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Original research

Physical activity and active recreation before and during COVID-19: The Our Life at Home study

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ARTICLE INFO

Article history:

Received 16 March 2021

Received in revised form 12 September 2021

Accepted 9 October 2021

Available online 14 October 2021

Keywords:

Lockdown restriction

Australia

Public health

Health policy

walking

ABSTRACT

Objectives: To examine the effects of COVID-19 related 'lockdown restrictions' on Australian's (5–75 years) physical activity recommendation achievement and active recreation participation.

Design: Cross-sectional online survey with self and proxy-report items (where the participant was a parent).

Methods: Adults ($n = 1360$) and adolescents ($n = 1292$) reported the frequency they performed 30- or 60-min of moderate-to-vigorous physical activity (MVPA), muscle-strengthening exercises, and participation in 11 active recreation behaviours in February 2020 (pre-COVID-19) and in April/May (during lockdown restrictions). Parents also proxy-reported activity for their child ($n = 147$, 5–12 years). Mixed effects logistic regressions or a logistic regression (with robust sandwich estimation for variance) assessed recall differences pre- and during lockdown, and interaction by sex.

Results: Compared to February, in April/May children were less likely to meet MVPA recommendations (OR = 0.27, 95%CI = 0.12–0.64); adolescents males, but not females, were less likely to meet MVPA (OR = 0.71, 95%CI 0.43, 1.17) and both recommendations (OR = 0.12, 95%CI = 0.02, 0.79); and adults were more likely to meet MVPA (OR = 1.26, 95%CI = 1.01, 1.57) but less likely to meet muscle-strengthening exercise recommendations (OR = 0.76, 9%CI = 0.65, 0.89). Across age groups more participants reported walking, muscle strengthening exercises at home, and yoga/Pilates/stretching at home, and fewer performed informal sport practice and play, and recreational activities.

Conclusions: Lockdown restrictions had different effects on physical activity and active recreation among age groups and by sex. Physical activity promotion strategies that target children and adolescents, at home physical activity options, active neighbourhoods, and (re)engagement in informal sport and recreational activities post-COVID-19 are critical for (re)engaging Australians in health-enhancing behaviours.

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Practical implications

- Australia's COVID-19 lockdown restrictions resulted in fewer children and more adults reporting meeting the moderate- to vigorous intensity physical activity recommendations during the lockdown compared to prior, with no differences among adolescents.
- Physical activity promotion strategies that target negating the declines or consistently low physical activity levels of children and adolescents and maintaining the improvements in adult's physical activity are warranted.

- Physical activity promotion strategies that promote at home physical activity options, active neighbourhoods, and (re)engagement in informal sport and recreational activities are critical for (re)engaging the population in health-enhancing behaviours post-COVID-19.

1. Introduction

Physical activity is a health enhancing behaviour positively associated with improved physical and psychosocial health among youth and adults.^{1,2} Physical activity has positive effects on immune functioning and inflammation, which are key for managing COVID-19 symptoms.³ Globally, compliance with age-specific physical activity recommendations, which have been established based on health and wellbeing outcomes^{4–7} is inadequate.⁸ The Australian physical activity guidelines recommend children and adolescents perform 60 min of moderate-to-vigorous intensity physical activity (MVPA) each day and muscle-strengthening exercises three times per week. However,

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Australian population data show only 26% of children and 8% of adolescents met these recommendations during typical conditions (2011–2012).^{9,10} It is recommended that adults (18–64 years) accumulate 150–300 min of moderate intensity or 75–150 min of vigorous intensity physical activity, or an equivalent combination each week, and perform muscle-strengthening exercises twice per week^{5,11}; and older adults (65 + years) perform 30 min of MVPA on most days and incorporate strength and flexibility exercises 2–3 times per week.¹² However, during typical conditions only 48% of Australian adults and 25% of Australian older adults met these recommendations (2017–2018).^{9,10} Restrictions associated with managing the COVID-19 pandemic may have resulted in further declines in compliance.¹³

