Changes in physical activity and sleep among adults in Russian Federation during COVID-19: a cross-sectional study.

Anna Kontsevaya (koncanna@yandex.ru)
Research Institute of Therapy and Preventive Medicine
Dinara Mukaneeva
Research Institute of Therapy and Preventive Medicine
Azaliia Myrzamatova
Research Institute of Therapy and Preventive Medicine
Anthony Okely
University of Wollongong
Oxana Drapkina
Research Institute of Therapy and Preventive Medicine

Research Article

Keywords: movement behaviours, pandemic, environments, adults, Russia

Posted Date: December 9th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-117916/v1

Abstract

Background

The aim of this study was to evaluate the impact of COVID-19 on the levels of physical activity and sleep and to examine specific COVID-19 factors that may be associated with changes in physical activity and sleep among adults in Russia.

Methods

Cross-sectional data were collected during the period of tightest restrictions between 26 April 2020 and 6 June 2020. Eligible participants included all Russian adults aged 18 years and over. Participants reported their sleep patterns and problems, frequency and duration of walking, moderate- and vigorous-intensity physical activity, and muscle strengthening activities before COVID-19 and during the past seven days. Access to an outdoor green space and fitness centres, use of online resources, adherence to self-isolation recommendations and other preventive measures from Ministry of Health were self-reported.

Results

The sample included 2432 participants from 62 regions, 83% of who were female. There was a significant decline in the number of days per week participants reported not getting enough sleep (3.21 ± 2.44 to 2.86 ± 2.57; $p < 0.001$); participants also reported an increase in the number of days per week they had trouble falling asleep (1.70 ± 2.24 to 2.13 ± 2.48; $P < 0.001$). The proportion of participants who met the WHO Guidelines for physical activity declined from 68–49% ($P < 0.001$). The proportion who participated in muscle strengthening activities for 2 or more days per week declined from 53–45% ($P < 0.001$).

Conclusion

Compared with before COVID-19, physical activity and sleep hygiene were adversely affected during COVID-19. Awareness of factors associated with these declines will assit policymakers in developing strategies to mitigate the negative lifestyle behaviours that have manifested during the COVID-19 confinement.

Background

Physical activity is one of the major risk factors [1], and it increases risk of all-cause mortality [2], nonfatal CVD and diabetes [3]. The WHO has developed guidelines describing physical activity levels allowing to maintain adequate health and fitness. It includes in at least 150 min of moderate-intensity physical activity or 75 min of vigorous-intensity physical activity per week or its combination for adults [4]. A meta-analysis of prospective studies reported that meeting the WHO recommendations for physical activity was associated with 17% lower risk of cardiovascular events, 23% lower risk of cardiovascular mortality and 26% lower incidence of type 2 diabetes [5]. Around 30% of adults in Russian Federation meet the WHO PA recommendations [4], a figure consistent with global rates [6].

The outbreak of novel coronavirus (COVID-19) in late December 2019 in China, and subsequent declaration by the World Health Organization (WHO) as a global pandemic in March 2020 [7] has forced countries to implement strict hygiene regimes and social distancing measures. Extensive social distancing policies were put into place restricting

people's daily activities. While these restrictions helped slow the rate of infection, there may also be concomitant negative effects as a result of limiting participation in normal daily activities such as walking and cycling for transport and leisure and access to many types of recreational activities such as team sports, gyms, fitness centres, and dancing classes.

Several studies have shown the detrimental effect of COVID-19 on the physical activity. An Australian survey of around 1500 participants found that nearly half reported a decrease in PA levels in April 2020 compared with before COVID-19 [8]. Reduction in physical activity levels were associated with increasing levels of depression and anxiety. An international survey of physical activity changes with Europe, Africa, Asia and both Americas participants found that pandemy had detrimental effect on all types of PA (vigorous, moderate, walking and overall) [9]. Sedentary time increased by 28.6% during restrictions, the number of days of vigorous intensity PA decreased by 22.7%, the number of days of walking decreased by 35% [9]. In contrast, an online survey of 3533 participants conducted across Italy in April 2020 reported a slight increase in physical activity [10]. In an early global study, 19.1 million daily step count measurements were provided by 455 404 unique users from 187 countries, within 10 days of the pandemic declaration. There was a 5.5% decrease in mean steps (287 steps), and within 30 days, there was a 27.3% decrease in mean steps (1432 steps) [7].

The Russian Federation reported one of the largest number of COVID-19 infections [https://epidemic-stats.com/] [11]. Social distancing, travel bans, the cancellation of sporting and other mass participation events, and changes to work practices have dramatically affected daily life throughout the country. Major restrictions were introduced on the 28th March 2020 with the level of restrictions varied depending on the epidemiology of the virus from region to region. Cities with a large number of cases had the most strict restrictions such as limitations on any outdoor activities. Further, citizens were requird to possess an electronic pass to leave the house and this was only permitted for workers during work hours, and to access essential services such as medical or health care, to shop for groceries, or to visit parks and green zones (excluding outdoor activities entirely). In cities with a smaller number of cases limitations were less strict, especially with outdoor activities. Indoor sport activities were limited across the country and outdoor sports were restricted – depending on the situation in the region. Social distancing measures such as keeping a minimum 1.5 meters between people were introduced, as well as a ban on any public gatherings of more than 50 people. On-line learning for schools and universities and recommendation for remote working for employees were introduced.

In the Russian Federation, population levels of physical activity are sub-optimal [12, 13] This low prevalence of adequate physical activity is a main contributing factor to the high prevalence of overweight and obesity [14]. In addition, the prevalence of adequate sleep (defined by the US CDC and National Sleep Foundation as 7–9 hours per night for adults) was only 37% [15]. However, the effect of COVID-19 on levels of physical activity and sleep is not known.

