

Title

Physical activity and sedentary behaviour during the COVID-19 pandemic: An Australian population study

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Abstract

Objectives and importance of study:

Participating in physical activity and minimising time spent sedentary is important to achieve and maintain good health. Time spent being physically active and sedentary could be negatively influenced by the 2019 novel coronavirus pandemic where home confinement restrictions are commonplace internationally. The aim of this study was to identify the percentage of Australian adults meeting the physical activity and sedentary behaviour guidelines during the 2019 novel coronavirus pandemic.

Study type:

Cross-sectional survey.

Methods:

Australian adults (≥ 18 years) were asked to complete a 15-20 minute questionnaire on 21-23 April, 2020, to identify their PA and sedentary behaviours during the 2019 novel coronavirus pandemic. Descriptive statistics were produced for demographic, physical activity and sedentary behaviour variables.

Results:

1,084 Australian adults responded to the survey. The majority of respondents did not meet the aerobic ($n=756$, 70%) or strength ($n=649$, 60%) components of the guidelines. The majority of respondents ($n=609$, 58%) participated in low sedentary time (<9 hr/day). Australians aged 18-29 years participated in more sedentary time than Australians aged 60-69 years (50% and 68% spent <9 hours sedentary daily, respectively). Slightly fewer adults from regional Australia met the aerobic and strength guidelines compared to city residents (Aerobic: 28% and 31% met the

guidelines, respectively. Strength: 36% and 41% met the guidelines, respectively).

However, slightly more adults from regional Australia participated in low levels of sedentary time compared to city residents (61% and 57% spent <9 hours sedentary daily, respectively).

Conclusion:

The majority of survey respondents did not meet the physical activity and sedentary behaviour guidelines during April, 2020 (part of the 2019 novel coronavirus pandemic). Low activity levels and high sedentary time might be attributed to the enforcement of home confinement restrictions. However, the restrictions might have had favourable effects on strengthening activities, where more people participated in strength-based exercise than usual. The provision of easily accessible, convenient and appealing exercise classes within the home might positively influence physical activity levels during and after the 2019 novel coronavirus pandemic.

Introduction

Participating in regular physical activity (PA) is important to maintain good health^{1, 2}. To achieve this, Australian adults (aged 18-64 years) are encouraged to participate in at least 30-minutes of moderate intensity activity (e.g. cycling) on at least 5-days per week, or 75-minutes of vigorous intensity activity (e.g. running) weekly, as well as two sessions of muscle strengthening activities weekly¹. Physical activity levels of adults globally have been reported as inadequate, leading this widespread problem of inactivity being described as a “global pandemic that requires global action”³.

Sedentary time is defined as time spent in activities like sitting, reclining or lying that require low energy expenditure (≤ 1.5 metabolic equivalents)⁴. Adults are encouraged not only to meet the PA guidelines but also to break up time spent sedentary to maintain good health^{1, 2}. Recent research suggests that adults should spend less than 9 hours being sedentary⁵, specifically spending less than 6-8 hours sitting⁶, to reduce all cause and cardiovascular disease mortality. Exceeding these levels of sedentary time, especially by sitting, can have deleterious health effects by increasing mortality risk⁷ and the prevalence of anxiety⁸, frailty in older adults⁹ and various other chronic diseases⁶.

The World Health Organisation declared the worldwide outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) a pandemic on 11 March, 2020¹⁰. Following this declaration, the Australian federal government enforced strict rules in order to control the spread of SARS-CoV-2 on 29 March, 2020¹⁰. These rules included restrictions on geographical movement, such as an order to remain at home unless it was necessary to leave (e.g. for groceries or to exercise) in addition to

orders to not leave the home for any reason other than emergencies for those who were suspected of having contracted SARS-CoV-2¹¹.

People were still encouraged to participate in PA for at least 30-minutes every day during the pandemic, with outdoor activity permitted¹². However, it is possible that thousands of Australians experienced increased periods of inactivity and sedentary time by remaining at home when home confinement restrictions were in place. This can be detrimental to physical health, because even short periods of inactivity can be enough to negatively affect cardiorespiratory fitness, lean muscle mass, insulin resistance, abdominal fat levels, total body fat percentage and inflammatory cytokine levels^{13, 14}. Furthermore, time in quarantine is associated with acute stress, depression, feelings of detachment, irritability and emotional exhaustion¹⁵. Symptoms such as these can be effectively managed with PA¹⁶.

