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Original Article

Effect of the COVID-19 lockdown period on the physical condition, living habits, and physical activity of citizens in Beijing, China

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Abstract. [Purpose] We aimed to explore the effects of the COVID-19-induced lockdown in Beijing. [Participants and Methods] We distributed a web-based questionnaire survey among 1,029 Beijing citizens to inquire about their physical condition, living habits, and physical activity before and during home isolation. [Results] In the context of forced home isolation due to COVID-19, both males and females reported reductions in daily steps and weekly exercise time and significant increases in daily physical activity time and daily sitting time. The proportions of smokers, patients with metabolic syndrome, and patients with internal diseases were higher in males than in females; females had lower daily step counts and spent more time sitting. [Conclusion] The COVID-19 lockdown affected the physical condition, living habits, and physical activity of both males and females; females were more affected than males. People should be cognizant of the various effects of COVID-19 lockdowns on the body. We recommend a reasonable diet and appropriate home exercise. There is a need to develop training methods and evaluation tools for home exercises in COVID-19 lockdowns.

Key words: COVID-19, Human physical conditioning, Exercise

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INTRODUCTION

Since the coronavirus disease, 2019 (COVID-19) was upgraded to a public health emergency, more than one billion people across China have faced restrictions after travel, owing to varying strictures, such as the prohibition of public transport, curtailed operations, and implementation of the 14-day quarantine[1, 2)]. To cope with the risks and outbreak threats posed by COVID-19 to human life, Beijing announced that it would recommend that all citizens live in isolation at home, greatly reducing unnecessary outings[3)]. Therefore, COVID-19 was the impetus for a new form of living at home for the citizens of Beijing.

Home isolation leads to a reduction in living space, and the reduction of commuting and outdoor activities reduced outdoor fitness and exercise. Over time, the newly adopted home life model may cause changes in the form of exercise, time and frequency of exercise, life habits, and lifestyle changes[4)]. People have been forced to stay at home, work at home,

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dramatically reduce outings, reduce social interaction, or work longer in stressful environments, with the potential for health risks associated with isolation, which can have a major influence on daily life[5].

Home isolation from COVID-19 may affect physical and mental health[6]. Home isolation reduces sunlight exposure and increases stress levels due to social isolation, social contact with family and friends, and engagement in satisfactory activities[7]. These changes gradually disrupt nighttime sleep and increase the risk of mental health problems[8]. Thus, the effect of this new life pattern on health, living habits, and exercise status over time need further exploration. In this study, we aimed to examine the effect of the COVID-19 lockdown on the physical condition, living habits, and physical activity of Beijing citizens by exploring all three dimensions before and after home isolation through a web-based questionnaire.

PARTICIPANTS AND METHODS

A web-based questionnaire was distributed to adult Beijing citizens through the Chinese social software "WeChat". Participants who answered all questions on the online questionnaire were included in the study. Exclusion criteria were persons with major motor disorders, bone and joint disorders, or neurological disorders or those who could not perform normal daily activities or sports. The background, purpose, and relevant instructions of the study were introduced on the first page of the questionnaire; participants then clicked "agree" to indicate informed consent, which allowed them to continue to the main questionnaire. The first questionnaire survey was conducted on January 21–25, 2020, to collect relevant data before formal entry into isolated life. The second survey was performed 3 months later to compare data before and after isolated life. Participants were asked about age, height, weight, metabolic syndrome, medical diseases, smoking index, daily exercise time, exercise days per week, daily physical activity time, sitting time, daily steps, and other information (Supplementary Table 1).

This study was approved by the ethics committee of the International University of Health and Welfare. The ethics committee approval number was 20-Io-64.