The aim of this study was to evaluate the impact of COVID-19 on the levels of physical activity and sleep and to examine specific COVID-19 factors that may be associated with changes in physical activity and sleep among adults in Russia.

The research questions were:

1. To what extent has physical activity and sleep changed as a result of the COVID-19 restrictions?
2. What COVID-19 factors were associated with these changes in physical activity and sleep?

Methods

Study design and population

The National Medical Research Center for Therapy and Preventive Medicine (Russia) organized online-survey "Study of the impact of restrictions on physical activity of the population in self-isolation due to COVID-19." Google platform was used for anonymous survey. A link to the survey was distributed using social media (Facebook, Vkontakte and Odnoklassniki), through web-sites and emails. To increase the regional participation a link to the electronic survey was send to the chief specialist in public health and preventive medicine in regional Ministries of Health who then distributed it at regional levels in Russia via a range of methods: shared link on the official web-pages and social media of regional Centers for public health and Medical Prevention and regional Ministries of Health official pages. The starting page of the survey informed participants about the goals and details of the survey at the landing page of the distributed link. This method of data collection cannot provide fully representative sample. However, it was effective considering the research goals, because it provided the dissemination of the survey throught all the bif country during a period where, due to COVID-19, there were many restrictions.

Eligible participants included all Russian adults aged 18 years and over. Data collection occurred between 26 April 2020 and 6 June 2020. This was the period of tightest restriction through the country, as from the 9th June 2020 there was a gradual releasing of restrictions depending on the regional context.

Survey development

The online survey was designed by a steering group at the National Medical Research Center for Therapy and Preventive Medicine of the Ministry of Health of Russia. Existing COVID-19 surveys from Canada, China, and the United Kingdom were used to inform development of the survey.

A 7-day self-report recall measure was selected as a method for physical activity assessment. Since the study was conducted during the challenging time of the pandemic-related lockdown, PA assessment was simplified to avoid the negative effect of the length of the questionnaire and its complexity on the response rate [16, 17].

The questionnaire contained 30 items and included mostly close-ended questions. Section 1 consisted of 10 general and context-related questions regarding demographic data and following self-isolation recommendations. Section 2 was designed to assess physical activity and sleep before Covid-19 and in the last 7 days during the pandemic. Section 3 evaluated how participants followed the Covid-19 preventive measures recommended by the Ministry of Health. Questions in Section 2 were presented in a differential format, to be answered directly in sequence regarding “before” and “during” confinement conditions. The full version of the questionnaire is available in the Supplementary file.

Physical activity was assessed using eight items assessing frequency and duration of walking, moderate and vigorous physical activity, and muscle strength activities before Covid-19 and during the past seven days. Total physical activity was calculated according to the WHO guidelines [4]: ≥150mins/week MPA or ≥75mins/week VPA or combination of MVPA, muscle strength activities ≥2 days/week. To calculate the proportion who meet the first guideline, we first worked out the number of minutes per week spent in vigorous-intensity activity, moderate-intensity physical activity and walking by multiplying the number of days spent in each of these activities by the time usually spent doing them. For the muscle strengthening, we added together the number of days strength training and the number of days basic calisthenic exercises (such as stretching, Zumba, yoga, pilates, Tai Chi) were undertaken.

Data Privacy and Consent of Participation

During the informed consent process, survey participants were assured all data would be used only for research purposes. Participants' answers were anonymous and confidential according to Google's privacy policy (https://policies.google.com/privacy?hl=en). Participants were not permitted to provide their names or contact information. Additionally, participants were able to stop participation and leave the questionnaire at any stage before the submission process; if they chose to do so their responses were not saved. Responses were saved only by clicking on the "submit" button at the end of the survey. By completing the survey, participants acknowledged their voluntary consent to participate in this anonymous study. ***This study was approved by the Ethics Committee of the National Medical Research Center for Therapy and Prevention of the Ministry of health of Russian Federation.***

Statistical analyses

Descriptive statistics

Descriptive statistics, including frequencies and percentages, were generated for categorical variables; means and standard deviations (SD) were generated for continuous variables. Data were analysed in SPSS 20 (SPSS Inc., Chicago, IL, USA). Normality of the data distribution was confirmed using non-parametric analysis of Wilcoxon rank-sum.

Linear and logistic regressions

Linear regression was used to test the associations between changes in physical activity and selected COVID-19 factors. Crude estimates and estimates adjusted for gender were reported with 95% Confidence Intervals (CI).

Finally, logistic regression was used to test which factors had impact on meeting the physical activity recommendations (both muscle strengthening activities and minutes per week of MPA/VPA). Binary logistic regression analyses were conducted to investigate the association between categorical variables (dependent) and continuous or categorical ones (independent). For these analysis 'meeting PA Recommendation (150mins/week MPA or 75mins/week VPA)' and 'meeting muscle-strengthening activities recommendation (≥2 days/week)' were specified as the dependent variables, and followed self-isolation recommendations, had access to outside/green zone, had an increase in the number of days per week with sleep problems, used digital or online PA resources, followed at least two relevant preventive measures from Ministry of Health, and geographic location were specified as independent variables. All data Statistical significance was set a priori at $p< 0.05$.

Results

The characteristics of the study sample are presented in Table 1. A total of 2540 participants from 62 regions commenced the survey with 18 participants (0.7%) failing to complete and their data not being used in the analyses. Of the 2432 participants who completed the survey, 83% were females. Compared with males, females tended to be older, married, have children under 18 living with them, and in full-time employment, less likely to have completed higher education, and more likely to follow self-isolation recommendations. In terms of employment status, 1714 (70.5%) participants had a full-time job, 399 (16.4%) were students, 65 (2.7%) were unemployed, and 47 (1.9%) were retired.