Understanding how active Australians were during this period will help us to understand if public health messaging sufficiently addressed PA and sedentary behaviours during this time. It can also inform future interventions designed to increase PA and reduce sedentary time in the home, which will be important if working from home becomes more common. Consequently, the purpose of this study was to measure the time Australians spent physically active and sedentary during the pandemic.

Methods

Ethics approval for this study was provided by the Monash University Human Research Ethics Committee (ID number: 23854). Each participant was provided with access to an explanatory statement (Appendix 1) at the beginning of the survey and indicated their consent to participate (Appendix 2). The reporting of this study was

informed by the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement.

A nation-wide cross-sectional survey of Australian adults aged 18 years and over, who were able to read and respond in English, was conducted on 21–23 April 2020. No additional exclusion criteria were applied. The survey was the second wave of Australian data collected in the Survey of COVID-19 [2019 novel coronavirus] Responses to Understand Behaviour (SCRUB), which comprised four waves as of July, 2020.

Respondents were contacted by a panel company and asked to participate in a 15–20-minute survey of their health behaviours during the pandemic. The survey was also promoted using social media platforms. Duplicate completions were avoided by preventing users with the same IP address from accessing the survey twice.

The survey instrument was designed by the authors, along with national and international colleagues with expertise in health behaviour change. The questions included in the instrument were piloted with a group of adults with behaviour change expertise to obtain feedback specific to the breadth of behaviours addressed, face validity of the included questions and useability of the online platform (Qualtrics). Responses to questions specific to PA and sedentary time were measured on Likert scales (0–7 and 0–24 points, as appropriate) and included:

1. In the past week, on how many days have you done a total of 30 min or more of PA, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places. This should not include housework or PA that may be part of your job.

2. In the past week, on how many days have you participated in muscle strengthening activities?
3. In the past week, on average, how many hours per day have you spent being sedentary (sitting or lying while awake)? Answer in hours per day (0–24). This may include TV viewing, video game playing, computer use, driving automobiles, and reading.

Data were exported and cleaned. Missing data were removed pairwise. All responses (incomplete and complete) were included for analysis. For the purpose of this paper, only descriptive statistics specific to demographic, PA and sedentary time variables were produced.

Results

A total of 1,084 Australian adults aged over 18 years of age responded to the survey. Each age and gender group were similarly represented in number, except for adults aged 80 years and over (5%). The majority of respondents resided in a major Australian city (77%) and in New South Wales (26%) or Victoria (29%). Most respondents were born in Australia (70%) and only spoke English at home (83%) (Table 1).

Age	N (%)
18-29	138 (13)
30-39	205 (19)
40-49	187 (17)
50-59	191 (18)
60-69	176 (16)

70-79	134 (12)
80+	53 (5)
Gender	N (%)
Male	516 (48)
Female	557 (51)
Other	0 (0)
N/A	11 (1)
Location of residence	N (%)
Australian Capital Territory	20 (2)
New South Wales	285 (26)
Northern Territory	2 (0)
Queensland	210 (19)
South Australia	88 (8)
Tasmania	26 (2)
Victoria	313 (29)
Western Australia	130 (12)
NA	10 (1)
Remoteness of residence	N (%)
Major Australian city	839 (77)
Inner regional Australia	139 (13)
Outer regional Australia	30 (3)
Remote Australia	2 (0)
Very remote Australia	0 (0)
N/A	74 (7)
Location of birth	N (%)

Australia	758 (70)
Other	318 (29)
N/A	8 (1)
Language spoken at home	N (%)
English only	901 (83)
Other language	176 (16)
N/A	7 (1)

Table 1: Characteristics of the 1,084 Australian survey respondents.

Key:

N/A = Not applicable

How physically active were Australian adults during the pandemic?

