



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Journal of Orthopaedic Science

journal homepage: <http://www.elsevier.com/locate/jos>

Original Article

JCOA The Japanese Clinical Orthopaedic Association the questionnaire survey on the physical changes after the self-restraint of outdoor activities with the COVID-19 crisis- corona loco and corona stress[☆]

Motoshige Nikaido^{*}, Sadao Arai, Keiji Fujino, Shohiro Hayashi*Orthopedic Clinic, 389-0806, 1194-1, Isobe Chikuma City Nagano Pref, Japan*

ARTICLE INFO

Article history:

Received 12 July 2021

Received in revised form

11 October 2021

Accepted 23 October 2021

Available online xxx

ABSTRACT

Background: Problems with COVID-19 are not limited to the infection itself, but also include the secondary health damage arising from the prolonged self-restraint, which has affected all age groups in the Japanese population. Numerous studies have reported clear evidence of the secondary health damage. Published reports cover a wide range of damages, from locomotive dysfunction caused by decreased physical activity to decreased cognitive function and changes in eating and oral functions, and further to decreased opportunities for social participation. Such damage can also lead to worsening of so-called frailty.

Under this circumstance, orthopedic surgeons conducted a questionnaire survey to determine the physical changes observed after the start of the COVID-19 self-restraint period. In this article, we report findings of the survey, along with some literature considerations.

Methods: The survey was started two months after the state of emergency in Japan was lifted, July 20 to August 12, 2020 (16 days total). And the analysis was conducted by simple and cross tabulation.

Results: Valid responses to the questionnaire were obtained from 12,254 participants. Approximately 40% of the subjects felt a lack of physical strength (Corona stress), with the percentage peaking in high school, in the elderly it remained rather below average. On the other hand, locomotive dysfunction (Corona loco) increased with age, independent of physical activity, and was not correlated with Corona stress.

Conclusions: Japanese citizens need to change their behaviors for the purpose of improving their exercise and lifestyle habits towards shifting to a new lifestyle norm. Looking ahead to the "With Corona" era, it is considered necessary by selecting a tailor-made training method suitable for each age group.

© 2021 The Japanese Orthopaedic Association. Published by Elsevier B.V. All rights reserved.

1. Introduction

The spread of COVID-19 has forced people to restrict their activities in a wide range of areas. Even with the lifting of the self-restraint, social activities appear to be headed for a new norm. In order to verify the impact of the prolonged self-restraint of activities on the motor functions of individuals, we conducted a survey to evaluate the physical changes associated with such restriction in all ages of patients who visited our orthopedic outpatient clinics and their family members.

2. Materials and methods

The questionnaire survey was conducted in patients who visited member institutions of the Japanese Clinical Orthopaedic Association (JCOA) and their families. The intent of the survey was explained to these subjects by the survey manager. After obtaining their informed consent, while they were seated in the waiting room, the survey staff, etc., asked them to fill out a form in a fill-in-the-blank format with answer choices on the website using their smartphone or a fill-in form, containing the following 18 questions.

After all the questionnaires were collected, the answers were re-entered on the website at a later date. All participants provided written informed consent and all procedures used in this research were approved by the Ethical Committee of JCOA. The 18 question items were as follows.

[☆] This research has been approved by the IRB of JCOA (No.2020-03).

^{*} Corresponding author. Fax: +26 275-5583s.

E-mail address: nikaido@ueda.ne.jp (M. Nikaido).

1. Gender (Male Female)
2. Age (Pre-schoolers Elementary school students Junior high school students Senior high school students University students < 20s 30s 40s 50s 60s 70s 80s<)
3. About exercise Whether or not exercise before the period of self-restraint (B.R) (Yes No) Yes:
 - 1) Type of exercise

(Walking, Strolling, Jogging Loco-training, Aerobic ex., Fitness Volley b, Basket b, Base b, Soccer, Dodge b. Cycling Golf, Mallet g, Gateball, Bowling Swimming Tennis, Badminton, Table tennis Climbing, Trekking Ballroom dance, Hula dance Ski, Snowboard, Skateboard others)
 - 2) Frequency of exercise (B.R)

(once/w 2~3times/w everyday others).
 - 3) Duration of exercise/during the period of self-restraint (D.R)

(<1hr 1~3hr 3hr<).
4. Whether or not having painful area/after the call for self-restraint (A.R)

(Yes No) Yes (Neck/Lower back Feet/Ankles Knees Shoulders/Elbows/Hands Hip joints others)
5. Subjective evaluation of the changes in the body A.R
 - 1) Changes in locomotive functions (Corona loco: 3 early signs of locomotive dysfunction)
 - (1) Easy to stumble (Yes No)
 - (2) Unstable to walk fast (Yes No)
 - (3) Difficulty in climbing the stairs (Yes No)

- 2) Changes in physical condition (Corona stress: 5 physical stress items)
 - (1) Loss of physical strength (Yes No)
 - (2) Easily fatigued (Yes No)
 - (3) Loss of energy (Yes No)
 - (4) Weight gain (Corona obesity) (Yes No)
 - (5) Loss of Appetite (Yes No)
- 3) Child loco

We conducted a survey particularly over the impact of the time spent exercising or playing smartphones/games on physical stress and pain of school students before and during school closure (total 10 items)

(9)The time spent playing on smartphones or games

(none <1hr 1~3hr 3hr<).