During the COVID-19 period, most participants completely or partially followed the self-isolation recommendations (n=2160, 88.8%). The preventive measures followed most frequently were "wash hands more often" (90.3%) and "maintain social distancing" (79.7%). Over 90% of participants still had access to outdoor areas and 70% had access to a green space during the restriction period. Two-thirds of participants reported that COVID-19 affected their physical activity, mostly as a result of their fitness centre closing, of not being able to leave the house and of being able to

undertake only simple calesthenic exercises at home. One-third of participants reported using online physical activity resources to help them be active, during this period.

Changes in sleep and physical activity from pre-COVID to during COVID are reported in Table 2. There was a significant decline in the number of days per week participants reported not getting enough sleep (3.21±2.44 to 2.86±2.57; p<0.001) and participants also reported an increase in the number of days per week they had trouble falling asleep (1.70±2.24 to 2.13±2.48; *P*<0.001). All physical activity outcomes declined significantly from pre- to during COVID. The average time spent in MPA and VPA each declined by around 12 minutes per day (42.43±37.57 to 30.44±35.35 and 37.79±37.80 to 26.56±34.69, respectively [all *P*<0.001]). The number of minutes per day spent walking decreased by around 20 minutes from 60.5±38.66 to 40.83±38.6 *(P*<0.001).

The proportion of participants who met the WHO Guidelines for any type of physical activity declined from 68% to 49% (*P*<0.001). The proportion who participated in muscle strengthening activities for 2 or more days per week declined from 53% to 45% (*P*<0.001).

Associations between changes in days and time spent in physical activity and sleep and selected COVID-19 factors are reported in Table 3. Factors consistently associated with a greater decline in minutes per week spent in VPA, in MPA and in walking included an increase in number of days with sleep problems (β=-28, 95%CI -41 to -15; β=-42, 95%CI -59 to -29; and β=-83, 95%CI -104 to -62, respectively), closure of fitness centre/gym (β=-99, 95%CI -116 to -84; β=-77, 95%CI -96 to -59; and β=-41, 95%CI -66 to -15, respectively) and not being able to leave the house for PA (β=-93, 95%CI -109 to -78; β=-123, 95%CI -141 to -105, and β=-217, 95%CI -243 to -192, respectively). Factors associated with a smaller decline in minutes per week in VPA and MPA included using digital or online resources (β=19, 95%CI 5 to 33 and β=23, 95%CI 7 to 38, respectively) and having access to a home gym (β=38, 95%CI 15 to 62 and (β=33, 95%CI 7 to 60, respectively). Factors associated with a greater decline in days per week participating in muscle strengthening activities included closure of fitness centre/gym (β=-99, 95%CI -116 to -84) and not being able to leave the house for PA (β=-93, 95%CI -109 to -78). Factors associated with a smaller decline in days per week participating in muscle strengthening activities included using digital or online resources (β=0.4, 95%CI 0.2 to 0.6), being able to participate in simple calesthenics at home (β=1, 95%CI 0.8 to 1.3), and having access to a home gym (β=0.9, 95%CI 0.5 to 1.2). Following self-isolation recommendations (β=-0.6, 95%CI -0.8 to -0.3) and having assess to a home gym (β=-0.1, 95%CI -0.4 to 0.2) were associated with a greater reduction in the number of days per week participants reported not getting enough sleep. In contrast, having children under 18 years of age in the residence (β=0.4, 95%CI 0.2 to 0.6) and not being able to leave the house for PA (β=0.2, 95%CI 0.02 to 0.4) were associated with a smaller reduction in the number of days per week participants reported not getting enough sleep.

Associations between meeting WHO Global PA and muscle-strengthening recommendations and selected COVID-19 factors are reported in Table 4. Compared with those who did not use online PA resources, those who did were 1.4 (95%CI 1.3, 1.5) and 1.9 (95%CI 1.8, 2.1) times more likely to meet the recommendations for PA and for muscle-strengthening activities, respectively. Compared with those who did not have access to a green space, those who did were more more likely to meet the PA (OR=1.2, 95%CI 1.1, 1.2) and muscle strengthening (OR=1.1, 95%CI 1.1, 1.2) recommendations. Those who owned a pet dog (OR=1.2, 95%CI 1.1, 1.3) and those who followed the self-isolation rules (OR=1.3, 95%CI 1.2, 1.4) were more likely to meet the PA and muscle strengthening recommendations, respectively, than those who did not. Conversely, compared with their urban counterparts, rural adults were less likely to meet the PA recommendation (OR=0.9, 95%CI 0.8, 0.9).

Discussion

We found that as a result of COVID-19 restrictions in Russia, there were significant declines in participation in physical activity and sleep duration compared with pre-COVID levels. Not being allowed to leave the house for physical activity and the closure of fitness centres were policies associated with greater declines in physical activity and sleep. Conversely, those individuals who could access a green space or who participated in activities at home – using online resources or with the necessary equipment – showed much smaller declines in physical activity and sleep. In addition, we found that those who lived in apartments and in rural areas were more likely to be adversely affected in terms of their participation in physical activity.

In our study the number of days per week that participants got enough sleep decreased while the number of days per week that participants had trouble falling asleep increased. These results are consistent with studies in China [18], and Italy [20, 21] showing the negative impact of COVID-19 home confinement on sleep. In Russia, COVID-19 upended daily routines in a number of ways: more people were working from home, meals times were altered, sedentary behavior – especially screen time – increased. These factors in addition to the social distancing requirements likely resulted in a disruption to circadian rhythms [22]. Home confinement is associated with reduced levels of physical activity which, in addition to the social isolation, may increase stress levels and disrupt night-time sleep. Physiological factors such as reduced sunlight exposure and weaker light–dark cycles as a result of less time spent outdoors may also have affected sleep and circadian rhythms [23].

