A Structural Analysis of the Effects on the Lifestyle and Health Status of Exercise Class Participants Owing to COVID-19 Prevention Measures

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Objectives: In this study, we aimed to clarify and measure the interrelationships among decrease in communication, exercise, and physical and mental health under COVID-19 prevention measures, restricting individuals from going out of the house. **Methods:** Participants included 540 middle-aged and older adults who are regular exercise class members. The survey was conducted between April 15 and May 10, 2020. For the self-administered questionnaire survey, a municipal employee of City A and an exercise instructor visited the home of each participant to collect the survey data. The survey items were sex, age, limitation of going out, feeling of inactivity, interaction with others, health status, and forgetfulness; a covariance structural analysis was performed to clarify the interrelationship between lifestyle and health status. **Results:** Restrictions on going out due to the COVID-19 prevention measures were associated with the physical and mental health of middle-aged and older adults who regularly attended exercise classes because they enforced inactivity and decreased the frequency of conversation. **Conclusions:** Several waves of COVID-19 may arrive in Japan in the future. Therefore, it is necessary to implement measures to prevent secondary health damage and not focus only on infection prevention.

Keywords: COVID-19; health status; feeling of lack of exercise; interaction with others

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Participation in exercise programs improves the health of middle-aged and older adults. In particular, classroom-based exercise programs (hereafter referred to as "exercise classes") are important opportunities for middle-aged and older adults as they improve and maintain physical and mental health.[1]

In February 2020, the number of individuals infected with the novel coronavirus infection (hereafter referred to as COVID-19) increased, forcing the first declaration of a state of emergency to restrict outbreaks.[2] However, the restriction of outings due to COVID-19 prevention measures may have led to a decrease in physical activity[3-5] and opportunities to interact with others[6,7]among healthy middle-aged and older adults.

It was reported that the average number of steps taken decreased by 27.3% (1432 steps) in the 30 days following the World Health Organization (WHO) pandemic declaration against COVID-19.[3] In Japan, a survey of older adults aged ≥ 65 years reported a decrease of approximately 30% (approximately 60 minutes) in the weekly physical activity time before and after the spread of COVID-19 infection.[4] Regarding the decrease in opportunities to interact with others, a survey of middle-aged and older adults aged ≥ 50 years reported that those who decreased their frequency of going out (out of the house at least once a week) before and after the first emergency declaration were 2.8 times more likely to decrease their frequency of conversation than those who continued to go out.[7]

Decreased physical activity and opportunities to interact with others may decrease subjective[8,9] and mental health.[10,11] For example, in a survey of adults aged ≥ 65 years, it was reported that those who did not engage in moderate exercise had a low subjective sense of health (odds ratio [OR]=0.72, p<.05), whereas those who engaged in social interaction had a high subjective

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sense of health (OR=1.61, p<.05).[8] Furthermore, a systematic review on physical activity and depression found a negative correlation between physical activity and depression, suggesting that physical activity may prevent the onset of depression.[10] A study that followed the occurrence of new depression in older adults who were not depressed at the beginning of the study reported that lack of social participation may increase the risk of developing depression (OR=1.28, p<.05).[11] Moreover, a decrease in health, including subjective and mental health, may increase the risk of developing dementia (cognitive function) by 1.4-2.4 times.[12,13] Therefore, in the future, it will be necessary to examine the impact of secondary damage to health caused by the restriction of outings owing to COVID-19 prevention measures in middle-aged and older adults.

Japanese municipalities have been conducting exercise classes to promote health; however, owing to COVID-19, the classes had to be temporarily suspended. For example, some participants had been attending the exercise classes held in City A for approximately 8 years; however, owing to COVID-19 prevention measures, this exercise class was suspended for approximately 2 months from March 2 to May 6, 2020. The suspension of exercise classes, which provides opportunities for exercise and human interaction, may cause long-term habitual participants to lose opportunities to exercise and interact with others, which in turn, may affect their physical and mental health status and cognitive functions.