Statistical analysis was performed using IBM SPSS for Windows version 26.0 software (IBM Corp., Armonk, NY, USA). Descriptive data are presented as mean ± standard deviation (SD), median (min–max), or number and frequency. The normality of the data was evaluated using the Shapiro-Wilk test. Homogeneity of variance was evaluated using Levine's test. The differences in weight, daily exercise time, daily physical activity time, number of exercises per week, sitting time, and step number before and during home isolation were assessed in male, female, and all participants. To determine the significance of differences between values, the Wilcoxon test was used for data without a normal distribution, and a paired sample t-test was performed for data with normal distributions. Including the above information and adding the age, height, proportion of metabolic syndrome, proportion of medical diseases, and smoking index between males and females, data were assessed using the independent sample t-test. Statistical significance was set at $p<0.05$.

RESULTS

A total of 1,342 questionnaires were retrieved; however, 206 questionnaires had incomplete responses and 107 questionnaires could not be fully understood, thus 313 (23.3%) questionnaires were discarded. A total of 1,029 (76.7%) were valid. Among the valid questionnaires, 318 of the respondents were male (30.9%) and 711 were female (69.1%). All participants were 18–76 years old. There were 660 people aged 18–29 (191 males and 469 females), 180 people aged 30–39 (62 males and 118 females), 83 people aged 40–49 (29 males and 54 females), 85 people aged 50–59 (25 males and 60 females), and 21 people aged 60–76 years old (11 males and 10 females).

Data from all participants (n=1,029) were compared before and after isolation (Table 1). Compared with before home isolation, the daily exercise time and daily steps decreased ($p<0.01$), and the daily sitting time and daily physical activity time increased ($p<0.01$) during isolation. No significant differences were found in the frequency of weekly exercises.

Data from male respondents (n=318) were compared before and after isolation (Table 2). Compared with before home isolation, the daily exercise time and daily steps decreased ($p<0.01$), whereas daily sitting time, and daily physical activity time increased ($p<0.05$) during isolation. No significant differences were observed in the frequency of weekly exercises.

Data from female respondents (n=711) were compared before and after isolation (Table 3). Compared with before home isolation, the daily exercise time and daily steps decreased ($p<0.01$), and BMI, weight, daily sitting time increased ($p<0.05$). No significant differences were found in the frequency of weekly exercises.

In the comparison of post-isolation data in terms of physical and health condition, males had higher height, weight, and BMI values ($p<0.01$) and had a higher rate of metabolic syndrome and medical diseases than females ($p<0.01$) (Table 4). As regards living habits and physical activity, females spent more time sitting and had fewer steps per day than males ($p<0.05$). The number of male smokers was significantly higher than that of females ($p<0.01$). However, no significant differences were found in age, daily exercise time, daily physical activity time, and frequency of weekly exercise.

Regarding effect sizes, the differences in steps per day had an intermediate effect, which illustrates that the effect of COVID-19 on step number is notable. The large effect sizes between males and females regarding the number of smokers and patients with medical diseases or metabolic syndrome imply that males should pay more attention to their physical health. Other items showed small or no effect sizes, which may be explained because the questionnaire only had a 90 day interval, and variables such as weight and days of exercise per week could take a larger amount of time to show changes. This also

Table 1. Comparison of data before and after home isolation caused by COVID-19 in all participants

n=1,029	Before home isolation	After home isolation	95% CI	ES
Exercise days per week (days)	3.3 ± 2.3	3.4 ± 2.4	[−0.24, 0.16]	0.04
Daily exercise time (min)	61.6 ± 54.8	40.9 ± 35.2**	[−24.02, −17.50]	0.45
Daily physical activity time (min)	149.8 ± 147.0	163.5 ± 120.8 **	[5.20, 22.17]	0.55
Seating time per day (min)	354.7 ± 198.3	428.0 ± 213.6 **	[61.83, 84.74]	0.36
Steps per day	7,878.5 ± 3,543.6	5,211.5 ± 285.5 **	[−2,961.08, −2,372.99]	0.68

*p<0.05; **p<0.01. Before vs. after home isolation by t-test as post-hoc analysis; ES: effect size.