We found that the restrictions during COVID resulted in a reduction in number of days per week and number of hours per day spent in PA and a reduction in all types of activities. Despite an increased offering of digital or online resources that could be accessed at home, participants were not able to maintain their normal pre-COVID PA levels. Those who did take up the offering and use such resources were more likely to meet PA recommendations. More support needs to be provided to those who were not able to access these resources, which may have been exacerbated by the higher increased levels of stress and uncertainty. Providing opportunities for PA is important in strengthening peoples immune systems and making them less susceptiable to infection.

However, the extent to which PA participation is impacted by the COVID-19 pandemic is dependent upon the confinement policies of individual governments. For example, in China different policies at regional levels was associated with differences in PA participation [24].

We found that an increase in sleep problems was associated with a a greater decline in PA and less likelihood to meet the PA guidelines. This re-inforces how PA and sleep are interrelated, which is consistent with evidence from systematic reviews demonstrating the association between sleep and exercise. Exercise promotes increased sleep efficiency and duration regardless of the mode and intensity of activity, especially in populations suffering from disease [19].

We identified several factors that were associated with healthier levels of physical activity and sleep during COVID-19. These suggest that the impact of the pandemic has not been uniform among Russian adults. People living in urban area were less likely to achive the PA recommendations, which is consistent with findings from before the pandemic and demonstrates that those living in urban areas are more active that their rural counterparts [12]. Living in a detached house, owning a dog, having a home gym were all favourably associated with healthy movement behaviours. In addition, having access to a green space was positively associated with physical activity. This information informs policymakers of population sub-groups who are at highest risk of being inactive during COVID and what should be considered when planning a response to provide opportunities to be active while at the same time adhering to social distancing requirements. Participants living in a house versus an apartment may have easier access to front or back yards for outdoor play and physical activity [25]. Families who had a dog had higher physical activity

and outdoor time. A recent systematic review also showed that dog-related interventions increased physical activity [26].

To the best of our knowledge, this is the first published study to report on physical activity and sleep among Russian adults during the COVID-19 pandemic. Another international online survey on physical activity had similar findings but did not include participants from the Russian Federation. [9]. Other studies from Australia [8] and Poland [27] reported similar reductions in physical activity and increases in sedentary behaviors during lockdown in adults. This is in contrast to a study from Italy reporting a slight increase in physical activity [10], especially in muscle strengthening activities.

There is a need to address the impact of COVID-19 on healthy levels of movement behaviours and subsequent NCD risk, including using modern technologies (on-line) as part of a suite of strategies [28]. To prevent the unintended consequences of COVID-19 restrictions and 'stay home' advice on physical activity and sleep – and as a corollary mental and social health, a balance is needed between preventing the spread of infection and providing opportunities for people to participate in healthy levels of movement behaviours.

Our results can be used to further research and development in public health promotion in Russia during the COVID-19 pandemic. Health promotion campaigns aimed at informing the population about the risks of physical inactivity are recommended. Evidence also suggests that web-[28] and app-based [29] interventions that people can access in their home might be especially beneficial if participants are motivated to adhere to the requirements. Some technology and social media have used gamification to overcome challenges in adherence. Further enhancements such as providing opportunities for social interaction should also be considered.

Limitations

While there are a number of strengths of the present study, such as the large sample size, and the timing of data collection relative to lockdown restrictions in Russia, there are a number of limitations. First, our study was cross-sectional meaning participants perceived the changes in their PA and sleep from before to during COVID-19. As such, participants may have been more likely to overstate the changes in PA and sleep in the absence of any true baseline data. Second, all data were self-reported and subject to recall bias such as overestimation of time spent in physical activity and in sleep. Third, our sample included an under-representation of males, which although unfortunate is consistent with other COVID-19 survey research among adults [8, 10, 27]. As such, these data should not be seen as a reflection of males living in Russia. In our opinion this survey can be generalized to some groups in the Russian population, predominantly women of young and middle age from five regions (Tver, Tatarstan, Irkutsk, Sakhalin, and Bashkortastan) who actively use Internet. This group would be a target for any or web- or app-based interventions to promote healthy levels of physical activity and sleep considering that it will likely impact not only on them but potentially also members of their families, children and male partners. Finally, during the COVID-19 outbreak, the main instruments of the investigating the changes of physical activities were on-line surveys [9, 10, 30].This method has limitations but was the only method available during this period and much easier to collect data compared with a telephone survey. Online research is therefore a recommended approach if one wants to reach a large group of participants in a short period of time, ensuring their safety under pandemic conditions [31].

Conclusion

Surveys results will provide data, useful for developing measures aimed to improve the negative impacts of COVID-19 pandemics on the lifestyle. Clear demonstration of the detrimental effects of pandemic on the levels of the physical activity requires health promotion strategies directed to improve health-related behaviors such as targeted social

media messaging. Continuing evaluation of the impact of restrictions is necessary to develop targeted health promotion strategies. Healthy levels of physical activity and sleep also affect the immune system through promoting healthy circadian rhythms and as such might serve as a protective strategy against infectious diseases.

This study have implications for policymakers in Russia. It demonstrates the need for efforts to stimulate wider use of on-line resources for physical activity, and to consider the possibility of re-opening gyms and fitness centres with all possible safety measures in the period of restrictions. Local councils should consider the importance of providing access to green spaces as part of their COVID-19 policies, especially if accompanied by infection control measures such as social distancing and wearing face masks. Special considerations should also be made for high risk groups such as adult people and people with chronic diseases.

Future studies should evaluate the longer-term consequences of the COVID-19 virus outbreak and recovery on physical activity, sedentary and sleep behaviours. To develop targeted health promotion strategies in Russia, it would be useful to identify province-specific or geographic differences influencing health behaviours.