Therefore, in this study, we aimed to clarify the interrelationships of feelings of inactivity, interaction with others, and physical and mental health status among middle-aged and older adults who habitually attend an exercise class when they are restricted from going out owing to COVID-19 prevention measures. In the future, we will obtain knowledge of measures to be taken when such a situation is observed again.

METHODS

Participants

A self-administered questionnaire was administered to 684 participants of an exercise class in City A. The 540 participants (male participants, 34.3%; mean age, 69.5 ± 9.3 years) who answered all the questions and had refrained from going out since the state of emergency was declared were included in the analysis. In this study, to conduct a covariance structure analysis, those who answered all of the questions were included in the analysis. Additionally, a gender and age comparison of the 144 and 540 participants excluded and included from the analysis, respectively, showed no statistically significant differences.

The questionnaires were administered between April 15 and May 10, 2020. Subsequently, the self-administered questionnaire survey was not conducted during the exercise class, but rather, a municipal employee of City A and an exercise instructor visited each participant's home to provide support and collect the questionnaire survey. The survey required approximately 10-15 minutes to complete.

The exercise class provides exercise and nutrition programs that are based on an individual's physical activity level and lifestyle using Information and Communication Technology and enables continuous support through "visualization" of data. Participants can perform approximately 50 minutes of aerobic exercise and strength training twice a week.

Survey Content

Restrictions on going out: To the question, "When did you start to refrain from going out by yourself to prevent COVID-19?" respondents were asked to choose one answer from the following options: "around February," "after 3/2 (suspension of exercise classes)," "mid-March," "April," "after the declaration of emergency," and "not refraining from going out." The responses from "around February" to "after the declaration of the state of emergency" were defined as "began to refrain from going out by the time the state of emergency was declared."

Feeling of lack of exercise and interaction with others: Respondents were asked to indicate their feelings of inactivity by answering the question, "Do you feel as though physical activity has been inadequate?" with one of the following options: "very much" (5 points), "fairly much" (4 points), "neither" (3 points), "not much" (2 points), or "not at all" (1 point).[14] Regarding interaction with others, respondents were asked to respond to the question, "Compared to before you started to refrain from going out (before the exercise class was suspended), has the frequency of talking with others (including phone calls) changed now?" by choosing one of the following options: "decreased" (5 points), "slightly decreased" (4 points), "unchanged" (3 points), "slightly increased" (2 points), or "increased" (1 point).

Mental and physical health: Respondents were asked to answer the question, "Please tell me your current health condition before and after you stopped going out." They were asked to choose one of the following options: "good" (1 point), "fair" (2 points), "normal" (3 points), "not so good" (4 points), or "not good at all" (5 points)[9]. The

following were the mental health scores: "I no longer feel cheerful and happy," "I no longer feel calm and relaxed," "I no longer feel motivated and active," "I don't get a good night's rest, and I don't wake up feeling good," and "I have lesser interest in my daily life," compared with before I started going out less (before the exercise class was stopped). The respondents were subsequently asked to choose a response from the following: "very applicable" (5 points), "fairly applicable" (4 points), "neither applicable nor not applicable" (3 points), "not very applicable" (2 points), or "not very applicable" (1 point).[15] The last item was, "I hear the same thing over and over again, or I worry about forgetting things," and the respondents were asked to choose one of the following options: "very applicable" (5 points), "fairly applicable" (4 points), "neither applicable" (3 points), "not that applicable" (2 points), or "not applicable at all" (1 point) compared with before they started going out less (before they stopped exercise classes).

Data Analysis

Simple aggregate values for each item are presented as percentages (number of individuals; Table 1). After reviewing the results of previous studies, a basic model was constructed to clarify the interrelationships of perceived lack of exercise, interaction with others, subjective sense of health, mental health, and memory loss due to COVID-19 prevention measures. This model was constructed by using the following variables: feelings of inactivity, interactions with others, subjective sense of health, mental health, and forgetfulness. In constructing the model, a path was established from subjective and mental health as factors regulating forgetfulness. A path was established based on feelings of inactivity and conversations with others as factors defining a subjective sense of health and mental health.