Table 2. Comparison of data before and after home isolation caused by COVID-19 in male

n=318	Before home isolation	After home isolation	95% CI	ES
Weight (kg)	76.2 ± 14.5	76.8 ± 15.0	[−1.09, −0.16]	0.04
BMI (kg/m^2)	24.7 ± 4.3	24.9 ± 4.4	[−0.35, −0.05]	0.05
Exercise days per week (days)	3.2 ± 2.2	3.4 ± 2.2	[−0.40, 0.09]	0.09
Daily exercise time (min)	64.2 ± 51.2	43.1 ± 38.1**	[14.42, 27.82]	0.47
Daily physical activity time (min)	152.6 ± 142.0	172.6 ± 141.6*	[−36.43, −3.49]	0.14
Seating time per day (min)	336.5 ± 200.9	406.5 ± 218.3**	[−91.37, −48.65]	0.33
Steps per day	8,666.8 ± 3,575.6	6,296.3 ± 4,711.6**	[1,781.40, 2,959.76]	0.57

*p<0.05; **p<0.01. Before vs. after home isolation by t-test as post-hoc analysis; ES: effect size.

Table 3. Comparison of data before and after home isolation caused by COVID-19 in female

n=711	Before home isolation	After home isolation	95% CI	ES
Weight (kg)	55.3 ± 10.1	57.6 ± 9.6*	[0.01, 0.86]	0.23
BMI (kg/m^2)	21.0 ± 3.7	21.9 ± 3.5*	[0.01, 0.34]	0.25
Exercise days per week (days)	3.3 ± 2.3	3.3 ± 2.4	[−0.10, 0.13]	0.01
Daily exercise time (min)	60.5 ± 50.0	39.9 ± 33.7**	[16.93, 24.25]	0.48
Daily physical activity time (min)	148.6 ± 139.9	159.5 ± 110.1	[−20.72, −1.03]	0.09
Seating time per day (min)	362.9 ± 196.7	437.6 ± 210.9*	[−88.34, −61.17]	0.37
Steps per day	7,525.9 ± 3,474.2	4,726.3 ± 3,989.7**	[2,464.91, 3,134.34]	0.75

*p<0.05; **p<0.01. Before vs. after home isolation by t-test as post-hoc analysis; ES: effect size.

Table 4. Comparison of male and female data in home isolation caused by COVID-19

n=1,029	Male	Female	95% CI	ES
Age (years)	30.8 ± 11.6	29.5 ± 11.2	[−0.17, 2.82]	0.12
Height (cm)	175.5 ± 5.9	162.4 ± 5.3**	[12.41, 13.86]	2.39
Weight (kg)	76.8 ± 15.0	57.6 ± 9.6**	[19.01, 22.07]	1.66
BMI (kg/m^2)	24.9 ± 4.4	21.9 ± 3.5**	[3.05, 4.05]	0.79
Number of patients with metabolic syndrome (proportion)	152 (47.8%)	143 (20.1%)**	[0.37, 0.59]	2.46
Number of patients with Internal medicine problems (proportion)	73 (23.0%)	95 (13.4%)**	[0.17, 0.54]	2.40
Percentage of smokers (%)	58 (18.2%)	4 (0.6%)**	[29.53, 44.70]	2.50
Exercise days per week (days)	3.4 ± 2.2	3.3 ± 2.4	[−0.20, 0.43]	0.04
Daily exercise time (min)	43.1 ± 38.1	39.9 ± 33.7	[−1.31, 8.00]	0.09
Daily physical activity time (min)	172.6 ± 141.6	159.5 ± 110.1	[−2.87, 29.09]	0.11
Seating time per day (min)	406.5 ± 218.3	437.6 ± 210.9*	[−59.32, -2.88]	0.43
Steps per day	6,296.3 ± 4,711.6	4,726.3 ± 3,989.7**	[1,010.56, 2,166.43]	0.37

*p<0.05; **p<0.01. Male vs. female data in home isolation by t-test as post-hoc analysis; ES: effect size.

illustrates the importance of new and continuing follow-up in this study, such as comparing data after one year.