Abbreviations

COVID-19: Coronavirus Disease 2019; WHO: World Health Organization; PA – physical activity, MPA – moderate physical activity, VPA – vigorous-intensity physical activity

Declarations

Ethics approval and consent to participate

All methods were carried out in accordance with relevant guidelines and regulations.

The survey was approved by the Ethics Committee of the National Medical Research Center for Therapy and Prevention of the Ministry of health of Russian Federation (approval N 03-04/20, 24 April 2020).

Written informed consent was obtained from participants via their online participation.

Consent for publication

Not applicable: this manuscript does not contain any personal data from participants.

Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

The authors declare that they have no completing interests.

Funding

No specific funding was received for writing this article.

Authors' contributions

AK, DM, AM analyzed the data, conceived the manuscript. AK, DM, AM, AO contributed to the interpretation of the data and the discussion of the results. AK and DM wrote the manuscript, and all the authors reviewed it. All authors read and approved the final manuscript.

Acknowledgements

We would like to acknowledge Ekaterina Ivanova, Loubov Drozdova, Marina Popovich for their input in the survey development as well as chief specialists in preventive medicine of the regional Ministries of health for help with survey promotion in the regions of the Russian Federation, especially Alla Solovjeva (Tver), Elena Slolyarova (Sakhalin), Ilnur Khalfiev (Tatarstan) and Alexander Seledtsov (Irkusts).

Key-points

1. Compared with before COVID-19, physical activity and sleep hygiene were adversely affected during COVID-19.
2. Awareness of factors associated with these declines will assit policymakers in developing strategies to mitigate the negative lifestyle behaviours that have manifested during the COVID-19 confinement.
3. Effective health promotion strategies directed at adopting or maintain positive health-related behaviors such as targeted social media messaging and balanced media reporting, should be used to reduce participant burden during these unprecedented times.

References

1. Sygit KM, Sygit M, Wojtyła-Buciora P, Lubiniec O, Stelmach W, Krakowiak J. Physical activity as an important element in organizing and managing the lifestyle of populations in urban and rural environments. Ann Agric Environ Med. 2019 Mar 22;26(1):8–12. doi: https://doi:10.26444/aaem/99177 PMID: 30922022
2. Cohen JA, Greaney ML, Sabik NJ. Assessment of Dietary Patterns, Physical Activity and Obesity From a National Survey: Rural-urban Health Disparities in Older Adults. PLoS One. 2018 Dec 5;13(12):e0208268. doi: https://doi.org/10.1371/journal.pone.0208268 PMID: 30517166
3. Kivimäki M, Singh-Manoux A, Pentti J, et al. Physical inactivity, cardiometabolic disease, and risk of dementia: An individual-participant meta-analysis. BMJ. 2019; 365:l1495. doi: https://doi:10.1136/bmj.l1495 PMID: 30995986
4. Global Recommendations on Physical Activity for Health. Geneva: World Health Organization; 2010. 1, EXECUTIVE SUMMARY. Available from: https://www.ncbi.nlm.nih.gov/books/NBK305060/ [cited 2020 July 29].
5. Wahid A, Manek N, Nichols M, et al. Quantifying the association between physical activity and cardiovascular disease and diabetes: A systematic review and meta-analysis. J Am Heart Assoc. 2016; 5: e002495. doi: http://doi:10.1161/JAHA.115.002495 PMID: 27628572
6. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1· 9 million participants. The Lancet Global Health. 2018 Oct 1;6(10):e1077-86. doi: https://doi.org/10.1016/S2214-109X(18)30357-7
7. Tison GH, Avram R, Kuhar P, Abreau S, Marcus GM, Pletcher MJ, Olgin JE. Worldwide Effect of COVID-19 on Physical Activity: A Descriptive Study. Ann Intern Med. 2020 Jun 29:M20-2665. doi: http://doi:10.7326/M20-2665 PMID: 32598162
8. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, Fenning AS, Vandelanotte C. Depression, Anxiety and Stress during COVID-19: Associations with Changes in Physical Activity, Sleep, Tobacco and Alcohol Use in Australian Adults. Int J Environ Res Public Health. 2020 Jun 7;17(11):4065. doi: http://doi:10.3390/ijerph17114065 PMID: 32517294

