272.6 min/week) and VPA (88.3 min/week) levels pre-lockdown respectively. During lockdown, women reported decreases in total MVPA and VPA levels in most age groups, with the greatest reduction being a 67.3% decrease in total VPA in women aged between 18-29 years. The smallest reduction was seen in total MVPA levels in women aged between 60-69. Interestingly, the age group 60-69 (women) was the only category to more than double in total VPA volume during the lockdown period, showing an increase of 147.0%, whilst no change was noted in the 70-79 age group for neither MVPA nor VPA. Men aged between 70-79 years reported the largest volume of MVPA (447.5 min/week) prior to the onset of lockdown restrictions, whereas, the 18-29 age group reported the highest VPA levels (229.2 min/week). The lowest mean MVPA and VPA values pre-lockdown in men were noted in the 40-49 age group, however, this age group also presented with the least percentage reductions in MVPA (30.8%) and VPA (19.2%) during lockdown. Men aged 30-39 reported a 70.9% decrease in their total MVPA levels, which was the greatest percentage shift noted for men in total MVPA.

Statistical significance was noted as $p<0.001$ for MVPA across all age categories. A pairwise comparison was then conducted using the Kruskal-Wallis Test to determine the between-group effects. The test showed statistical significance in only 4 comparisons: 18-29 – 60-69 ($p=0.047$); 18-29-50-59 ($p=<0.001$); 40-49-50-59 ($p=0.002$) and 30-39-50-59 ($p=0.008$).

***Physical activity levels with WHO guidelines***

The survey assessed compliance with WHO PA guidelines to gauge participants' level of PA engagement with what is prescribed to achieve and maintain healthy PA levels. The findings revealed that only approximately one-third (n=150; 32.9%) of 456 participants were compliant with WHO PA guidelines before and during lockdown implementation. Similarly, nearly one-third (n=137; 30%) met the WHO PA guidelines before SARS-CoV2 lockdown restrictions, however, were non-compliant during lockdown measures. There were 19 (4.2%) participants who were non-compliant before lockdown but became compliant during the lockdown. A total of 150 (32.9%) of the participants were non-compliant with WHO guidelines, before and during lockdown implementation. The overall comparison amongst the WHO compliance categories is statistically significant ($p=<0.001$), however, the significance lies in the comparison between the 'post' only group and the other 3 groups. When comparisons were conducted between the 'pre and post', 'pre-only', and 'neither pre- nor post' groups, insignificant p-values were obtained.

When categorised according to age, the results showed that the 18-29 age group was the most compliant with WHO guidelines among all the categories of lockdown measures. The 18-29 age group contributed to the guidelines categories as follows; pre and post: 63 (42%); pre-only: 75 (54.7%); post only: 9 (47.4%) and neither pre-nor post: 107 (71.3%). There was a general trend of decreasing adherence as age increased, with participants aged 70-79 showing the least adherence to guidelines in any category; pre and post: 3 (2%); pre-only: 1 (0.7%); post-only: 0 (0%) and neither pre-nor post: 1 (0.7%). A p-value of 0.001, suggests that the differences in adherence across age groups were statistically significant.

As shown in Figure 2, 82 (54.7%) and 73 (45.3%) of the participants who were compliant with WHO guidelines before and during lockdown were women and men, respectively.