DISCUSSION

To the best of our knowledge, this study is the first to examine the effect of the COVID-19 lockdown on the physical condition, living habits, and physical activity of Beijing citizens. According to our statistical analysis, home isolation resulted in a decrease in daily exercise time and daily steps and an increase in sitting time and daily physical activity time in both males and females. When comparing the results of the data analysis between males and females, the prevalence of smoking, metabolic syndromes, and medical diseases were much higher in males than in females, and females had fewer steps per day and more sitting time than did males.

Home isolation, due to the excessive narrowness of living space, leads to an inability to maintain original exercise habits. A study reported that with the extension of isolation time, interest in exercise decreases, and exercise time is significantly shortened[9]. This is consistent with the results of the present study. During isolation, irregular lifestyle and eating habits may form, and some addiction hobbies may appear[10].

Our findings show increased daily physical activity time following home isolation, which is not consistent with previous findings. Because of prolonged home isolation, the population maintained physical activity to ensure a relatively healthy lifestyle and exercise habits. However, the movement space was small, and the total exercise time could not be guaranteed. The populace chose to perform activities, such as housework, to maintain their most basic daily physical activity.

Physical activity refers to all movements, including those during leisure time, transport, or work[11]. Physical activity can improve cardiopulmonary function and balance and delay sarcopenia and weakness in advanced age; many studies have indicated that physical activity is recommended during the COVID-19 epidemic to maintain basic physical health, help relieve stress, and reduce depression and other negative psychological situations. During isolation, citizens experience tremendous stress, making them more prone to overeating, sedentary lifestyle, and weight gain. Obesity is a major risk factor for cardiovascular disease, diabetes, and kidney disease and has adverse effects on lung function[12]. It may also increase the risk of COVID-19.

Females are generally less physically active than males, and this difference increases post-menopause. In postmenopausal females, the basal metabolic rate decreases, leading to a decline in skeletal muscle mass and a loss of bone mineral density[13]. In addition, there is a direct relationship between seated time, physical activity, and risk of cardiovascular disease in postmenopausal females[14]. Prolonged sitting can have many negative effects, such as increased energy intake and decreased skeletal muscle lipoprotein lipase activity, which are risk factors for cardiovascular disease.

Males had significantly higher smoking indices and a higher prevalence of metabolic syndrome and medical diseases than did females. Preliminary data suggest that severe acute respiratory syndrome coronavirus 2 affects more males than females[15], possibly because males have the highest incidence of chronic diseases, which are risk factors for COVID-19. Furthermore, males are more prone to unhealthy living habits, such as smoking and inadequate exercise, than are females, which increases the risk of coronavirus infection[16].

To maintain healthy living and exercise habits, prevent the emergence of various chronic diseases (such as metabolic syndrome or cardiovascular disease), increase autoimmunity through exercise, and prevent the occurrence of COVID-19, it is necessary to specify and guide exercise prescriptions for those isolated at home[17]. It has been documented that increasing aerobic exercise has the potential to enhance immune capacity and respiratory function, which can help resist COVID-19. Furthermore, because the irregular lifestyle and lack of exercise resulting from the long-term COVID-19 lockdown will increase a series of health risks, further research is warranted to develop relevant home-exercise prescriptions and easy evaluation indicators of risk factors.

This study has limitations. First, the post-lockdown questionnaire survey was conducted after only 3 months of complete home isolation; there remains a need to investigate longer-term effects of COVID-19 on lifestyle habits and exercise in the future. Second, none of the respondents were under 18 years of age in this study. In the future, special studies and investigations on minors are needed, including its effects on their visual acuity, psychology, and growth process.

In conclusion, with the current resurgence in COVID-19 propensity, tailored lifestyle modifications are recommended, with emphasis on home movement or activity, avoidance of increased cardiovascular risk propensity, and excessive fat accumulation. Development of an easy evaluation criteria for home exercise prescriptions and related risk indicators in the large COVID-19 environment are needed by researchers in exercise science and related specialties.

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Conflict of interest

The authors declare that they have no conflicts of interest related to this work.

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