Government restrictions and physical distancing requirements in response to the COVID-19 pandemic in Australia (and many other countries), hereafter referred to as ‘lockdown restrictions’, saw the closure of schools, workplaces and active recreation facilities such as playgrounds and sporting clubs. Consequently, important sources of physical activity for children and young people (e.g. school recess and lunch,¹⁴ after-school,¹⁵ sport, and active travel to school¹⁶) and adults (e.g. fitness/gym activities¹⁷) were not available during this period. The importance of maintaining physical activity during restrictions has been acknowledged^{18,19}; however, a systematic review of the changes in physical activity before and during lockdown restrictions found that most studies reported decreases in physical activity during lockdown²⁰ relative to beforehand. Determining the impact of lockdown restrictions on participation in physical activity among various population groups is recognised as a key requirement globally³; yet only one study in this review (from Italy) examined behaviours across the lifespan²¹ and the included Australian data were only among small samples of adolescents ($n = 464$)²² and university students ($n = 149$).²³

During the April/May period of lockdown restrictions in Australia, being active was one of the few allowable reasons to leave home. However, the effect of lockdown on meeting physical activity and muscle-strengthening recommendations, and participation in various types of active recreation among Australian children, adolescents and adults is unknown. Understanding population changes in specific active recreation behaviours is important for population health outcomes as a ‘new COVID-normal’ emerges. This data may inform government investment in physical activity promotion and engagement strategies among different age groups, and may assist with the development and implementation of effective physical activity policies and programs³ that support any increases in activities while mitigating declines. This study explored changes in subjectively measured meeting of MVPA and muscle-strengthening recommendations, and active recreation participation among children, adolescents, and adults in Australia between February (pre-COVID-19 restrictions) and April/May (lockdown restrictions) and examined sex-differences.

2. Methods

Australia's first case of COVID-19 was reported on January 25th 2020, and Stage 3 ‘stay-at-home’ lockdown restrictions first came into effect on March 23rd 2020 (easing May 1st 2020). As part of these restrictions, exercise, shopping for essentials, caring for self and others, and work/study that could not be done at home were the only permissible reasons to leave home. A timeline of the restrictions in place across Australian states and territories during the recall period of this study is shown in Supplementary Fig. 1.

The Our Life at Home study is a purpose-designed longitudinal study investigating the impact of the COVID-19 pandemic on physical activity, sedentary behaviour, health and wellbeing of Australians. Participants aged 13–75 years and residing in Australia were recruited via social media advertising, personal and professional networks, media, and snowballing techniques. After confirming eligibility and providing consent (digitally), an online survey was completed with age-appropriate questions directed to adults and adolescents. Adults with a child aged

between 5 and 17 years were invited to proxy-report their child's physical activity. Ethical approval was obtained from the Deakin University Human Ethics Advisory Group-Health (HEAG-H:59_2020). In total, 14,764 survey link clicks were recorded, and 6520 individuals consented to participate (response rate 44%). This paper conforms to the STROBE checklist (Supplementary Table 1).

Data were collected in May 2020. Participants provided their age, sex, highest level of education and state or territory of residence. They were asked to recall their physical activity and active recreation during a usual week in the past month (April/May 2020). They were also asked to retrospectively recall their physical activity and active recreation during a usual week in February 2020 (pre-COVID-19 lockdown restrictions) to gain behavioural data prior to the pandemic and during lockdown restrictions, respectively.

Children (via parent proxy-report) and adolescents (self-report) reported the number of days per typical week they engaged in at least 60-min of MVPA²⁴ in February and in the last month (April/May). Data were dichotomised at seven days per week as achieving the recommendations (≥ 60 min of MVPA every day). Using a valid and reliable measure,^{24,25} adults reported the number of days per typical week they performed MVPA for at least 30-minutes²⁵ in February and in the last month (April/May). This measure does not separate VPA from MPA, therefore the recommendations were operationalised based upon the combined MVPA recommendation. As this operationalisation aligns with the recommendations for both adult and older adult age groups, data for 18–75 year olds (hereon termed ‘adults’) were dichotomised at ≥ 5 days/week to approximate achieving the recommendations.⁴ Participants also reported the number of times per week they typically performed muscle-strengthening exercises in February and in the last month (April/May). This was dichotomised at ≥ 3 times/week for children and adolescents, and ≥ 2 times/week among adults to indicate achieving the recommendations.