9. Ammar A., Brach M., Trabelsi K. Et al. Effects of COVID-19 Home Confinement on Eating Behaviour and Physical Activity: Results of the ECLB-COVID19 International Online Survey. Nutrients. 2020 May 28;12(6):1583. doi: http://doi:10.3390/nu12061583 PMID: 32481594
10. Laura Di Renzo, Paola Gualtieri, Francesca Pivari et al. Eating habits and lifestyle changes during COVID–19 lockdown: an Italian survey. Transl Med. 2020;18:229. doi: https://doi.org/10.1186/s12967-020-02399-5
11. Karadag E. Increase in COVID-19 cases and case-fatality and case-recovery rates in Europe: A cross-temporal meta-analysis [published online ahead of print, 2020 May 21]. J Med Virol 2020;10.1002/jmv.26035. doi: https://doi.10.1002/jmv.26035
12. BalanovaYuA, Kontsevaya AV, Shalnova SA, et al. The prevalence of behavioral risk factors for cardiovascular diseases in the Russian population according to the results of the ESSE-RF study. Russian Journal of Preventive Medicine and Public Health. 2014; 5: 42–51.
13. Marques A, Sarmento H, Martins J, Saboga Nunes L. Prevalence of physical activity in European adults - Compliance with the World Health Organization's physical activity guidelines. Prev Med. 2015 Dec;81:333-8. doi: https://doi.10.1016/j.ypmed.2015.09.018 PMID: 26449407.
14. Kontsevaya A, Shalnova S, Deev A, Breda J, Jewell J, Rakovac I, Conrady A, Rotar O, Zhernakova Y, Chazova I, Boytsov S. Overweight and Obesity in the Russian Population: Prevalence in Adults and Association with Socioeconomic Parameters and Cardiovascular Risk Factors. Obes Facts. 2019;12(1):103–114. doi: https://doi.10.1159/000493885 PMID: 30844809
15. Golenkov AV, Poluektov MG. Osobennosti predstavlenii o pravilakh gigieny sna v rossiiskoi populyatsii [Awareness on sleep hygiene rules in Russian population]. Zh Nevrol Psikhiatr Im S S Korsakova. 2016;116(8):57–61. Russian. doi: https://doi.10.17116/jnevro20161168157-61 PMID: 27635614
16. Sahlqvist S, Song Y, Bull F, Adams E, Preston J, Ogilvie D; iConnect consortium. Effect of questionnaire length, personalisation and reminder type on response rate to a complex postal survey: randomised controlled trial. BMC Med Res Methodol. 2011 May 6;11:62. doi: https://doi.10.1186/1471-2288-11-62 PMID: 21548947
17. Rolstad S, Adler J, Rydén A. Response burden and questionnaire length: is shorter better? A review and meta-analysis. Value Health. 2011 Dec;14(8):1101-8. doi: https://doi.10.1016/j.jval.2011.06.003 PMID: 22152180
18. Lin LY, Wang J, Ou-Yang XY, Miao Q, Chen R, Liang FX, Zhang YP, Tang Q, Wang T. The immediate impact of the 2019 novel coronavirus (COVID-19) outbreak on subjective sleep status. Sleep Med. 2020 Jun 1:S1389-9457(20)30221-5. doi: https://doi.10.1016/j.sleep.2020.05.018 PMID: 32593614
19. Dolezal BA, Neufeld EV, Boland DM, Martin JL, Cooper CB. Interrelationship between Sleep and Exercise: A Systematic Review. Adv Prev Med. 2017; 2017:1364387. doi: https://doi.10.1155/2017/1364387 PMID: 28458924
20. Gualano MR, Lo Moro G, Voglino G, Bert F, Siliquini R. Effects of Covid-19 Lockdown on Mental Health and Sleep Disturbances in Italy. Int J Environ Res Public Health. 2020 Jul 2;17(13):4779. doi: https://doi.10.3390/ijerph17134779 PMID: 32630821
21. Cellini N, Canale N, Mioni G, Costa S. Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. J Sleep Res. 2020 May 15:e13074. doi: https://doi.10.1111/jsr.13074 PMID: 32410272
22. Zvolensky MJ, Garey L, Rogers AH, Schmidt NB, Vujanovic AA, Storch EA, Buckner JD, Paulus DJ, Alfano C, Smits JAJ, O'Cleirigh C. Psychological, addictive, and health behavior implications of the COVID-19 pandemic. Behav Res Ther. 2020 Nov;134:103715. doi: https://doi.10.1016/j.brat.2020.103715 PMID: 32891956
23. Leone MJ, Sigman M, Golombek DA. Effects of lockdown on human sleep and chronotype during the COVID-19 pandemic. Current Biology 30, R905–R931, August 17, 2020

24. Hossain MM, Sultana A, Purohit N. Mental health outcomes of quarantine and isolation for infection prevention: a systematic umbrella review of the global evidence. Epidemiol Health. 2020;42:e2020038. doi: https://doi.10.4178/epih.e2020038 PMID: 32512661
25. Lambert A, Vlaar J, Herrington S, Brussoni M. What Is the Relationship between the Neighbourhood Built Environment and Time Spent in Outdoor Play? A Systematic Review. Int J Environ Res Public Health. 2019 Oct 11;16(20):3840. doi: https://doi.10.3390/ijerph16203840 PMID: 31614536
26. Rhodes RE, Baranova M, Christian H, Westgarth C. Increasing physical activity by four legs rather than two: systematic review of dog-facilitated physical activity interventions. Br J Sports Med. 2020;54:1202–1207. doi: https://doi.org/10.1136/bjsports-2019-101156
27. Sidor A, Rzymski P. Dietary Choices and Habits during COVID-19 Lockdown: Experience from Poland. Nutrients. 2020 Jun 3;12(6):1657. doi: https://doi.10.3390/nu12061657 PMID: 32503173
28. Jahangiry L, Farhangi MA, Shab-Bidar S, Rezaei F, Pashaei T. Web-based physical activity interventions: a systematic review and meta-analysis of randomized controlled trials. Public Health. 2017 Nov;152:36–46. doi: https://doi.10.1016/j.puhe.2017.06.005 PMID: 28734170
29. Romeo A, Edney S, Plotnikoff R, Curtis R, Ryan J, Sanders I, Crozier A, Maher C. Can Smartphone Apps Increase Physical Activity? Systematic Review and Meta-Analysis. J Med Internet Res. 2019 Mar 19;21(3):e12053. doi: https://doi.10.2196/12053 PMID: 30888321
30. Moore SA, Faulkner G, Rhodes RE. et al. Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey. Int J Behav Nutr Phys Act 17, 85 (2020). doi: https://doi.org/10.1186/s12966-020-00987-8
31. Geldsetzer P. Use of Rapid Online Surveys to Assess People's Perceptions During Infectious Disease Outbreaks: A Cross-sectional Survey on COVID-19. J Med Internet Res. 2020 Apr 2;22(4):e18790. doi: https://doi.10.2196/18790 PMID: 32240094