Covariance structure analysis was performed on the constructed model (Figure 1). The path coefficients in Figure 1 are standardized coefficients. The following 3 indices of the standardized coefficient of fit were used: goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and root mean square error of approximation (RMSEA). SPSS Statistics 25.0 (IBM, Armonk, NY) and Amos 24.0 (IBM, Armonk, NY) were used for all analyses, with a statistical significance level of<.05.

RESULTS

Perceived Lack of Exercise, Frequency of Conversation, and Subjective and Mental Health Status

Overall, 72.4% of respondents felt that there is a lack of exercise; 67.4% talked with others less frequently than before self-confinement; 11.3% had a worsened subjective sense of health; 36.7% were no longer in a cheerful and happy mood; 41.3% were less motivated and active; and 10.0% reported that they heard things repeatedly or became concerned about forgetting things (Table 1).

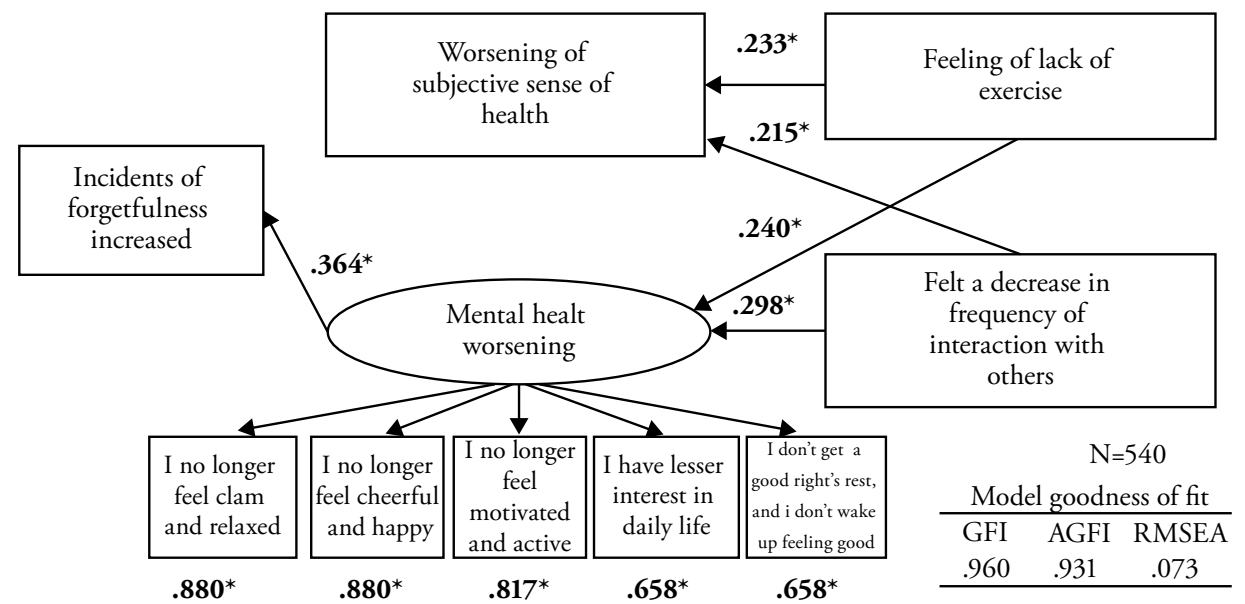
Table 1
Perceived Lack of Exercise, Frequency of Conversation, and Subjective and Mental Health Status