Aerobic activity

The majority of survey respondents did not meet the aerobic component of the PA guidelines. Only 326 (30%) respondents participated in ≥ 30 minutes of moderate intensity PA across 5 days in the week preceding the survey (Table 2). One fifth (20%) of respondents reported performing no aerobic activity in the previous week.

Age	Participating in at least 30-mins of aerobic activity on 5 days in the past week (n [%of group])		Participating in strength activities twice or more in the past week (n [%of group])		Participating in <9- hours of sedentary time daily in the past week (n [%of group])
18-29 (n=138)	28 [20]	18-29 (n=137)	70 [51]	18-29 (n=131)	66 [50]
30-39 (n=205)	57 [28]	30-39 (n=202)	89 [44]	30-39 (n=195)	102 [52]
40-49 (n=187)	55 [29]	40-49 (n=187)	72 [39]	40-49 (n=178)	108 [61]
50-59 (n=191)	54 [28]	50-59 (n=191)	66 [35]	50-59 (n=188)	108 [57]
60-69 (n=174)	72 [41]	60-69 (n=175)	68 [39]	60-69 (n=173)	117 [68]
70-79 (n=134)	46 [34]	70-79 (n=134)	45 [34]	70-79 (n=132)	75 [57]
80+ (n=53)	14 [26]	80+ (n=53)	20 [38]	80+ (n=53)	33 [62]
TOTAL (n=1082)	326 [30]	TOTAL (n=1079)	430 [40]	TOTAL (n=1050)	609 [58]

Table 2: Participation in physical activity and sedentary time by age

Respondents aged 60-69 years performed the most aerobic activity and those aged 18-29 performed the least out of all age groups (41% and 20% met the guidelines, respectively) (Table 2). Males were slightly more active than females (31% and 29% met the guidelines, respectively) (Table 3). Slightly fewer adults from regional Australia met the guidelines compared to major city residents (28% and 31% met the guidelines, respectively) (Table 4).

Gender	Participating in at least 30-mins of aerobic activity on 5 days in the past week (n [%of group])	Participating in strength activities twice or more in the past week (n [%of group])	Participating in <9- hours of sedentary time daily in the past week (n [%of group])
Male (n=515)	162 [31]	Male (n=515) 224 [44]	Male (n=497) 285 [57]
Female (n=556)	163 [29]	Female (n=553) 201 [36]	Female (n=544) 318 [58]
TOTAL (n=1071)	325 [30]	TOTAL (n=1068) 425 [40]	TOTAL (n=1041) 603 [58]

Table 3: Participation in physical activity and sedentary time by gender

Remoteness of residence	Participating in at least 30-mins of aerobic activity on 5 days in the past week (n [%of group])	Participating in strength activities twice or more in the past week (n [%of group])	Participating in <9- hours of sedentary time daily in the past week (n [%of group])
Major Australian city (n=838)	263 [31]	Major Australian city (n=836)	342 [41]
Regional Australia (n=168)*	47 [28]	Regional Australia (n=168)*	60 [36]
TOTAL (n=1006)	310 [31]	TOTAL (n=1004)	402 [40]
		Major Australian city (n=816)	466 [57]
		Regional Australia (n=164)*	100 [61]
		TOTAL (n=980)	566 [58]

Table 4: Participation in physical activity and sedentary time by remoteness of residence

Key:

*This group comprises members of both inner and outer regional Australia

Strength activity

The majority of survey respondents did not meet the strength component of the PA guidelines. Only 430 (40%) respondents participated in ≥ 2 days of muscle strengthening activities in the previous week (Table 2). Over half (51%) of respondents reported performing no strengthening activities in the previous week.

In contrast to aerobic activity, respondents aged 18-29 years performed the most strengthening activity and those aged 70-79 performed the least out of all age groups (51% and 34% met the guidelines, respectively)(Table 2). Similar to aerobic activity, males were more active than females (44% and 36% met the guidelines, respectively) (Table 3) and fewer adults from regional Australia met the guidelines compared to major city residents (36% and 41% met the guidelines, respectively) (Table 4).

How sedentary were Australian adults during the pandemic?

The majority of survey respondents participated in low levels (defined as <9 hours) of sedentary time (n=609, 58%) (Table 2). Three quarters of respondents reported participating in 3-12 hours of sedentary time each day (n=785, 75%).