Tables

Table 1. Sample characteristics

	Male (n=328)	Female (n=2104)	All (n=2432)
Age (Mean, SD)	33.6±14.9	38.2±13.1	37.6±13.4
Marital status, n (%)			
Married	145 (48.3)	1267 (64.2)	1412 (62.1)
Single	133 (44.3)	453 (23.0)	586 (25.8)
Divorced	19 (6.3)	178 (9)	197 (8.7)
Widow/widower	3 (1.0)	75 (3.8)	78 (3.4)
Live in urban area, n (%)	243 (74.1)	1482 (70.4)	1725 (70.9)
Have children under 18 living with them, n (%)	101 (30.8)	925 (44.0)	1026 (42.2)
Higher Education completion, n (%)	181 (55.2)	964 (45.8)	1145 (47.1)
Full-time employment status, n (%)	197 (60.1)	1517 (72.1)	1714 (70.5)
Followed self-isolation recommendation (completely or partially), n (%)	262 (79.9)	1898 (90.2)	2160 (88.8)
Current area of residence, n (%)			
City	243 (74.1)	1482 (70.4)	1725 (70.9)
Village	84 (25.6)	609 (28.9)	693 (28.5)
Type of residence, n (%)			
Mansion, Townhouse	85 (25.9)	635 (30.2)	720 (29.6)
Flat, Hostel	239 (72.9)	1457 (69.2)	1696 (69.7)
Own a pet dog, n (%)	73 (22.3)	570 (27.1)	643 (26.4)
Access to outdoors, n (%)	288 (87.8)	1932 (91.8)	2220 (91.3)
Access to a “green space”, n (%)	219 (66.8)	1486 (70.6)	1705 (70.1)
Use digital/online physical activity resources, n (%)	98 (29.9)	764 (36.3)	862 (33.6)
How COVID-19 affected your physical activity, n (%)			
No effect	107 (32.6)	717 (34.1)	824 (33.9)
Fitness centre was closed	97 (29.6)	380 (18.1)	477 (19.6)
Could not leave house	71 (21.6)	453 (21.5)	524 (21.5)
I started participating in basic calisthenic exercises[1]	49 (14.9)	418 (19.9)	467 (19.2)
I started using a home exercise bike or treadmill	30 (9.1)	163 (7.7)	193 (7.9)
Other	57 (17.4)	329 (15.6)	386 (15.9)
What COVID-19 measures were followed, n (%)			
Wash hands more often	286 (87.2)	1909 (90.7)	2195 (90.3)
Avoid touching face	209 (63.7)	1479 (70.3)	1688 (69.4)
Avoid traveling	211 (64.3)	1580 (75.1)	1791 (73.6)
Maintain social distancing	260 (79.3)	1679 (79.8)	1939 (79.7)
Self-isolation	262 (79.9)	1898 (90.2)	2160 (88.8)

[1]this was defined as exercises such as stretching, Zumba, yoga, Pilates, and Tai Chi.

Table 2. Changes in sleep and physical activity from pre- to during COVID-19

	Males			Females			Total		
	Pre-COVID	During COVID	P-value	Pre-COVID	During COVID	P-value	Pre-COVID	During COVID	P-value
Number of days per week not getting enough sleep (M, SD)	2.88 ± 2.39	2.66 ± 2.56	<0.001	3.26 ± 2.45	2.9 ± 2.57	<0.001	3.21 ±2.44	2.86 ± 2.57	<0.001
Number of days per week having trouble falling asleep sleep (M, SD)	1.74 ± 2.32	2.14 ± 2.54	<0.001	1.7 ± 2.23	2.13 ± 2.47	<0.001	1.7 ± 2.24	2.13 ± 2.48	<0.001
Number of days per week waking up earlier than wanted (M, SD)	2.65 ± 2.64	2.45 ± 2.61	<0.001	2.62 ± 2.62	2.62 ± 2.6	0.905	2.6 ± 2.62	2.59 ± 2.6	0.505
Days per week engaged in MPA	3.4 ± 2.39	2.47 ± 2.38	<0.001	2.92 ± 2.44	2.1 ± 2.32	<0.001	2.99± 2.44	2.15 ± 2.33	<0.001
Average time per day spent in MPA, mins	52.5 ± 38.5	37.59± 37.59	<0.001	40.87± 37.18	29.32± 34.87	<0.001	42.43 ± 37.57	30.44 ± 35.35	<0.001
Days per week engaged in VPA	2.6 ± 2.29	2.03 ± 2.25	<0.001	2.18 ± 2.19	1.74 ± 2.18	<0.001	2.24 ±2.21	1.78 ± 2.19	<0.001
Average time per day spent in VPA, mins	48.98 ± 40.81	32.88 ± 37.53	<0.001	36.05 ± 37.01	25.57 ± 34.13	<0.001	37.79 ± 37.80	26.56 ± 34.69	<0.001
Days per week spending walking (M, SD)	5.22 ± 2.25	3.58 ± 2.67	<0.001	5.37 ± 2.09	3.78 ± 2.64	<0.001	5.35 ±2.12	3.76 ± 2.64	<0.001
Average time per day spent walking (M, SD), mins	63.48 ± 38.66	40.75 ± 38.05	<0.001	60.04 ± 38.65	40.84± 38.7	<0.001	60.5 ± 38.66	40.83 ± 38.6	<0.001
Number of days per week doing resistance training	1.86 ± 2.09	1.52 ± 2.1	<0.001	1.12 ± 1.79	0.96 ± 1.82	<0.001	1.22± 1.85	1.04 ± 1.87	<0.001
Number of days per week spent doing exercises such as gymnastics, yoga	1.27 ± 2.12	1.1 ± 1.98	<0.001	1.55 ± 2.11	1.45 ± 2.17	0,002	1.51± 2.11	1.41 ± 2.15	0.001
Meeting PA Guidelines, %									
≥150mins/week MPA or ≥75mins/week VPA or	45.7%	31.1%	<0.001	35.0%	20.8%	<0.001	36.4%	22.2%	<0.001
Combination of MVPA	56.7%	39.9%	<0.001	45.5%	29.7%	<0.001	47.0%	31.0%	<0.001
	78.0%	57.9%	<0.001	66.0%	47.3%	<0.001	67.6%	48.8%	<0.001
Muscle strength. activities ≥2 days/week	57.9%	47.3%	<0.001	52.2%	44.2%	<0.001	53.0%	44.6%	<0.001