		N=540	
		%	(n)
Feeling of lack of exercise	strongly agree	24.6	(133)
	somewhat agree	47.8	(258)
	neutral	11.7	(63)
	somewhat disagree	12.4	(67)
	strongly disagree	3.5	(19)
Frequency of talking to others	decreased	33.0	(178)
	somewhat decreased	34.4	(186)
	unchanged	32.0	(173)
	somewhat increased	0.6	(3)
	increased	0.0	(0)
Subjective sense of health	excellent	14.3	(77)
	good	14.1	(76)
	average	60.4	(326)
	fair	10.6	(57)
	poor	88.7	(4)
I no longer feel cheerful and happy	strongly agree	6.5	(35)
	somewhat agree	30.2	(163)
	neutral	35.7	(193)
	somewhat disagree	15.9	(86)
	strongly disagree	11.7	(63)
I no longer feel calm and relaxed	strongly agree	5.4	(29)
	somewhat agree	26.3	(142)
	neutral	34.1	(184)
	somewhat disagree	20.7	(112)
	strongly disagree	13.5	(73)
I no longer feel motivated and active	strongly agree	8.1	(44)
	somewhat agree	33.1	(179)
	neutral	31.1	(168)
	somewhat disagree	15.2	(82)
	strongly disagree	12.4	(67)
I don't get a good night's rest, and I don't wake up feeling good	strongly agree	1.7	(9)
	somewhat agree	12.4	(67)
	neutral	42.0	(227)
	somewhat disagree	26.7	(144)
	strongly disagree	17.2	(93)
I have lesser interest in my daily life	strongly agree	3.7	(20)
	somewhat agree	22.0	(119)
	neutral	35.6	(192)
	somewhat disagree	23.3	(126)
	strongly disagree	15.4	(83)
Memory loss became a concern	strongly agree	0.9	(5)
	somewhat agree	9.1	(49)
	neutral	39.4	(213)
	somewhat disagree	26.9	(145)
	strongly disagree	23.7	(128)

Interrelationships among Feelings of Lack of Exercise, Frequency of Conversation with Others, and Mental and Physical Health Status

Using a structural analysis of covariance, the results of the interrelationships among feelings of lack of exercise, frequency of conversation with others, subjective sense of health, mental health, and forgetfulness are presented in Figure 1. The path coefficient from "worsened subjective sense of health" to "increased forgetfulness" was not statistically significant (p>.05); therefore, it was removed. The model was revised and reanalyzed, and the goodness-of-fit of the final model was acceptable (GFI=.960, AGFI=.931, and RMSEA=.073). The path coefficients from "feelings of lack of exercise" to "deterioration in subjective sense of health" and "deterioration in mental health" were .233 and .240, respectively. The path coefficients from "decreased frequency of conversation" to "worsened subjective sense of health" were .215 and .298, respectively, for "worsened mental health." Furthermore, the path coefficient from "worsened mental health" to "increased forgetfulness" was .364.

Figure 1
Interrelationships among Feeling of Inactivity, Frequency of Conversation with Others, and Physical and Mental Health Status



DISCUSSION

In Japan, the number of individuals infected with COVID-19 began to increase in February 2020, and the national and local governments requested individuals to refrain from leaving their homes. On April 7, 2020, the government issued the first emergency declaration.[2] Along with the declaration of a state of emergency, infection prevention measures were strongly urged in daily life, such as thorough handwashing, gargling, wearing masks, and avoiding enclosed spaces, crowded places, and close quarters. Consequently, for more than one month, several municipalities temporarily suspended all types of collective activities they sponsored prior to the declaration of the state of emergency. Moreover, with the spread of COVID-19, several companies and organizations implemented telework, and several places where people used to go out, including various commercial, entertainment, and sports facilities, temporarily disappeared. These measures are important to reduce the risk of infection with COVID-19. However, there is concern about secondary damage to health caused by the curtailment of outings owing to COVID-19 prevention measures. Physical inactivity and reduced interaction with others may have a negative impact on physical and mental health.

Interrelationships among the Feelings of Lack of Exercise, Frequency of Conversation with Others, and Physical and Mental Health Status