Respondents aged 18-29 years were most sedentary and those aged 60-69 were the least sedentary out of all age groups (50% and 68% spent <9 hours sedentary daily, respectively) (Table 3). Males participated in a similar amount of sedentary time to females (57% and 58% spent <9 hours sedentary daily, respectively)(Table 3). Finally, more adults from regional Australia participated in low levels of sedentary time compared to major city residents (61% and 57% spent <9 hours sedentary daily, respectively) (Table 4).

Discussion

This survey of 1,084 adults identified the levels of PA and sedentary time Australians participated in during April, 2020. This was one month after the WHO declared COVID-19 to be a worldwide pandemic and the Australian federal government implemented home confinement restrictions. The majority of respondents did not meet PA guidelines but participated in low levels of sedentary time. A greater proportion of older adults participated in aerobic activities compared to younger Australians, however this observation was reversed for strengthening activities. Younger Australians participated in more sedentary time than older Australians. Fewer adults from regional Australia met the aerobic and strength guidelines compared to city residents, however they also participated in less sedentary time. Males were more active than females, however both participated in similar amounts of sedentary time.

A similar number of Australian adults in this study participated in ≥ 30 -minutes of activity on ≥ 5 days per week (30%) during the pandemic compared to 2017-2018 ABS data (29%)¹⁷. This might mean that 30% of adults in this study achieved ≥ 150 -minutes of weekly aerobic activity, which is lower compared to 2017-2018 ABS data (53%)¹⁷. A reduction in PA has been seen globally¹⁸ and in another Australian survey where 49% of the 1,491 surveyed adults reported a decline in regular activity levels, 31% reported no change and 21% reported an increase¹⁹. Our study found that 20% of adults did not do any aerobic activity in the previous week, which is lower compared to 2017-2018 ABS data (34%)¹⁷. These findings suggest that most Australian adults did not meet the aerobic component of the guidelines but that some

might have increased or changed their activity levels during the pandemic, potentially by trying online fitness classes and walking more around their local areas²⁰.

More Australian adults met the strength component of the guidelines compared to times outside of the pandemic. More respondents from both city (41%) and regional (36%) areas of Australia met the strength component of the guidelines (40% in total) compared to 2017-2018 ABS data (23%)¹⁷. This is also greater than the 10% of 195,926 Australian adults who reported meeting the strength guidelines between 2001 and 2010²¹ and the 5% of 1,237 Australian adults participating in sufficient strength activities for health in a 2017 Central Queensland survey²². More men than women participated in strengthening activities in the present study, which is consistent with previous work^{17,22}. The greater participation in strengthening activities during this period might be explained by both the increased desire of people to participate in exercise as a way to overcome boredom during excessive leisure time experienced while confined to the home and the increased promotion of home-based exercises that comprise resistance training²³.

Australians are spending more time sedentary when compared to times outside of the pandemic. More than half of the survey respondents (58%) reported low sedentary time, however this is less than that found in another Australian study of 9,435 adults where 79% reported low sedentary time (defined by the authors as participating in less than 8 hours of sedentary time daily)²⁴. Furthermore, younger adults were more sedentary than older adults, which is in contrast to ABS data indicating that activity levels decline with age¹⁷. The home confinement restrictions and the normative nature of “binging” favourite TV shows on streaming services that offer special subscription deals during the pandemic could have contributed to increases in sedentary time. The popularity of streaming services with younger

generations in particular might also explain why younger adults participated in more sedentary time compared to older adults²⁵.

Replacing or at least breaking up sedentary time (such as sitting time²) with light or moderate-vigorous intensity PA can help to mitigate the negative effects of excess sedentary time⁷. It is important to support people during times of home confinement, as seen during the COVID-19 pandemic in Australia, by providing them with opportunities to participate in PA and limit sedentary time.