Table 3. Associations between changes in time spent in physical activity and sleep and selected COVID-19 factors

	Change (In the last 7 days minus Before COVID-19)									
	Mins per week VPA		Mins per week MPA		Mins per week walking		Days per week muscle strengthening activities		Days per week not getting enough sleep	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Had children U18 living with you	-0.64	-1.28, 0	-0.74	-1.48, 0	-0.2	-1.22, 0.82	-0.01	-0.02, 0.01	0.414	0.25, 0.58
Followed self-isolation recommendation	4.02	-15.96, 23.99	-13.94	-36.99, 9.11	-84.01	-115.73,-52.29	0.09	-0.22, 0.4	-0.555	-0.82, -0.29
Owned a pet dog	-0.36	-1.56, 0.85	-0.83	-2.22, 0.56	-0.9	-2.81, 1.02	-0.01	-0.03, 0.01	-0.002	-0.21, 0.20
Had access to the outside	0.99	-0.01, 2.00	0.64	-0.53, 1.8	0.59	-1.01, 2.19	-0.001	-0.02, 0.01	-0.151	-0.44, 0.14
Had access to a “green space”	-0.38	-1.10, 0.34	-0.33	-1.17, 0.5	-0.6	-1.74, 0.54	0.004	-0.01, 0.015	-0.098	-0.29,0.09
Had increase in number of days per week with sleep problems	-28.10	-41.09, -15.11	-44.32	-59.31, 29.34	-82.90	-103.53, -62.27	-0.03	-0.23, 0.17	1.302	1.13,1.47
Used digital or online PA resources	18.85	5.16, 32.55	22.62	6.81, 38.42	8.28	-13.48, 30.03	0.42	0.21, 0.63	-0.44	-0.62, -0.26
Followed at least two relevant preventive measures from Ministry of Health	12.79	-17.99, 43.57	6.80	-28.72, 42.32	-28.21	-77.10, 20.67	0.29	-0.19, 0.76	-0.091	-0.49,0.31
Fitness centre/gym closed	-99.56	-115.61, -83.51	-77.03	-95.55, -58.50	-40.74	-66.23,-15.24	-1.36	-1.61,-1.11	0.044	-0.16,0.25
Couldn’t leave the house for PA	-93.41	-109.21, -77.62	-122.75	-140.98,-104.53	-217.48	-242.56, -192.39	-1.25	-1.49, -1.01	0.231	0.02,0.44
Able to participate in calisthenic activities at home	19.42	2.80, 36.05	1.30	-17.89, 20.48	-21.92	-48.33, 4.48	1.07	0.82, 1.33	-0.473	-0.69, -0.256

Had a home gym	38.46	15.33, 61.59	33.24	6.54, 59.93	-20.68	-57.42, 16.05	0.88	0.53, 1.24	-0.134	-0.43,0.17
Live in a Metropolis/city	-16.46	-43.23, 10.30	-8.36	-39.25, 22.52	-5.12	-47.63, 37.38	-0.13	-0.54, 0.28	-0.081	-0.43,0.27
Live in a flat/apartment	-11.70	-27.92, 4.51	-25.95	-44.67, -7.24	-38.44	-64.19, -12.68	0,01	-0.24, 0.26	-0.123	-0.34,0.1
Live in urban area (population)	15.18	-12.38, 42.74	3.33	-28.49, 35.13	-12.29	-56.06, 31.48	0.07	-0.36, 0.49	-0.337	-0.70,0.02

All analyses adjusted for sex and age.

Table 4. Associations between meeting WHO Global PA Recommendations and selected COVID-19 factors

	Meeting PA Recommendation (150mins/week MPA or 75mins/week VPA)		Meeting muscle-strengthening activities recommendation (≥2 days/week)	
	%	OR (95%CI)	%	OR (95%CI)
Follow self-isolation recommendation No (ref) Yes	88.0%	0.95 (0.85 – 1.05)	92.2%	1.28 (1.17 – 1.4)
Own a pet dog No (ref) Yes	32.5%	1.23 (1.13 – 1.33)	27.3%	1.04 (0.95 – 1.12)
Had access to outside No (ref) Yes	92.8%	1.12 (1.01 – 1.24)	91.2%	0.99 (0.87 – 1.12)
Had access to a green space No (ref) Yes	75.4%	1.17 (1.09 – 1.24)	73.7%	1.14 (1.06 – 1.23)
Had increase in number of days per week with sleep problems No (ref) Yes	66.1%	0.88 (0.83 – 0.94)	62.9%	0.95 (0.88 – 1.02)
Used digital or online PA resources No (ref) Yes	47.0%	1.40 (1.3 – 1.51)	52.0%	1.93 (1.75 – 2.13)
Following at least two relevant preventive measures from Ministry of Health No (ref) Yes	4.2%	1.00 (0.86 – 1.17)	4.6%	1.08 (0.89 – 1.30)
Geographic location Urban (ref) Rural	25.7%	0.89 (0.82 – 0.96)	23.6%	0.95 (0.87 – 1.04)
Live in a flat/hostel No (ref) Yes	61.1%	0.8 (0.74 – 0.87)	65.5%	0.91 (0.84 – 0.98)

all analyses adjusted for sex and age

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplement.docx