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.
Short Communication

Trends in emergency transportation due to heat illness under the new normal lifestyle in the COVID-19 era, in Japan and 47 prefectures

Shinya Uryu,1, Yuta Tanoue,2, Shuhei Nomura,3,⁎, Kentaro Matsuura,4, Koji Makiyama,5, Takayuki Kawashima,6, Daisuke Yoneoka,1, Akifumi Eguchi,1, Yumi Kawamura,1, Stuart Gilmour,6, Haruka Sakamoto,3, Kazuki Shimizu,7, Chris Fook Sheng Ng,8, Masahiro Hashizume9

1 Center for Environmental Biology and Ecosystem Studies, National Institute for Environmental Studies (NIES), Tokyo, Japan
2 Institute for Business and Finance, Waseda University, Tokyo, Japan
3 Department of Health Policy and Management, School of Medicine, Keio University, Tokyo, Japan
4 Department of Global Health Policy, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
5 Department of Management Science, Graduate School of Engineering, Tokyo University of Science, Tokyo, Japan
6 HOXO-M Inc., Tokyo, Japan
7 Department of Mathematical and Computing Science, Tokyo Institute of Technology, Tokyo, Japan
8 Graduate School of Public Health, St. Luke’s International University, Tokyo, Japan
9 RIKEN Center for Sustainable Resource Sciences, Chiba University, Chiba, Japan
10 School of Tropical Medicine and Global Health, Nagasaki University, Nagasaki, Japan
11 School of Public Health and Policy, London School of Hygiene and Tropical Medicine, London, UK
12 School of Sustainable Health Science, Center for Preventive Medical Sciences, Chiba University, Chiba, Japan
13 Department of Health Policy, London School of Economics and Political Science, London, UK
14 Department of Health Policy and Management, School of Medicine, Keio University, 35 Shinanomachi, Shinjuku-ku, Tokyo 160-8582, Japan.
P. E-mail address: s-nomura@keio.jp (S. Nomura).

HIGHLIGHTS

• Under the ‘new normal’ lifestyle calling for the mask wearing as a COVID-19 control measure, heat illness is a concern.
• We estimated the expected weekly number of emergency transportations from heat illness.
• By prefecture, age, and severity, there were some weeks where decreased cases were observed.
• The decrease in the cases was possibly associated with COVID-19 measures, such as, outdoor activity restrictions.
• Continuous and appropriate awareness-raising activities to prevent heat-related illness remain important.

GRAPHICAL ABSTRACT

Number of emergency transportations due to heat illness in Japan

ARTICLE INFO

Article history:
Received 12 November 2020
Received in revised form 11 December 2020
Accepted 22 December 2020
Available online 7 January 2021

ABSTRACT

In Japan, in response to the spread of the new coronavirus disease (COVID-19), a ‘new normal’ in the era of the COVID-19 was proposed by the government, which calls for thorough wearing of masks as an infection control measure in the era of the COVID-19, but related heat illness has been a great concern this summer. We applied quasi-Poisson regression models to the daily number of emergency transportations due to heat illness from 2008 to 2020 from the Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications, Japan, to estimate the expected weekly number of emergency transportations from heat illness, with adjustment.
1. Introduction

In recent years, the increased risk of heat illness has become a global policy issue due to high temperature associated with global warming and the heat island effect in large cities (World Health Organization, 2018). When the core temperature elevates, heat illness can develop to heat stroke, a life-threatening condition that necessitates intensive neurological care. The latest Global Burden of Disease (GBD) study reported approximately 50% from 1990 (GBD 2019 Risk Factors Collaborators, 2020). In Japan, 1288 deaths from heat stroke were reported in 2018, and over 80% of them were in the elderly aged over 65 years old (Ministry of Health, Labour and Welfare, n.d.).

In Japan, in response to the spread of the new coronavirus disease (COVID-19), a ‘new normal’ in the era of COVID-19 was proposed at the Expert Meeting on Novel Coronavirus Disease Control held on May 4, 2020 (Ministry of Health, Labour and Welfare, 2020). It calls for each person to practice a lifestyle that incorporates enhanced measures against infectious diseases, such as ensuring physical distance, wearing a mask, and thorough hand washing and avoiding settings characterized by the “3Cs” (closed spaces, crowded places, and close-contact settings).