Participants reported whether they participated (yes/no) in 11 active recreation activities in February and in the last month (April/May). Recreation activities included: running outdoors; cycling for leisure, cycling at home; muscle-strengthening exercises at home; yoga/Pilates/stretching at home; fitness/aerobics class at home; informal sport practice or play; recreational activities (e.g., skateboarding/surfing); and walking for exercise or leisure on their own/with a group/with family.

All statistical analyses were conducted using Stata 16.0 (StataCorp LP., College Station, TX, USA). Proxy-reported data for adolescents aged 13–17 years were not included in the current analyses; self-reported data were relied on instead. Data were analysed by age group: children (5–12 years; proxy-reported), adolescents (13–17 years), and adults (18–75 years). Mixed effects logistic regression models including random intercepts for individuals (level 1: time point; level 2: participant) were performed to compare the achievement of MVPA and muscle-strengthening exercise recommendations separately and in combination, and participation in each of the active recreation behaviours in February and April/May. Where this model could not achieve convergence, a logistic regression with robust sandwich estimation for variance was used. Sex differences were examined by including an interaction term (sex \times time), and significant interactions ($p < 0.05$) were further explored by stratified analysis to identify sex-specific results. As this survey was completed at one time point, no adjustment for time invariant factors were made. The relative difference in meeting recommendation between February and April/May and calculated as $(([\text{April/May}\% - \text{February}\%]/\text{February}\%)*100$.

3. Results

The participant characteristics for the final sample of children ($n = 147$), adolescents ($n = 1296$), and adults ($n = 1360$) are presented in Table 1. The sample was predominantly female (except

Table 1
Participant characteristics.

	Children (n = 147)	Adolescents (n = 1296)	Adults (n = 1360)
Mean age, years (SD)	9.1 (2.2)	16.2 (1.2)	36.9 (15.1)
Sex	61 (41.5)	903 (69.7)	
Female, n (%)			1121 (82.4)
Education			
University or tertiary qualification, n (%)	N/A	N/A	921 (67.4)
State/territory, n (%)			
Australian Capital Territory	8 (5.4)	27 (2.1)	54 (4.0)
New South Wales	28 (19.1)	329 (25.4)	255 (18.8)
Northern Territory	2 (1.2)	8 (0.6)	11 (0.8)
Queensland	14 (9.5)	252 (19.5)	154 (11.3)
South Australia	11 (7.5)	96 (7.4)	93 (6.8)
Tasmania	6 (4.1)	59 (4.6)	58 (4.3)
Victoria	69 (47.0)	399 (30.8)	652 (47.9)
Western Australia	9 (6.1)	126 (9.7)	83 (6.1)

Note: N/A = not applicable.

for the child sample), highly educated, and the majority resided in the state of Victoria.

Table 2 shows the proportion, relative difference, and odds of meeting MVPA, muscle-strengthening, and both recommendations among children, adolescents and adults between February and April/May. Children were 73% less likely to meet the MVPA recommendations in April/May compared to February. Despite relative increases from February to April/May of 60% and 26%, respectively, there was no significant difference in likelihood of children meeting muscle-strengthening and both recommendations. Among adolescents, there was no significant difference of the overall sample meeting any recommendations, however stratified analysis showed that males were 88% less likely to meet both recommendations in April/May compared to February. There was also a significant interaction by sex for MVPA guidelines, where adolescent males tended to have lower, and females had higher odds of meeting this recommendation in April/May. Adults were 26% more likely to meet MVPA recommendations and 24% less likely to meet muscle-strengthening recommendation in April/May compared to February.