Our data suggest that the subjective sense of health

and mental health may be negatively affected by the feeling of a lack of exercise and a decrease in the frequency of conversation with others in middle-aged and older adults who habitually attended an exercise class prior to COVID-19 prevention measures. A previous study has shown a decrease in physical activity[3-5] and frequency of interaction with others[6,7] in healthy middle-aged and older adults before and after the COVID-19 pandemic. Other studies have shown that this decrease subsequently leads to deterioration in subjective and mental health and contributes to the exacerbation of underlying diseases, regardless of the effects of COVID-19.[8-11,16] In this study, we found that even among health-conscious middle-aged and older adults who make exercise classes a part of their daily lives under the circumstances of having to limit their outings to prevent COVID-19 infection, a sense of inactivity and decreased frequency of interaction with others was associated with deterioration in subjective and mental health. In middle-aged and older adults who habitually exercise, a decrease in muscle strength was observed when they stopped exercising,[17] which may increase the risk of developing sarcopenia and frailty. Therefore, to prevent health conditions from worsening, it will be necessary to consider how exercise classes should be conducted in restricted areas, such as including adequate ventilation to prevent the creation of enclosed spaces, thorough handwashing and disinfection, and the use of remotely held exercise classes.

Impact of Worsened Mental Health on Increased Forgetfulness

Regardless of the effects of COVID-19, it has been reported that decreased opportunities to interact with others may increase the risk of worsening mental health, such as depression.[11] Furthermore, worsened mental health may increase the risk of developing dementia.[12,13] Our data suggest that a decrease in the frequency of conversation may worsen mental health and be associated with increased forgetfulness in middle-aged and older adults who habitually attended exercise classes, which COVID-19 restricts them from attending currently. The results of this study partially support the findings of previous studies. Individuals who are more concerned about their health have been reported to be at a lower risk of worsened mental health problems, such as depression, than those who are less concerned about their health.[18,19] The suspension of exercise classes due to COVID-19 may be associated with deterioration in mental health and an increase in forgetfulness, even in a population with a high interest in health that attends exercise classes, owing to a decrease in conversations between participants and their instructor, which had become a routine. Therefore, even if exercise classes are suspended owing to COVID-19 prevention measures, it will be necessary to create an environment in which individuals can continue to interact with each other.

Limitations and Strengths

This study had several limitations. First, as the participants in the analysis had attended exercise classes in City A for an average of 8 years, it is unclear whether similar results would be obtained if the participants were less interested in health or had lower physical fitness. Second, among those who attended exercise classes, it is not clear whether similar results were observed for different forms of exercise classes or when exercise classes were conducted in other municipalities. Third, because this study compares health status and behaviors prior to COVID-19 to the time of the survey, it is possible that a recall bias may have occurred. Finally, the study did not eliminate the influence of confounding factors, such as basic attributes and health behaviors, which may have been influenced by confounding factors.

However, considering that we were able to visit the homes of 684 participants in the exercise class and administer a questionnaire during the COVID-19 pandemic provided valuable data for understanding the actual health status of middle-aged and older adults who were restricted from leaving their homes. More than 2 years have passed since the first emergency declaration was issued, and the curfew restrictions imposed by the declaration may have reduced the risk of COVID-19 infection for several residents. However, the restriction of outings may have had a serious impact, not only on the industrial sector, such as tourism and retail food services, but also on the health sector, such as the deterioration of residents' health status. Our data showed that restricting outings may worsen the physical and mental health status of participants who habitually attended exercise classes. Therefore, we can assume the possibility of secondary damage to health, including greater deterioration in physical and mental health, had a similar survey been conducted with a population less concerned with health. In the future, there is a need to increase the evidence on the impact of the COVID-19 restriction on the health status of residents, particularly those less concerned about their health, and devise ways to prevent the deterioration of their physical and mental health status during the curfew.

Conclusion

Regarding middle-aged and older adults who habitually attend exercise classes with a restriction on going out due to COVID-19 prevention measures, the results suggest that the feeling of inactivity and decreased interaction with others may be associated with their subjective sense of health and mental health. Furthermore, their mental health may be associated with a negative effect on memory loss. As the COVID-19 pandemic has been prolonged and the number of infected individuals is expected to increase in the future, it is necessary to implement not only infection prevention measures but also measures to prevent secondary damage to health.

Human Subjects Approval Statement

Prior to conducting this study, approval was obtained from the Ethics Review Committee of the Graduate School of Comprehensive Human Sciences, University of Tsukuba (approval number: Body No. 021-65).

Conflict of Interest Disclosure Statement

The authors declare that they have no competing interests.

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