(10)Poor posture (Yes No)

3. Results

3.1. Attributes of the respondents

Valid responses to the questionnaire were obtained from 12,254 participants. The male: female ratio was 2:3. By age group, in their 70s accounted for the highest number, and more than half of all were in their 60s or older (Fig. 1).

3.2. About exercise

1) By age group, a higher proportion of school students and the elderly engaged in exercises, as compared to the significantly lower proportion in 20s–50s. The proportion in 20s–30s who

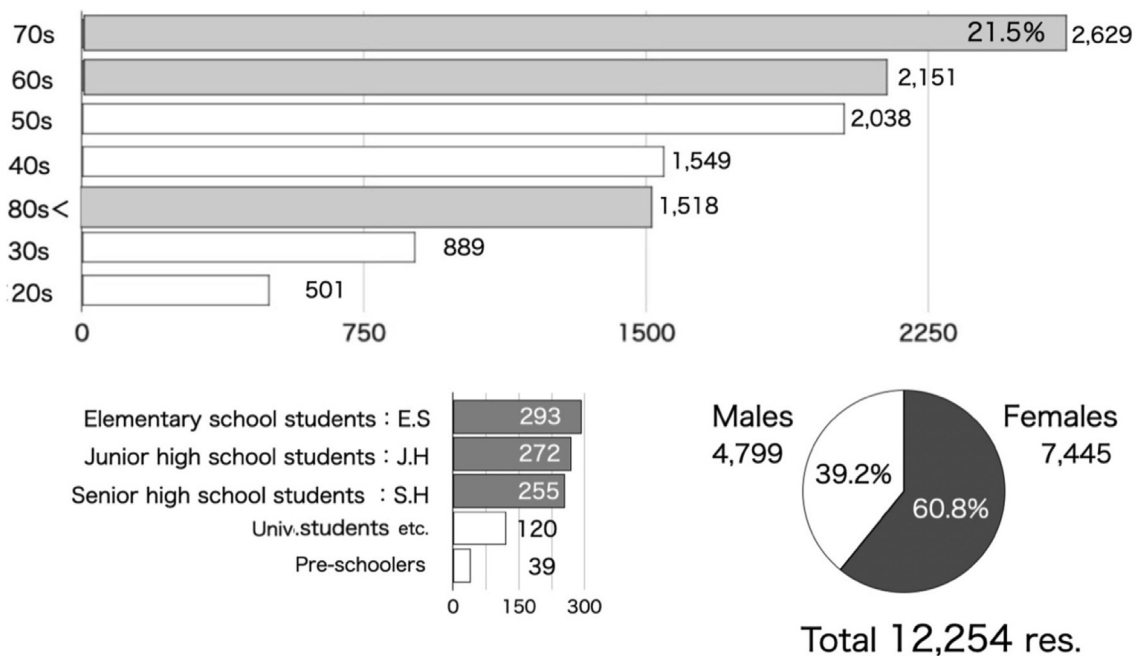


Fig. 1. Number of respondents by age group sex ratio. The number of valid responses was 12,254. Those in their 60s or older accounted for 51.4% of the total, while school students accounted for 6.7%.

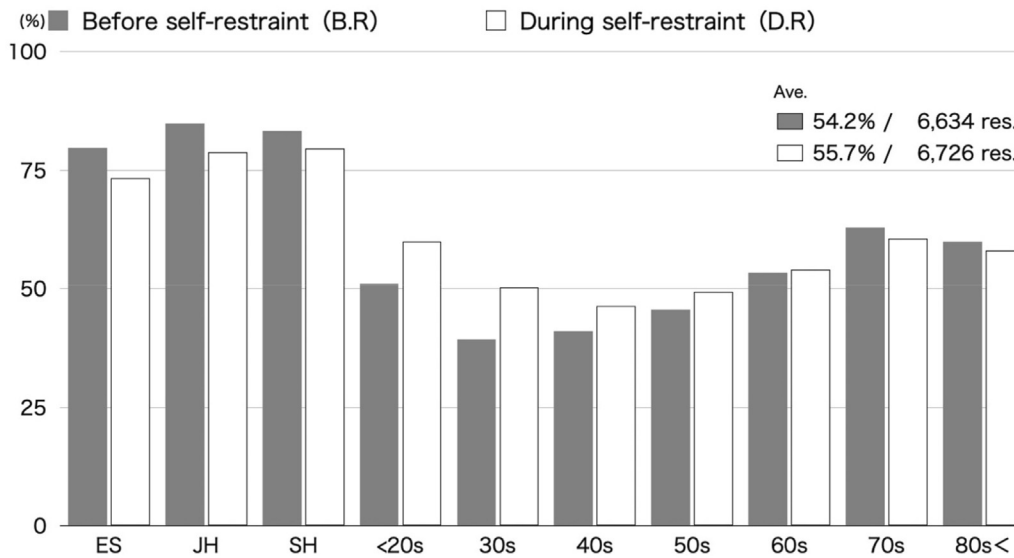


Fig. 2. Percentage of respondents who exercised before and during self-restraint by age group. The proportion of people who exercised was slightly greater D.R than B.R. The rate increased by 8.9% among 20s and 11.0% in 30s, while it decreased by 5.4% among school children and by 2.2% in 70s and 80s.

exercised was greater D.R. than B.R. On the other hand, the proportions of school students and 70s–80s who exercised was lower D.R than B.R (Fig. 2).