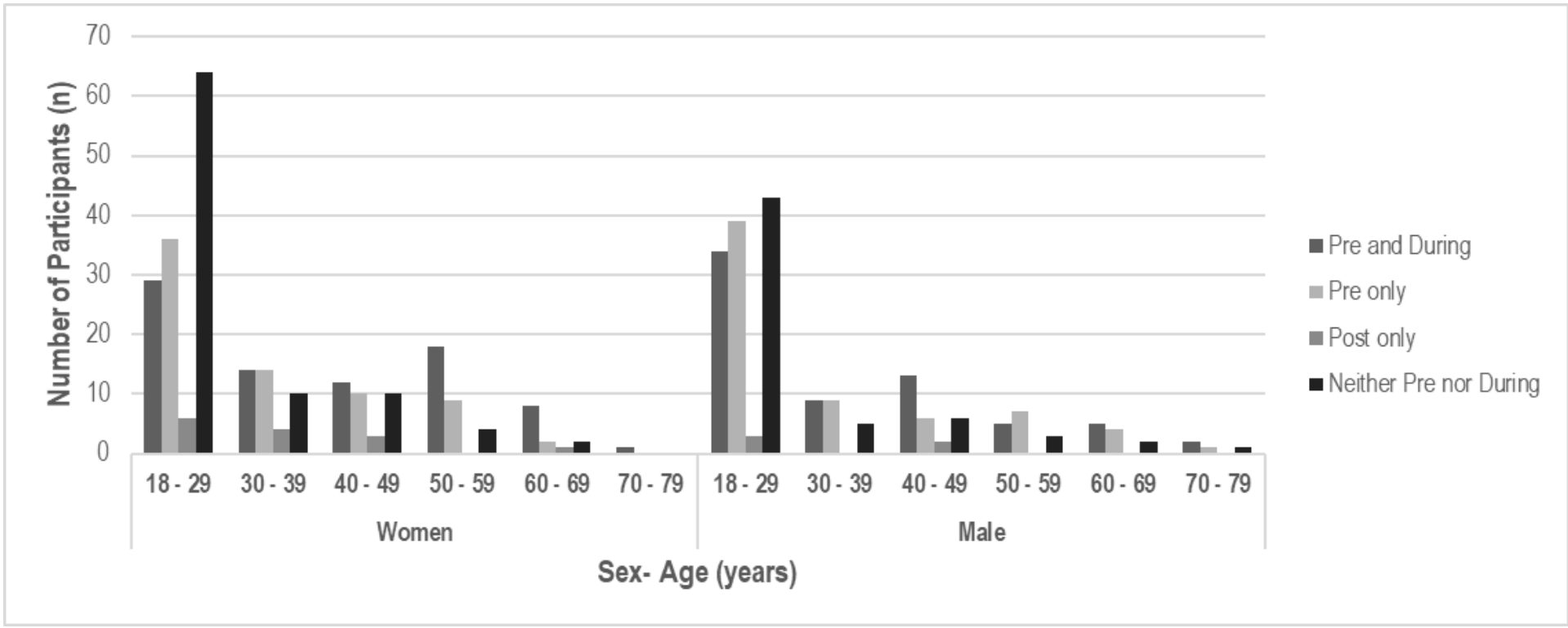


**Figure 2:** Compliance with WHO physical activity guidelines according to sex and age

Women appeared to be more likely than men to comply with guidelines across all age categories (p=0.002). A marked difference was noted between the number of women (n=14, 73.7%) and men (n=5, 26.3%) who were not compliant with WHO PA guidelines before lockdown, but became compliant during lockdown, although not statistically significant (p=0.217). Notably, the 18-29 category for both men (n=119, 59.8%) and women (n= 135, 52.5%) was the most compliant group in terms of meeting WHO guidelines across the comparison categories and the 70-79 category was the least compliant, with men reported as 4 (2%) and women as 1 (0.4%).

### *Logistic regression analysis*

A logistic regression analysis (Table 3) examined the extent of interaction between sex, age and combined age and sex on the likelihood of participant compliance with WHO guidelines before and during lockdown restrictions. The reference category used for this analysis was the "pre and post" category as this would be most favourable in terms of adherence to WHO guidelines.