Enforcing restrictions that encourage all Australians to stay at home unless they must leave for essential activities removes opportunities for activity and provides opportunities for sedentariness. Furthermore, such a restriction imposed by a trusted agency (e.g. medical professionals) who both promote and practice the behaviours (e.g. practicing physical distancing during media appearances) increases the likelihood that the restriction will be followed²⁶. In this case, opportunities to be active must be provided that still allow people to adhere to the restrictions. Promoting gym membership might not increase PA levels in usual times²⁷ and gyms were closed for some part of the pandemic. Thus, more creative strategies are needed. Improving and maintaining access to free outdoor gyms²⁸ and bike/walking paths²⁹ might assist people to increase PA levels and reduce sitting time. However, outdoor gyms were also closed during the pandemic, potentially negatively influencing PA participation, especially for adults seeking an alternative to gym-based activities.

Encouraging people to use a smartphone app or wearable to monitor their PA and sedentary time has been shown to increase PA³⁰. Thus, promoting technology use, and the use of bike and walking paths by keeping them open, might facilitate an increase in activity levels and reduction in sedentary time during the pandemic.

Future research should identify the activities physically active individuals participated in during the pandemic to inform promotion strategies for use during future pandemics or other forms of lifestyle change (e.g. increase in prevalence of people working from home where incidental activity is reduced).

There are strengths and limitations of this study that warrant consideration. It is rare for a survey to measure aerobic, strength and sedentary behaviour components of the guidelines. Thus, this expanded approach used in this study is a strength.

However, it is unclear how many respondents met one, two or all three components of the guidelines. It would be useful to compare the percentage of respondents meeting both the aerobic and strength components to the most recent ABS data (15% of Australian adults met both components in 2017-18¹⁷). Furthermore, it would also be useful to also explore the number of adults achieving ≥ 150 -minutes of aerobic activity weekly to provide additional direct comparisons to previously collected ABS data.

Our study examined leisure-time PA and did not address occupational PA, or PA obtained at work. This could have led to an underestimation of the PA levels of people in regional Australia. This group reported participating in less PA but also less sedentary time compared to city residents. Adults in regional areas might have more active occupations (e.g. farming) where a lot of PA is performed, leading to less sedentary time and also less leisure-time PA participation due to the need for rest and recovery away from work. Future research should clearly distinguish between these types of PA to improve accuracy.

This cross-sectional survey only provides a snapshot of the PA and sedentary behaviours of a sample of the Australian population at one point in time during the

COVID-19 pandemic. Thus, a change in these behaviours throughout the crisis cannot be determined. The restrictions placed on the population and, thus, Australians' behaviours change quickly during such a time. Therefore, follow-up data should be collected at another point during the pandemic to provide a more holistic picture of the influence COVID-19 has on health behaviours.

The survey sample predominantly comprised participants from major Australian cities (77%) and living in New South Wales (26%) or Victoria (29%). Therefore, it may be inappropriate to generalise the results to individuals living in less urbanised states.

Conclusion

This nationwide survey explored the amount of PA and sedentary time Australian adults participated in during April, 2020 (during the COVID-19 pandemic). Compared to previous studies, Australians participated in insufficient levels of aerobic activity and more sedentary time. However, more adults participated in strengthening activities. Fewer respondents from regional Australia met the aerobic and strength components of the guidelines compared to those from major cities, however they also participated in less sedentary time, possibly due to having more physical occupations. Finally, more older adults met the aerobic component of the guidelines compared to younger adults, which was in contrast to strength activities where more younger adults met the guidelines, which could be due to the popularity of technology-based (online) exercise classes designed specifically for the pandemic that comprise mainly strength training. Pandemics, and times of largescale change, can make maintaining good health behaviours like participating in PA and limiting sedentary time challenging. However, opportunities such as participating in online

exercise classes and using public walking paths while adhering to government-imposed restrictions might help to attenuate the loss of healthy behaviours, or attainment of unhealthy behaviours, that can lead to poor future health outcomes.

Key points

- Participating in physical activity and low sedentary time is good for health but might be hard to do during a pandemic
- Most adults did not meet the aerobic activity and sedentary behaviour components of the guidelines during the pandemic
- More Australian adults met the strength guidelines compared to usual times. Younger adults did more strengthening activities than older adults
- Online exercise classes might have helped people to do more strength activities during stay-at-home restrictions.

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