- 2) Walking, strolling and jogging exercises were the most common types of exercises throughout all age groups, the proportion increasing with 20s and older, and exceeding 50% in 70s (Fig. 3).
- 3) The most commonly reported frequency of exercise B.R was 2–3 times a week. More than half of the high school students (S.H), 40% of junior high school students (J.H), and 25% of 80s or older exercised every day (Fig. 4).
- 4) The most common duration of exercise D.R was under 1 h. About 10% of S.H and J.H exercised for 3 h or more (Fig. 5).

3.3. Physical pain and having painful areas

30% of all reported that they had pain somewhere in the body. The proportion who had pain was consistent across age groups, except for being lower in elementary school students (E.S) and 20s. In regard to affected area, more than half of each age group,

except children, complained of neck and lower back pain. On the other hand, 40% of E.S and 30% of J.H complained of feet and ankles pain (Fig. 6).

3.4. Subjective evaluation

1) Corona locomo

The proportion of any changes in locomotive function increased with age, and changes in dynamic balance control ability exceeded in static balance control ability in all age groups (Fig. 7).

2) Corona stress

38.5% of respondents across age groups perceived loss of physical strength. It was especially high in S.H (55.1%), whereas slightly below average in the elderly (37.5%). In most age groups, 35%–40% of all were aware of weight gain. In their 70s or older, the proportion reporting it decreased (Fig. 8).

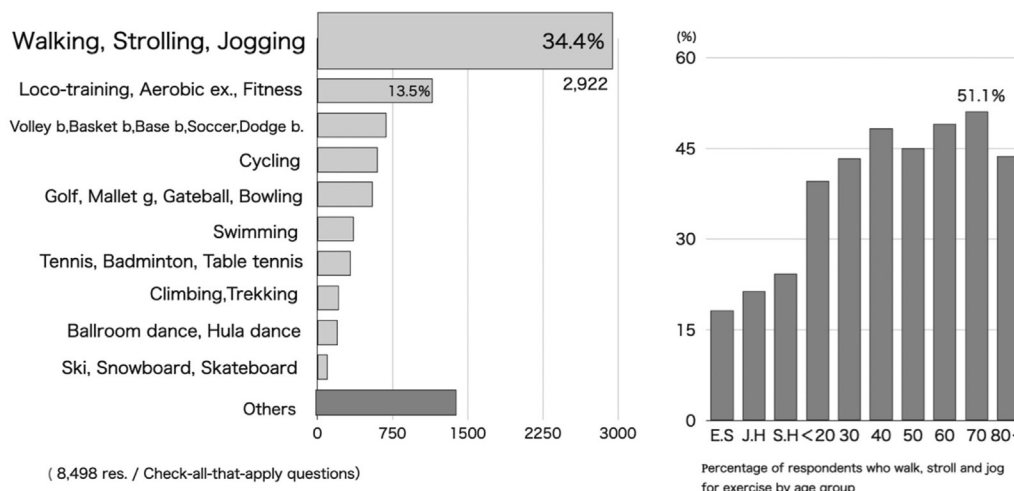


Fig. 3. Type of exercise performed before self-restraint. Walking was one of the most common activity. The average rate was increasing with age, and 51.1% for those in their 70s.