**Table 3:** Logistic Regression – sex, age, combined sex and age

| Guidelines Pre post[a] | | B | Wald | df | Sig. | Exp(B) | 95% Confidence Interval for Exp(B) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower Bound | Upper Bound |
| **Sex** | | | | | | | | |
| Pre-only | [Sex=Women] | -0,11 | 0,23 | 1 | 0,630 | 0,89 | 0,56 | 1,42 |
| Post only | [Sex=Women] | 0,84 | 2,38 | 1 | 0,123 | 2,32 | 0,80 | 6,77 |
| Neither Pre-nor Post | [Sex=Women] | 0,22 | 0,87 | 1 | 0,351 | 1,24 | 0,79 | 1,97 |
| **Age** | | | | | | | | |
| Pre-only | Age | -0,02 | 5,76 | 1 | 0,016 | 0,98 | 0,97 | 1.00 |
| Post only | Age | -0,02 | 1,02 | 1 | 0,311 | 0,98 | 0,95 | 1,02 |
| Neither Pre-nor Post | Age | -0,05 | 25,08 | 1 | <0.001 | 0,96 | 0,9 | 0,97 |
| **Sex and Age** | | | | | | | | |
| Pre-only | [Sex=Women] * Age | -0,02 | 6,68 | 1 | 0,010 | 0,98 | 0,96 | 1.00 |
| | [Sex=Men] * Age | -0,02 | 3,42 | 1 | 0,065 | 0,98 | 0,97 | 1,00 |
| Post only | [Sex=Women] * Age | -0,01 | 0,52 | 1 | 0,469 | 0,99 | 0,95 | 1,02 |
| | [Sex=Men] * Age | -0,03 | 2,13 | 1 | 0,144 | 0,97 | 0,93 | 1,01 |
| Neither Pre-nor Post | [Sex=Women] * Age | -0,04 | 22,38 | 1 | <0.001 | 0,96 | 0,94 | 0,97 |
| | [Sex=Men] * Age | -0,05 | 21,48 | 1 | <0.001 | 0,95 | 0,94 | 0,97 |

a. The reference category is: Pre and Post.

In the 'pre-only' category, the effect of age varied by sex. In women (sex=0.00) each additional year of age significantly reduced the odds of falling into this category by 2.2% (OR=0.98, p=0.010, CI:0.96–1.00), in other words, as age increased, the likelihood of meeting WHO guidelines pre-lockdown was reduced. In men (sex=1.00), each additional year of age also showed a trend towards reducing the odds of meeting WHO guidelines pre-lockdown by 1.6%, although this reduction was not statistically significant (OR=0.98, p=0.065, CI:0.97–1.00). In the 'post only' category, the changes in odds due to age also varied by sex, but neither were statistically significant. Consequently, this implied that the likelihood of meeting WHO guidelines during lockdown was not affected by age or sex.

The 'neither pre-nor post' category showed a strong influence by age-sex interaction. For both women and men, each additional year (in terms of age) significantly reduced the odds of being categorised into this group, with women seeing a 4.4% decrease (OR=0.96, p<0.001, CI:0.94–0.97) and men a 4.6% decrease (OR=0.95, p<0.001, CI:0.94–0.97), i.e.as age increases, there is a decrease in the likelihood of not meeting guidelines pre-and-post-lockdown.

## Discussion

Our re-analysis of the ASAP survey data (Wilke *et al*., 2020), focusing on the specific consequences of lockdown restrictions in SA, revealed that there was a distinct decrease in the amount of PA during lockdown when compared to levels before the implementation of lockdown restrictions. Our analysis showed that total MVPA decreased by 53.5% and total VPA decreased by 58.0%. These changes in PA levels were higher than the percentage reported in the overall global ASAP survey results, which showed only a 41% reduction in MVPA and 42.2% in VPA (Wilke *et al*., 2021b: 1). SA's reduction in total MVPA and MVPA was recorded as 1 of 4 countries with the largest reductions across the global study, the remaining three countries were Argentina, Brazil, and Chile. These four countries contributed to 21.4% of the combined global results (Wilke *et al*., 2021b: 1). Furthermore, among the countries that participated in the global ASAP survey, SA was one of the countries that reported the lowest pre-lockdown MVPA and VPA volumes (Wilke *et al*., 2021b: 1).