Among children, walking with family, informal sport practice or play, and cycling for leisure outdoors were the most commonly

performed activities both in February and April/May (Appendix Table A.1). Fitness/aerobics classes at home and yoga/Pilates/stretching at home were the most infrequently performed activities at both time-points. Compared to February, in April/May children were less likely to engage in informal sport practice or play and more likely to walk with family, walk on their own and engage in muscle-strengthening at home. Stratified analysis showed in April/May compared to February, boys were less likely to participate in informal sport practice and the trend was similar for girls, and girls more likely to participate in muscle-strengthening exercises at home with a similar trend for boys.

Among adolescents, walking on their own was the most common activity at both time-points and cycling at home and fitness/aerobics at home were the most infrequently performed activities at both time-points (Appendix Table A.2). Compared to February, in April/May adolescents were less likely to participate in informal sport practice/play, recreational activities, walking with a group, running outdoors, cycling at home, walking on own, cycling for leisure outdoors, and walking with family. Stratified analysis showed in April/May compared to February, males were less likely to cycle for leisure outdoors with a similar trend for females.

Among adults, walking on their own and walking with family were the most common activities at both time points (Appendix Table A.3). Compared to February, in April/May, adults were less likely to participate in recreational activities, informal sport practice or play, walking with a group, and walking on their own, while more likely to engage in fitness/aerobics classes at home, muscle-strengthening exercises at home, yoga/Pilates/stretching at home, and walking with family. Stratified analysis showed in April/May females and males were more likely to participate in muscle-strengthening exercises at home compared to February.

4. Discussion

This study is the first to describe the effects of government COVID-19 related 'lockdown restrictions' in April/May compared to pre-lockdown in February on subjectively-measured physical activity recommendations and active recreation participation among Australian children, adolescents, and adults. Key findings showed that fewer children and more adults reported meeting the MVPA recommendations during the

Table 2
Proportion of sample, relative difference, and odds of meeting moderate-to-vigorous intensity physical activity (MVPA), muscle strengthening, and both recommendations before (February) and during (April/May) COVID-19 lockdown restrictions.

Recommendations	Children			Adolescents			Adults		
	Overall	Males	Females	Overall	Males	Females	Overall	Males	Females
MVPA									
February (% met)	34.0	44.7	19.7	8.0	11.3	6.8	30.2	35.1	29.3
April/May (% met)	21.8	27.1	14.8	8.1	8.3	8.2	33.0	37.0	32.5
Relative difference [¶]	-35.9%	-	-	1.3%	-26.5%	20.6%	9.3%	-	-
Odds ratio	0.27	-	-	1.04	0.71	1.22	1.26	-	-
[95%CI] [‡]	[0.1–0.6]			[0.62, 1.73]	[0.43, 1.17]	[0.85, 1.73]	[1.01, 1.57]		
Muscle strengthening									
February (% met)	10.2	8.2	13.1	28.7	31.0	22.8	48.0	42.6	44.2
April/May (% met)	16.3	10.6	24.6	27.0	31.2	25.8	37.2	34.2	38.0
Relative difference [¶]	59.8%	-	-	-5.9%	-	-	-22.5%	-	-
Odds ratio	1.72	-	-	1.03	-	-	0.76	-	-
[95%CI] [‡]	[0.86, 3.43]			[0.79, 1.34]			[0.65, 0.89]		
MVPA and muscle strengthening									
February (% met)	2.7	3.5	1.6	3.9	4.2	3.1	17.9	16.7	17.0
April/May (% met)	3.4	2.4	4.9	3.3	1.1	4.2	16.6	18.5	16.4
Relative difference [¶]	25.9%	-	-	-15.4%	-73.8%	35.5%	-7.3%	-	-
Odds ratio	0.62	-	-	0.95	0.12	1.48	0.88	-	-
[95%CI] [‡]	[0.33, 1.15]			[0.56, 1.61]	[0.02, 0.79]	[0.83, 2.71]	[0.65, 1.20]		