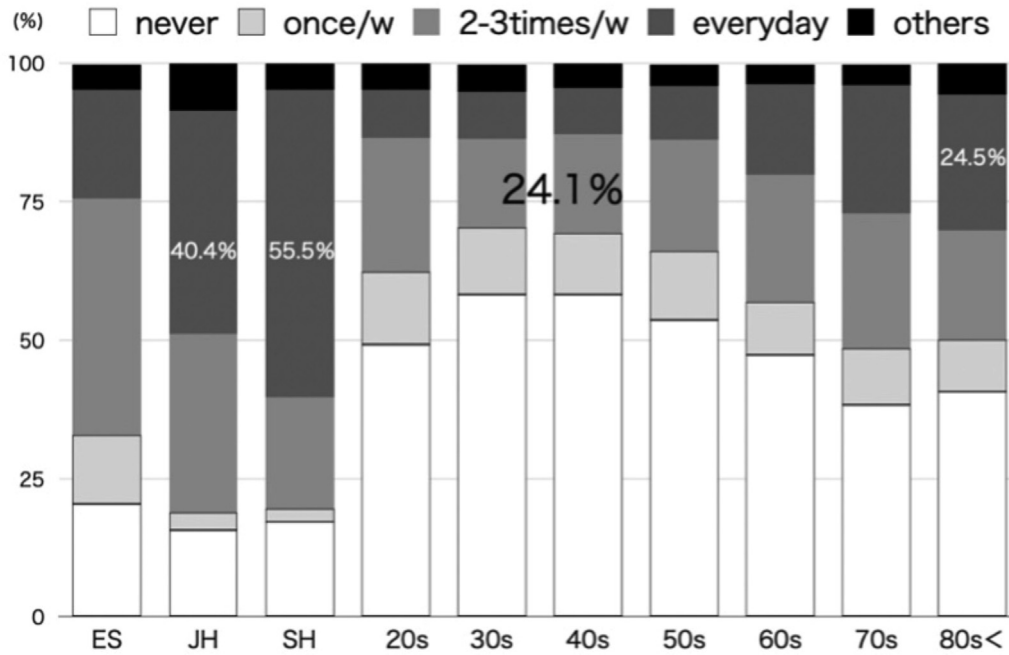


Fig. 4. Exercise frequency before self-restraint. B.R, 55.5% of S.H, 40.4% of J.H and 24.5% of 80s and older exercised daily, the data showed high percentage at both poles.

3) Child locomo

Loss of physical strength was the most common change in all the children, and peaked in S.H. A similar profile was also observed for having painful areas. Poor posture was more common in E.S, and weight gain was almost consistent across all the school students (Fig. 9).

In D.R, “never exercise” group was the most frequently selected option in E.S, both “exercising for 3 h or more a day” group and “spending 3 h or more a day playing on smartphones/games” group

were the most frequent in S.H. In each group, loss of physical strength was the most frequent in extreme under-exercising group, whereas in extreme over-exercising group, J.H accounted for the highest proportion in any physical conditions, including easily fatigued (Fig. 10).

4. Discussion

This survey showed that despite 2 months having elapsed since the lifting of the call for self-restraint to the start of the survey, the

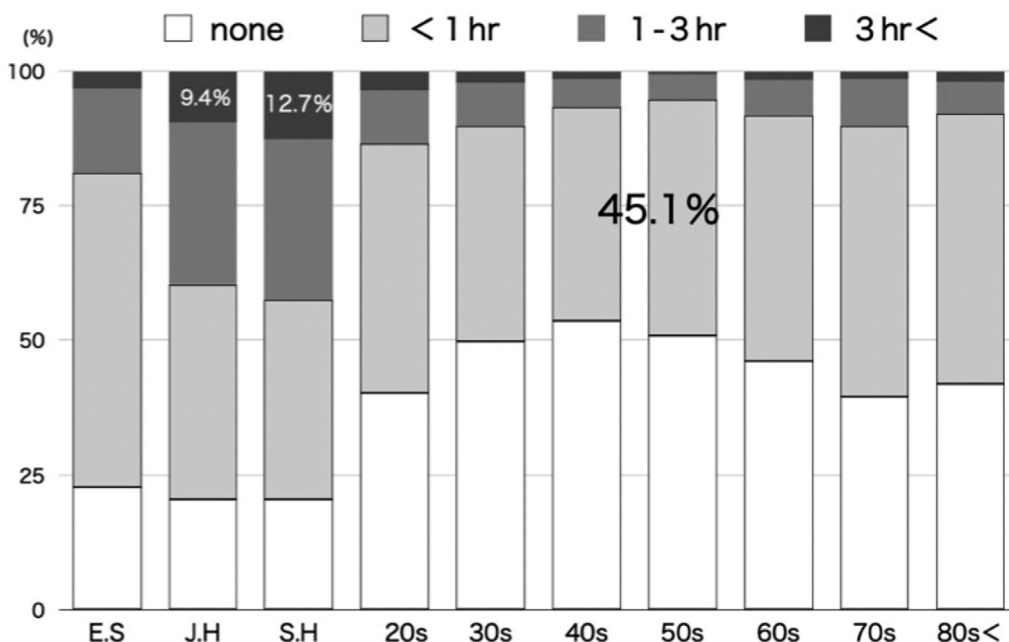


Fig. 5. Duration of exercise during self-restraint. D.R, 12.7% of S.H and 9.4% of J.H exercised more than 3 hours.