The literature has shown that there are significant physical and mental health risks that are associated with decreased PA levels (Paudel *et al.,* 2023: 921), with the potential to exacerbate existing physical and mental health-related conditions, as well as increase the risk for the development of pathologies in previously healthy individuals (Ficarra *et al*., 2022: 402; Xie *et al.,* 2020: 4; De Nys *et al*., 2022: 1). This, coupled with the overall increased mental load and uncertainty experienced throughout the world during the peaks of the pandemic, placed the general population at a higher risk of declining health. Studies investigating PA concerning its' benefits between men and women, have shown that despite the benefits associated with disease prevention and management, women do not engage in PA as readily as men do (Hugh-Jones *et al*., 2023: 1). This was reiterated in the significant differences in MVPA ($p=0.004$) and VPA ($p<0.001$) between sexes, before the onset of lockdown, noted in our survey. Although there was no statistical significance generated between sexes during the lockdown stage of the survey (MVPA p=0,461 and VPA p=0,163), the overall suggestion aligns with that of other studies which show that men are more likely to engage with PA than women are, thus potentially increasing the risk of health decline in women. (Vaccarezza *et al*., 2020: 1). When analysing age to PA changes, the survey results revealed significant statistical values among 4 paired age categories: 18-29 vs 60-69 ($p=0.047$), 18-29 vs 50-59 ($p<0.001$), 30-39 vs 50-59 ($p=0.008$) and 40-49 vs 50-59 ($p<0.002$). Studies have previously indicated a link between PA and aging, showing that increasing PA as an individual age has positive effects in preventing and managing the overall deterioration in mental and physical function (McPhee *et al.,* 2016: 567). Maher *et al.* (2015: 1407) suggest that as an individual becomes older their general well-being decreases and their predisposition to physical and mental conditions increases. However, regular PA practices have the potential to positively impact mental and physical well-being during the aging process (Marquet *et al*., 2020: 1). Hence, a decrease in PA during periods of lockdown may have a higher negative impact on older individuals.

The survey further assessed participant compliance with WHO PA guidelines and the compliance changes during the onset of lockdown restrictions. In accordance with the general decrease of PA during the restrictions 30.0% of the participants were WHO PA guidelines compliant before the implementation of SARS-CoV2 lockdown measures, however, became non-compliant during the restrictions. The results further showed that 32.9% maintained PA levels according to WHO PA guidelines before and during SARS-CoV2 lockdown measures. A further 32.9% were non-compliant with WHO PA guidelines irrespective of SARS-CoV2 restrictions. A minor portion of the sample (4.2%) were compliant with WHO recommendations during the lockdown period but were non-compliant prior to the lockdown. Due to the effect that PA has on general well-being and the benefits associated with regular PA (Bowden-Davies *et al*., 2018: 1282; Stubbs *et al*., 2017: 545; Biddle *et al*., 2017: 134; Lear *et al*., 2017: 2643) the WHO has implemented guidelines for PA, these guidelines serve to inform good PA practices and encourage healthy levels of PA across sex and age groups, hence, non-compliance can increase the risks of developing mental and physical conditions.

The WHO PA guidelines compliance in this cohort across all categories was highest among men and women within the 18-29 age category, with a general decline in overall compliance noted as the age groups progressed. The least compliant group was 70-79 years, in both men and women across all compliance categories. Long-term decreases in PA are likely to affect the physical and mental well-being of individuals (Wilke *et al*., 2020: 1). There are significant amounts of literature that support the need for regular PA, and that document the adverse effects of insufficient PA or sedentary living (Garber *et al*., 2011: 1334). The findings of this survey suggested that sex alone cannot be linked to the likelihood of WHO guideline compliance. However, the statistics relating to age and sex, bring into focus a need for more tailored sex-age-specific guidelines to encourage compliance. These findings

highlight the complexity of how sex and age together influence health outcomes in response to WHO guidelines, and compliance thereof. The significant effects in the "pre-only" and "neither pre-nor post " categories for both sexes suggest that age-specific and sex-specific strategies may be required to optimise guideline effectiveness. The consistent trend of age and sex impacting WHO PA guideline compliance underscores the need for further investigation into how these factors interact to shape responses to health interventions, potentially guiding a more tailored approach to patient care.