Note: Child data were proxy-reported by parents/guardians; [¶]relative difference calculated as ((April/May%- February%)/February%)*100; Mixed effects logistic regression (with interaction for time × sex) or logistic regression with robust sandwich estimation for variance assessed differences in the whole sample between February 2020 and April/May 2020; Odds ratio (OR) represents the odds of meeting the recommendation in April/May compared to February (referent group = February); CI = confidence intervals; [‡]relative difference and odds ratio only computed for males and females if there was a significant interaction ($p < 0.05$).

lockdown, with no differences among adolescents, identifying children and adolescents as key targets for physical activity promotion strategies post-COVID-19. Findings show that there are key opportunities to promote physical activity for all age groups via supporting at home physical activity options and active neighbourhoods, while strategies to promote reengagement in informal sport practice and play and recreation activities should be sought. This study directly addresses Phases 3 and 4 of the *Behavioral Epidemiology Framework applied to studying physical activity and coronavirus disease-2019 (COVID-19)*³ by providing new insights into the effects of lockdown on physical activity behaviours. The findings can inform physical activity promotion, policy and strategy targets that aim to restore population levels of physical activity or maintain any gains observed during lockdown restrictions.

The lower proportion and odds of children meeting the MVPA recommendations during lockdown restrictions is particularly concerning, yet is consistent with other countries.²⁶ Although no differences in the odds of adolescents achieving recommendations pre- and during lockdown were reported, prevalence rates were worryingly low at both time points. An international meta-analysis has shown that between age three and 18-years, on average, physical activity declines by 3.4%–5.9% per year.²⁷ Lockdown restrictions may have resulted in physical activity declines typically seen over many years, suggesting the need for targeted efforts to promote children's and adolescents' physical activity. In contrast, a higher proportion of adults met MVPA recommendations during the lockdown than prior to COVID-19 restrictions, but lower compared to previous Australian population data.^{17,28} Further research should investigate the factors that influenced these differences. For example, time reallocation (e.g., reduced commutes) and increased flexibility and opportunities to be active throughout the day may have made it easier for adults to incorporate physical activity into their lives. In addition, having exercise as one of only four reasons to leave home may have emphasised the importance of being active, particularly in one's neighbourhood. Understanding and supporting engagement in MVPA should be a high priority to maintain these apparent improvements among adults and mitigate the declines among children and consistently low engagement among adolescents in the long-term.

During lockdown restrictions, there was an uptake in at home physical activity options across all groups, particularly among females, which highlight these activities as potential physical activity promotion targets. The increase observed among women and sex-specific changes in physical activity are consistent with changes observed among UK adults during COVID-related restrictions.²⁹ At both time points in the current study, females across age groups reported engaging in activities that required minimal equipment or access to facilities (e.g. yoga/Pilates/stretching), and there were further increases in the proportion participating in these activities during the lockdown. Research should determine if this is indicative of behavioural preferences and enjoyment,³⁰ and/or adaptation to the situation, and how this can be maintained. Future investigation into the factors that facilitate and support at home physical activity is required to promote these when access to facilities and equipment may be limited, such as during restrictions or among rural and remote population groups.

Key findings from this study relate to participation in walking which is readily performed within the local neighbourhood. In the current study, during both February and the lockdown restrictions, walking for leisure (either on own, with family or a group) was one of the most common behaviours among all age groups, and is reflective of previous Australian population data showing that walking is the most common physical activity performed by Australian adults.¹⁷ During lockdown, a greater proportion of adults and children reported walking as a family and more children were walking on their own than pre lockdown restrictions. Importantly, neighbourhood walking with family members may lead to greater social connections with the community, which may be particularly important when participation in walking groups is limited.³¹ The findings also suggest that children's independent mobility may have been positively impacted by the lockdown restrictions. The factors that contributed to this change, such as whether

children gained skills and confidence through family walks or due to reduced traffic, and whether independent mobility continues post-COVID, should be explored. Cycling during lockdown has also received focus, particularly from the media, however, this study found declines among adolescent males. Although this study assessed recreational cycling, there may also be opportunities to support utility cycling during and following the easing of lockdown restrictions.³² Walking and cycling can be readily accessible activities that may be key to maintaining physical activity irrespective of access to traditional sport and recreation facilities. Our findings support calls to promote active neighbourhoods with adequate infrastructure that supports active travel.