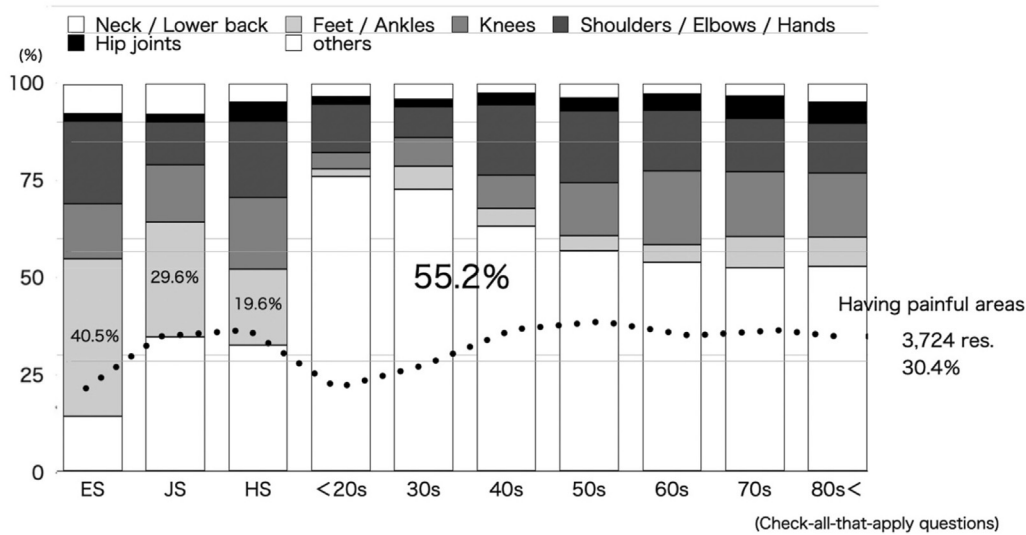


Fig. 6. Having painful areas after the lifting of self restraint. Overall, 30.4% of the respondents reported pain in some part of their body A.R. More than half complained of pain in the neck and lower back, and 40.5% of the E.S in the feet and ankles.

physical condition had not recovered to the normal state in nearly 40% of the respondents.

Yamada [1] conducted a web-based urgent questionnaire survey on the physical changes in 5000 people before the state of emergency was declared. She reported that the amount of physical activities decreased by 48% from the previous year in participants aged 60 years and older.

Our survey revealed that predominantly children had Corona stress and predominantly elderly people had Corona loco (Fig. 11).

The quality and quantity of exercise were deeply associated with the extent, specific to each age group, of locomotive dysfunction and physical stress.

1) School student

The proportion of respondents suffering from “Corona stress” was extremely high (55.1%) among high school students.

Both the frequency of exercise before the self-restraint period and the duration of exercise during the self-restraint period were higher in the order of high school students to junior high school students. The time spent in playing with smartphones/games for ≥3 h per day was greater in the order of high school students to junior high school students.

It has been suggested that the stress in high school students is attributable to the rapid change in their daily exercise habits,

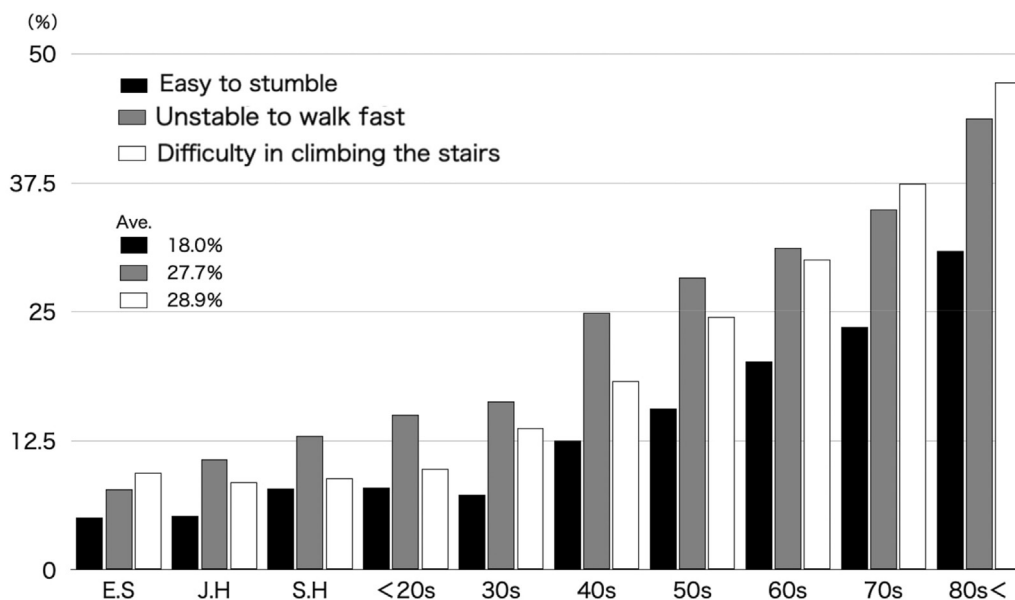


Fig. 7. Corona loco. All three signs of early decline in locomotive function increased with age, and the dynamic balance control ability Ave.28.3% was greater than the static balance control ability 18.0% in all age groups.