The effects of insufficient PA levels extend but are not limited to the cardiovascular, neurological, endocrine, respiratory, and gastrointestinal systems (Chau *et al*., 2017: 617; Myers *et al*., 2019: 1; Vella *et al*., 2023: 132). The psychological impacts of PA and the lack thereof cannot be ignored either, as studies show a correlation between PA and conditions such as depression, anxiety, and mood disorders (Harridge and Lazarus, 2017: 152). SA is no exception, and local studies conducted have shown that there is a definite connection between insufficient PA and disease processes (Schuch and Vancampfort, 2021: 177; Micklesfield, 2021: 1), hence, the exaggerated decrease noted during the SARS-CoV2 lockdowns, raises the concern for further negative effects on physical and mental health conditions. Studies regarding SARS-CoV2 and how it's containment measures lead the way for protocol development for future pandemics, have concluded that social distancing and contact restrictions should be the basis for addressing any future pandemic emergence (Khanna *et al*., 2020: 702; Kolié, 2022: 1). Considering the obvious decline in PA noted in the global ASAP study (Wilke *et al*., 2021a: 1) and the specific South African results in this cohort, it is imperative to ensure that future global and local events requiring person to person contact restrictions do not impact the overall well-being of the general healthy population by impeding PA opportunities. The general findings of the South African data align with those of the overall global data, showing the need for effective PA resources for individuals who are not able to or simply do not want to participate in regular PA activities at regular PA establishments. This study and other studies like this have the potential to assist in the development of future frameworks and guidelines for PA during periods of isolation.

Our analysis adds to the global ASAP results by providing a deeper analysis of PA during the lockdown period in SA and, to the best of our knowledge, is the only study specifically looking at this. Our analysis further provides likelihood ratios by way of a logistic regression with particular reference to sex and age concerning WHO PA guideline compliance.

## Conclusion

The findings of the South African data align with those of the overall global data, showing the need for effective PA resources for individuals who are not able to or simply do not want to participate in regular PA activities at regular PA establishments. These results highlighted the need for improved PA mechanisms to ensure that individuals have access to viable PA options in the instances when regular PA activities may not be accessible or feasible. SARS-CoV2 and its resultant effects, have contributed to a foundation upon which the plans for any future health or environmental catastrophes will be developed. The basis for management during these future events rests largely on physical distancing and decreased interactions between individuals. This study highlights that, although physical distancing may prevent widespread disease progression, it may decrease well-being by impacting the accumulation of PA for individuals during lockdown periods. This study, and other studies like this, has the potential to assist in the development of future frameworks and guidelines for PA during periods of isolation. Hence the need for the development of tailored PA programs that may be accessed remotely. This would allow for the maintenance of WHO recommended PA levels and prevent the risks associated with sedentariness across age and sex during any future calamities requiring lockdown restrictions that limit individual movement.

As the South African cohort was part of a much larger international study, the results reflected an overall generic insight. This result could be improved by further PA and PA compliance studies targeting South Africans only, allowing for specific data collection and interpretation in the context of the country, its population, resources as well as social, cultural, and economic influences. A further limitation was that the survey did not fully consider the effect that the pandemic itself may have had on the participants' hesitance to engage in PA during lockdown, but instead focused more on PA opportunities during lockdown restrictions. This limitation could be remedied in future studies by including participant-specific or open-ended questions around aspects such as hesitance. This report was not able to analyse the impact of 'remote' versus 'office' work on PA levels and WHO PA guideline compliance, particularly because a large percentage (44.3%) of the participants in this cohort were not working at all during the lockdown period. A further investigation and analysis of these variables could provide added insight into the changes reported in our findings.

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