The differences in informal sport practice and play, and recreational activities (e.g., skateboarding) pre- and during lockdown were evident among all age groups. These differences, along with the closure of sporting organisations/clubs, gyms and recreation facilities highlight the contribution of these facilities and organisations to physical activity levels across age groups.¹⁷ The closure of schools may have also impacted children's and adolescents' overall physical activity levels,¹⁴ and in combination, these closures may in-part explain children's and adolescents' poor compliance with the MVPA recommendations in lockdown. Efforts to support the (re)commencement of informal sport practice and play, and organised and community sport among children and adolescents will be important to negate declines.

The strengths of the current study include the large sample of Australians from a wide age range (5–75 years) although the sample were slightly younger than the wider Australian population.³³ The collection of data on meeting physical activity recommendations and active recreation from before and during the lockdown period are also major strengths, although the retrospective nature of these questions at one point in time, and the length of recall should be acknowledged. In addition, the brief item used to quantify the percentage of adults meeting MVPA recommendation was valid and reliable,^{24,25} however as it based on the number of days achieving 30-min of MVPA and therefore would not have captured if a participant met the recommendations via vigorous-intensity physical activity only (e.g. VPA for 75-min). The use of self-report (and child proxy-report), the relatively small child sample, the highly educated sample, and bias toward females and residents from one state (Victoria) are also limitations. Further, the findings may reflect natural seasonal differences in behaviour, and it is possible that participants engaged in other physical activities (e.g., formal sport engagement) not included in the current study. Results by state/territory were not compared as some were under-represented. Lastly, while there are separate Australian physical activity recommendations for adults and older adults, these age groups were combined for the current analysis as the older adult sample was too small for separate analysis (18–64 years, $n = 1296$; 65–75 years, $n = 64$), and the operationalisation of meeting physical activity recommendations used aligned with the recommendations for both age groups. Future research should examine longer-term changes in these behaviours as lockdown restrictions ease.

5. Conclusion

The results of this study suggest that Australian COVID-19 lockdown restrictions in April/May 2020 may have negatively impacted the proportion of children, and positively impacted the proportion of adults meeting MVPA recommendations, with no change among adolescents. There were varying reported effects on active recreation across age groups and by sex. Potential physical activity promotion strategies as COVID-19 lockdown restrictions progress and ease include supporting at home physical activity options, active neighbourhoods and (re)engagement in informal sport practice and play and recreational activity. These findings can inform government policy and investment in public health, sport and recreation strategies to maintain adults' physical activity and (re)engage children and adolescents' physical activity post-COVID-19.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jsams.2021.10.004>.

Funding information

This study received seed funding from Deakin University's Institute for Physical Activity and Nutrition (IPAN). The funders played no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. JS is supported by a National Health and Medical Research Council Investigator Grant (APP 1176885). RU is supported by Alfred Deakin Postdoctoral Research Fellowship. JV and NDR are supported by an Australian National Heart Foundation Future Leader Fellowship (JV: ID 101928, NDR: 101895).

Appendix A

Appendix Table A.1

Children's proxy-reported participation in active recreation behaviours before (February) and during (April/May) COVID-19 lockdown restrictions: percent (%) of sample participating and odds of participation in April/May compared to February.