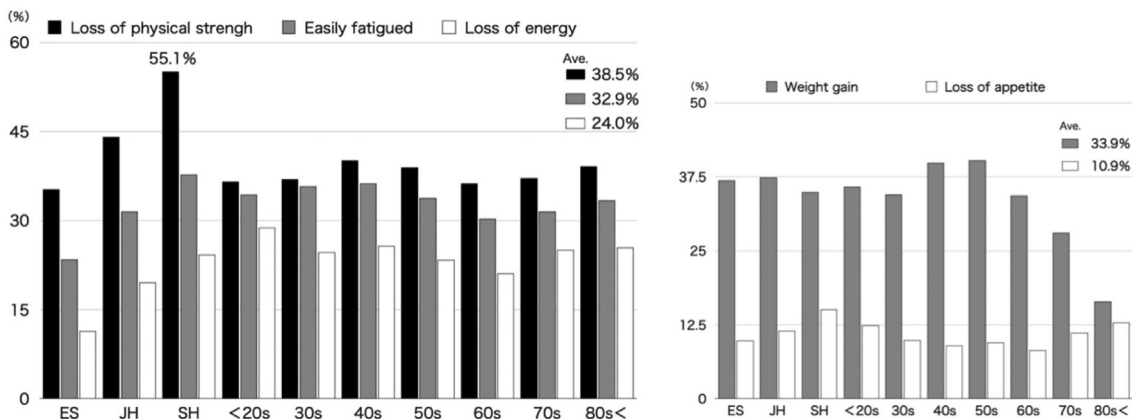


Fig. 8. Corona stress. 38.5% of respondents across age groups perceived loss of physical strength, especially high in S.H (55.1%), 35-40% of people in each age group were aware of weight gain on average, while only 10.9% of them had decreased appetite.

resulting from polarization of the amount of exercise (“lack of exercise vs. excessive exercise”) during the COVID-19 pandemic.

In addition, 40% of E.S complained of pain around feet and ankles.

Stiffened joints during the school closure period affect especially feet and ankles among the weight-bearing joints. As a result, a situation may develop wherein resumption of exercise leads to inconceivable injuries under normal circumstances, such as “breaking ankle when jumping rope”. Muramatsu [2] states that the incidence rate of fractures in J.H has trebled from 1.0% to 3.0% in 40 years. Hayashi et al. [3] gave the term “Child loco” for locomotive dysfunction without a clear underlying disease in children. They have been widely conducting Child loco prevention and awareness raising activities, through conducting school medical examination of locomotive

organs in Saitama Pref., under multidisciplinary cooperation of parents, school doctors, classroom teachers, school nurses, and dietitians.

Also, a survey conducted by the Japan Sports Agency in 2018 [4] revealed that the physical strength and athletic ability of school students declined over time. The incidence of Child loco has been rising steadily year after year.

2) Young and middle-aged adults

Many young and middle-aged people, who are supporters of society, were forced to change their lifestyles, such as long-term teleworking from home, due to the call for self-restraint for a period of about seven weeks. As a result, they were exposed to various health hazards.

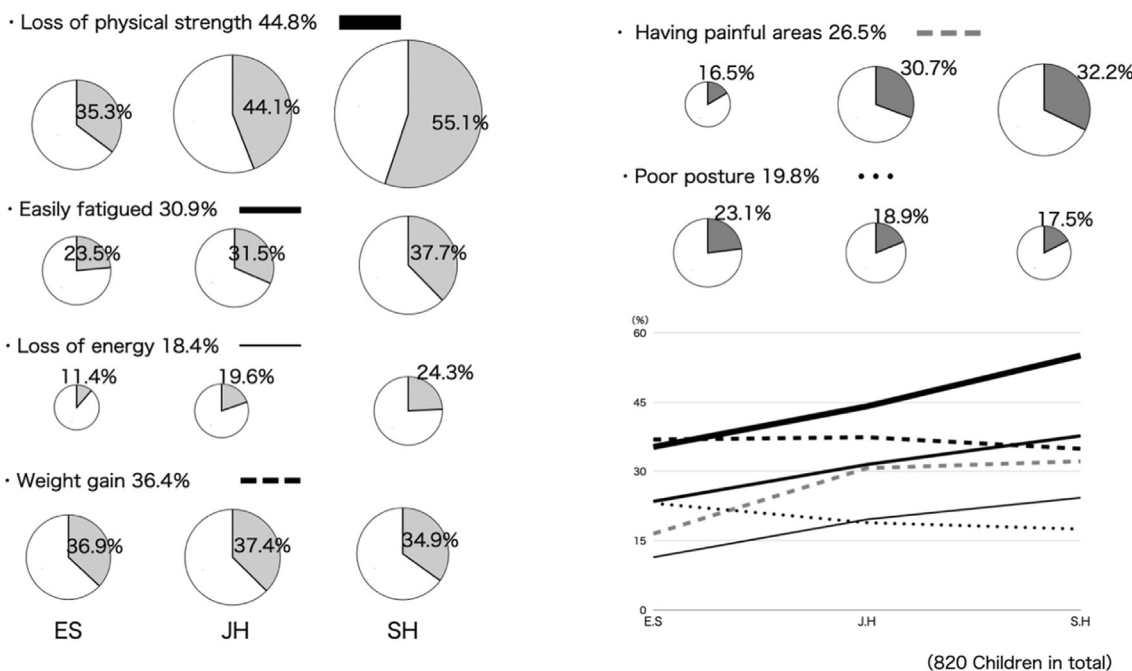


Fig. 9. Child loco. 44.8% of all the school children felt loss of physical strength. 23.1% of E.S were aware of poor posture and felt constant weight gain across all grades at around 36.4%.

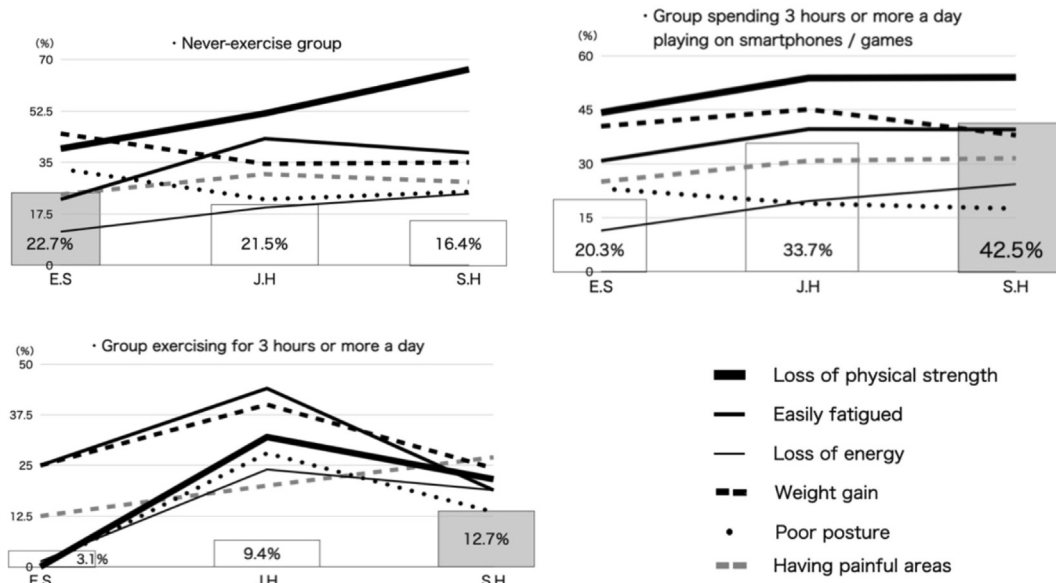


Fig. 10. Changes in the physical condition in children. Loss of physical strength was the most common change in extreme under-exercising or playing smartphones / games group .Whereas in extreme over-exercising group, J.H accounted for the highest proportion in any physical conditions, including easily fatigued.

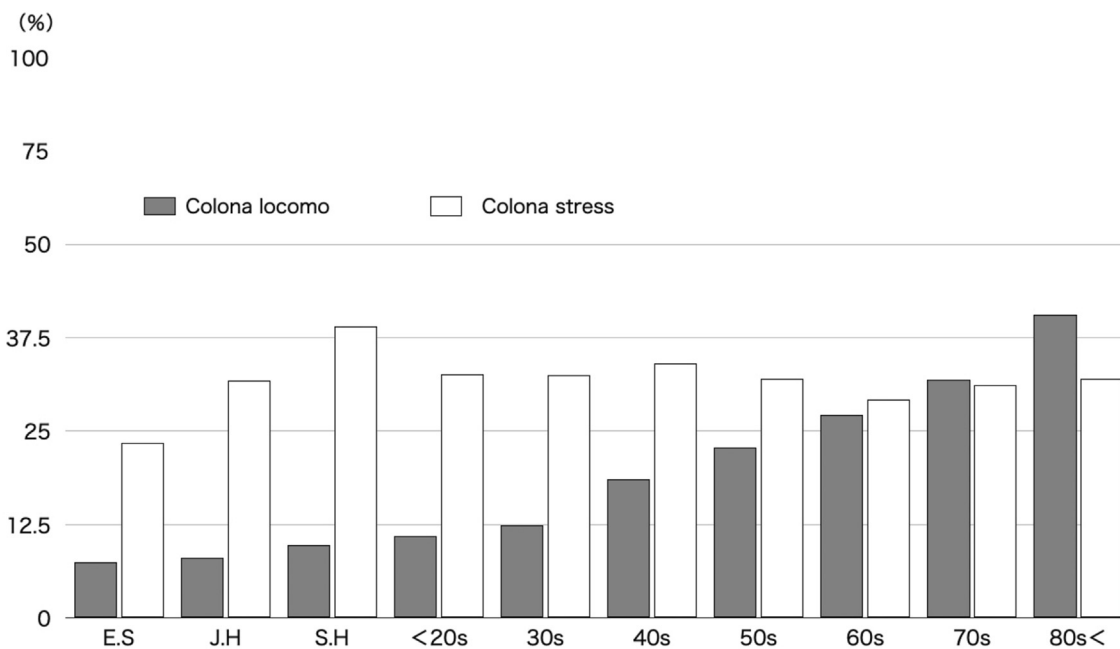


Fig. 11. Physical changes after lifting of self-restraint. Clearly corona stress was predominant in the young segment and corona loco in the elderly. The average proportion of the total of 7 items subjective evaluation was 22.5% in the age group of 30s.

This survey also revealed that more than 70% of their 20s and 30s complained of stiff neck and lower back pain, and that at least 40% in 40s and 50s were aware of weight gain.

The increase in the proportion of respondents engaging in exercise D.R, especially 20s and 30s, as compared to that B.R, is considered to reflect the sense of danger that young and middle-aged people felt regarding their health. Therefore, this finding is very interesting.

3) Elderly people

After the declaration of the state of emergency, all sports facilities were closed, and group sporting events were cancelled. In addition, due to the limited medical care provided by medical institutions and closure of outpatient rehabilitation and long-term care facilities, elderly people were also forced to change their daily lifestyles rather suddenly.