	Overall sample					Sex				
	n	February (%)	April/May (%)	Odds ratio [95%CI]	p value ^a	Boys		Girls		p value ^b
					February (%)	April/May (%)	February (%)	April/May (%)		
Walking for leisure/exercise with family	139	69.1	81.3	2.79 [1.31, 5.95]	0.008	71.8	84.3	66.7	76.4	0.610
Informal sport practice or play	133	63.2	49.6	0.31 [0.14, 0.69]	0.003	71.1	50.0	50.0	47.2	0.044
Sex-stratified analysis: OR [95%CI] ^f						0.16 [0.05, 0.50]		0.74 [0.24, 2.32]		
Cycling for leisure outdoors	133	51.9	52.6	1.13 [0.53, 2.37]	0.757	51.8	53.2	48.2	50.9	0.663
Running outdoors	133	42.1	40.6	0.88 [0.41, 1.88]	0.734	51.2	49.4	25.9	26.9	0.720
Recreational activities	131	35.9	28.2	0.49 [0.23, 1.05]	0.065	39.8	27.3	29.6	30.2	0.143
Cycling at home	133	24.1	24.1	0.98 [0.20, 4.74]	0.984	24.1	25.3	22.2	20.8	0.406
Walking for leisure/exercise with a group	137	16.1	11.7	0.65 [0.30, 1.44]	0.287	15.4	9.6	15.3	14.6	0.474
Walking for leisure/exercise on own	138	7.3	21.8	8.62 [2.27, 32.78]	0.002	8.4	20.2	5.0	21.8	0.393
Muscle strengthening exercises at home	129	5.4	13.2	216.69 [2.56, 18,271.46]	0.017	6.3	10.0	3.7	17.3	0.024
Sex-stratified analysis: OR [95%CI] ^f						1.67 [0.52, 5.35]		5.44 [1.11, 26.74]		
Yoga/Pilates/stretching at home	133	5.3	9.0	1.84 [0.70, 4.84]	0.216	4.8	7.5	5.6	11.3	0.760
Fitness/aerobics class at home	132	3.0	7.6	2.72 [0.83, 8.93]	0.098	2.4	7.5	3.7	7.7	0.733

Note: Activities order based on most to least common in February for the whole sample; February is before COVID-19 and April/May during lockdown restrictions; child data were proxy-reported by parents/guardians; Mixed effects logistic regression (with interaction for time × sex) assessed or logistic regression with robust sandwich estimation for variance assessed differences between February 2020 and April/May 2020 in the whole sample and between sexes. OR = odds ratio which represents the odds of performing an activity in April/May compared to February; CI = confidence intervals; ^ap value for time difference for the whole sample; ^bp value for time × sex interaction; odds ratio only computed for males and females if there was a significant interaction ($p < 0.05$).

Appendix Table A.2

Adolescents' self-reported participation in active recreation behaviours before (February) and during (April/May) COVID-19 lockdown restrictions: percent (%) of sample participating and odds of participation in April/May compared to February.

	Overall sample					Sex				
	n	February (%)	April/May (%)	Odds ratio [95%CI]	p value ^a	Males		Females		p value ^b
					February (%)	April/May (%)	February (%)	April/May (%)		
Walking for leisure/exercise on own	1223	60.7	51.5	0.44 [0.36, 0.56]	<0.001	60.1	47.3	61.7	53.2	0.116
Running outdoors	1053	51.1	40.6	0.43 [0.34, 0.54]	<0.001	60.0	42.5	51.1	40.4	0.079
Informal sport practice or play	1027	47.1	24.0	0.16 [0.12, 0.22]	<0.001	51.9	28.5	46.6	22.3	0.632
Walking for leisure/exercise with family	1217	46.1	43.0	0.73 [0.58, 0.92]	0.007	42.5	35.5	49.1	46.4	0.128

(continued on next page)

Appendix Table A.2 (continued)

	Overall sample					Sex				
	n	February (%)	April/May (%)	Odds ratio [95%CI]	p value ^a	Males		Females		p value ^b
						February (%)	April/May (%)	February (%)	April/May (%)	
Muscle strengthening exercises at home	1029	43.3	46.5	1.15 [0.90, 1.47]	0.242	52.4	48.0	44.0	46.5	0.106
Yoga/Pilates/stretching at home	1027	36.9	36.0	0.88 [0.67, 1.15]	0.341	21.4	16.6	44.7	43.3	0.083
Recreational activities	1033	33.4	20.8	0.19 [0.13, 0.28]	<0.001	36.6	22.2	33.7	19.9	0.809
Walking for leisure/exercise with a group	1209	27.5	20.9	0.49 [0.38, 0.63]	<0.001	25.1	19.2	29.1	21.2	0.999
Cycling for leisure outdoors	1041	25.4	22.5	0.64 [0.47, 0.87]	0.005	36.4	27.2	22.9	20.4	0.025
Sex-stratified analysis: OR [95%CI] ^c						0.39 [0.22, 0.70]		0.84 [0.57, 1.23]		
Fitness/aerobics class at home	1028	16.0	18.2	1.01 [0.86, 1.33]	0.053	8.7	9.0	20.6	22.2	0.787
Cycling at home	1030	12.2	10.0	0.18 [0.10, 0.34]	0.001	16.1	10.9	13.0	9.4	0.106