However, there was almost no change in the proportion of people who were engaged in habitual exercise, either before or during the self-restraint period.

In regard to walking, which was the most common exercise, 51.1% of people in their 70s and 1 in 4 people in their 80s walked by way of exercise every day. This result suggests that it is possible, even during the COVID pandemic, to continue walking, as part of elderly's daily activities, without worrying about "denseness" (Fig. 3).

The result showing an increase in the incidence of Corona loco with age, despite no reduction in the amount and frequency of exercise during the self-restraint period, suggests the following: walking for exercise is a typical aerobic exercise, and is considered to be effective for the prevention of not only metabolic syndrome and dementia, but also of mental stress.

For elderly people who are highly health conscious, moderate exercise appears to be more effective for preventing mental deterioration than physical deterioration.

Therefore, preventive measures against Corona loco, which is more likely to develop with increasing age, involving not only aerobic exercise, but also low-intensity muscle strengthening exercises interspersed with locomotion-training, aimed at improving the static balance control ability.

The results of the present survey showed that the proportion of respondents who perceived changes in the static balance control ability, which is an early sign of locomotive dysfunction, was lower than the dynamic balance control ability, across all age groups.

This finding is inconsistent with Frankenberg's theory, which states that the balance control ability is established first for dynamic balance, followed by static balance during infancy, and with aging, static balance deteriorates first, followed by dynamic balance. Murray MP [6] states that "one-leg standing", that is, the single-limb support period, accounts for 80% of the gait cycle at normal walking speed. In addition, Dai, et al. [7] states that the static balance control ability plays a supportive role by supporting and stabilizing the dynamic balance control ability (walking).

It is difficult to assess the subjective judgment that deterioration of the static balance control ability leads to unstable walking and easy stumbling. Moreover, also from Ono's report [8] suggesting that the dynamic balance control ability markedly deteriorates with increasing age, it is considered that the ability to pay attention to stumbling also diminishes with increasing age.

5. Conclusions

We still cannot see the convergence towards the end of the covid-19 crisis. Therefore, Japanese citizens need to change their behaviors for the purpose of improving their exercise and lifestyle habits towards shifting to a new lifestyle norm.

Looking ahead to the "with corona era", which is likely to last longer, it appears necessary for school students to build a regular lifestyle and to include proper stretching before and after physical exercises.

For young and middle-aged people, it may be necessary to incorporate active training sufficient to overcome a chronic lack of sufficient daily physical activities. For elderly people, it may be necessary not only to encourage them to walk for exercise as they had done so far, but also to include an intervention with daily locomotive-training to prevent "Locomo-frail" [9]. Thus, it is

considered necessary to improve exercise and lifestyle habits by selecting a tailor-made training method suitable for each age group.

In the era of accelerating aging of the society with a declining birthrate, in order to obtain a treasure for a lifetime, a "healthy locomotive system", it is necessary to make efforts to extend healthy life expectancy by carrying out locomotive syndrome prevention and awareness raising activities suitable for all ages. We orthopedists have a significant role as key persons in conducting these activities.

Ethics approval and consent to participate

Written informed consent was obtained from all participants in advance.

Application for approval of this study made to the Ethics Committee of the Japanese Clinical Orthopaedic Association.

Funding

This work was supported by the research project of JCOA The Japanese Clinical Orthopaedic Association.

Consent for publication

All authors agreed to submit it and will agree to transfer the copyright.

Data statement (availability of data and materials)

The corresponding author has full access to all data in the study and assumes final responsibility for the decision to submit for publication.

Declaration of competing interest

There are no conflicts of interest to declare.

Acknowledgements

We thank all of the orthopaedic surgeons, their staff members of JCOA, further patients and their families who participated in this study.

References

- [1] Yamada K. The COVID-19 outbreak limits physical activities and increases sedentary behavior : a possible secondary public health crisis for the elderly. *J Orthop Sci* 2020;25(6):1093–4.
- [2] Muramatsu Y. From the data of "Disaster under the control of the school authorities- annual basic statistics" nissei fundamental research laboratory letter. 2019.
- [3] Hayashi S, Shibata T, Samejima H. Child locomotive syndrome and school medical examination of locomotive organs. *J Jpn Orthop Assoc* 2017;91(5): 338–44.
- [4] Summary of the annual survey on physical strength and athletic ability in 2018 by the Japan Sports Agency. 6. Analysis of investigation results
- [6] Murray MP. Gait as a total pattern of movement. *Am J Phys Med* 1967;46(1): 290–333.
- [7] Dai J, Matsuo C. Development of exercise program of improving dynamic balance function for elderly people. *The Japan journal of coaching studies* 2010;24(1):57–71.
- [8] Ono A, Ryushi T. A comparative study of static and dynamic postural control characteristics in healthy younger and elderly people. *J. Physiol. Anthropol* 1999;4(4):165–71.
- [9] Sakuma M, Aoki K, Endo N. Frailty and locomotive syndrome. prospect and rearranging of the concepts. *J Jpn Orthop Assoc* 2019;93(4):217–21.