Note: Activities order based on most to least common in February for the whole sample; February is before COVID-19 and April/May during lockdown restrictions; Mixed effects logistic regression (with interaction for time × sex) assessed or logistic regression with robust sandwich estimation for variance assessed differences between February 2020 and April/May 2020 in the whole sample and between sexes; OR = odds ratio which represents the odds of performing an activity in April/May compared to February; CI = confidence intervals; ^ap value for time difference for the whole sample; ^bp value for time × sex interaction; odds ratio only computed for males and females if there was a significant interaction ($p < 0.05$).

Appendix Table A.3

Adults' self-reported participation in active recreation behaviours before (February) and during (April/May) COVID-19 lockdown restrictions: percent (%) of sample participating and odds of participation in April/May compared to February.

	Overall sample					Sex				
	n	February (%)	April/May (%)	Odds ratio [95%CI]	p value ^a	Males		Females		p value ^b
						February (%)	April/May (%)	February (%)	April/May (%)	
Walking for leisure/exercise on own	1335	62.6	59.0	0.74 [0.59, 0.90]	0.003	62.0	55.5	63.0	59.7	0.586
Walking for leisure/exercise with family	1327	48.7	54.5	1.65 [1.31, 2.08]	<0.001	40.2	39.8	50.4	57.4	0.061
Running outdoors	1247	28.9	30.7	1.22 [0.92, 1.60]	0.160	40.2	37.7	28.2	29.7	0.184
Yoga/Pilates/stretching at home	1239	27.5	43.7	4.24 [3.22, 5.59]	<0.001	16.5	23.3	30.5	47.6	0.057
Muscle strengthening exercises at home	1238	27.9	48.1	4.50 [3.47, 5.83]	<0.001	34.4	45.4	28.4	48.5	0.029
Sex-stratified analysis: OR [95%CI] ^c						3.14 [1.60, 6.17]		4.77 [3.58, 6.35]		
Informal sport practice or play	1236	24.4	14.6	0.31 [0.23, 0.42]	<0.001	33.8	20.1	22.6	13.5	0.509
Walking for leisure/exercise with a group	1320	20.5	16.0	0.54 [0.42, 0.70]	<0.001	22.2	13.9	20.6	16.6	0.113
Cycling for leisure outdoors	1240	17.8	20.7	1.16 [0.96, 1.41]	0.127	25.0	26.0	17.0	19.8	0.557
Recreational activities	1235	12.4	6.6	0.46 [0.35, 0.60]	<0.001	15.5	8.8	12.7	6.3	0.714
Cycling at home	1237	6.6	8.2	1.16 [0.87, 1.56]	0.306	8.9	10.2	6.8	7.5	0.911
Fitness/aerobics class at home	1229	8.5	23.4	7.45 [4.87, 11.39]	<0.001	4.2	9.3	10.1	26.3	0.225

Note: Activities order based on most to least common in February for the whole sample; February is before COVID-19 and April/May during lockdown restrictions; Mixed effects logistic regression (with interaction for time × sex) assessed or logistic regression with robust sandwich estimation for variance assessed differences between February 2020 and April/May 2020 in the whole sample and between sexes; OR = odds ratio which represents the odds of performing an activity in April/May compared to February; CI = confidence intervals; ^ap value for time difference for the whole sample; ^bp value for time × sex interaction; odds ratio only computed for males and females if there was a significant interaction ($p < 0.05$).

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