On the other hand, the Ministry of Health, Labour and Welfare (MHLW) and Ministry of the Environment (MOE) have jointly called on local governments to take extra precautions to prevent heat stroke while taking measures against infectious diseases by wearing masks. Yokobori, 2020). In a nationwide survey conducted by the MHLW on August 12–13, 2020, using a social networking service, 82.5% of the more than 15 million respondents reported that they were thoroughly wearing masks as a COVID-19 countermeasure (LINE Corporation, 2020). Wearing a mask has been found to increase body temperature near the face, and may also make breathing difficult and increase heart and respiratory rates (Yokobori, 2020; Johnson, 2016; Samannan et al., 2020), and we hypothesize that the habit of wearing masks in the ‘new normal’ may contribute to an increased risk of heat illness in the summer (NHK, 2020). An increase in the number of heat illness-related emergency transfers and visits to medical institutions could place additional burdens on medical institutions dealing with new coronavirus infections.

In this study, we analyzed data on the number of people transported to emergency departments due to heat illness by prefecture in 2020 during the COVID-19 pandemic, which were compared with that in previous years to see the possible change in the heat illness risk in the ‘new normal’, where the wearing of masks as a measure against COVID-19 has become the norm. With no end to the COVID-19 pandemic in sight, this study will be useful for examining advanced countermeasures against heat illness and the burden of heat illness on the emergency medical system from next year onward.

2. Methods

We obtained the daily number of emergency transportations due to heat illness (diagnosed in the emergency departments) from 2008 to 2020 from the Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications, Japan (Fire and Disaster Management Agency, n.d.). The diagnoses made for patients following emergency transportation for heat illness was not a definitive diagnosis, but the expert opinion of the physician carrying out initial examinations. A quasi-Poisson regression was used to estimate the expected weekly number of emergency transportations from heat illness, with adjustment for their long-term trend and the weather conditions, including temperatures. We found that, at the national level, the number of heat illness emergency transports did not significantly increase or decrease from the annual trend in 2020. By prefecture, on the other hand, there were some prefectures in which the number of heat illness emergency transports was less than the average year, and most of them were in the week of August 10–16. By age group, the number of heat illness emergency transports in the 0–17 and 18–64 age groups was particularly low in some prefectures, and by severity, those in mild cases was particularly low. A caution is necessary that there is a possibility that a decrease in cases possibly associated with COVID-19 measures, such as, outdoor activity restrictions at schools/universities and cancellation of public events, may offset the possible increase in heat illness cases occurring elsewhere associated with wearing masks. Given that the end of the COVID-19 pandemic is not expected yet, continuous and appropriate awareness-raising activities to prevent heat-related illness remain important.
Figs. 1 and 2, respectively, and their exact values in 2020 are provided in Table 1.

By prefecture, as a whole, there were no weeks in 2020 where the number of observed emergency transportations exceeded the 95% upper bound in all 47 prefectures. On the other hand, weeks where the number of observed emergency transportations fell below the 95% lower bound were observed in 14 prefectures, most of which were in the week of August 10–16 (Supplementary fig. 1).

By age group, the number of observed emergency transportations exceeding the 95% upper bound was observed only in the week of August 23–30 in Aomori Prefecture in the children and adolescents group (excess transportations 3–25; percent excess 11.85–111.86) (Supplementary fig. 2). On the other hand, weeks with the number of observed transportations below the 95% lower bound was observed in 15 prefectures in the children and adolescents group and in 16 prefectures in the working age adults group, while those were observed in only three prefectures in the older adults group. They were most common in all groups during the week of August 10–16. Weekly observed and excess and exiguous number of emergency transportations due to heat illness in 2020 for all and by age group and severity level are presented in Supplementary table 1.

Furthermore, by severity level, the observed number of emergency transportations in excess of the 95% upper bound was observed only in the week of August 23–30 in Toyama Prefecture for the mild level (excess transportations 4–44; percent excess 5.90–78.73) (Supplementary fig. 2). For moderate levels, they were found in the week of July 20–26 in Wakayama and Ehime Prefectures (1–12; 6.59–163.91, and 1–17; 3.46–141.28, respectively), and for severe levels in the week of July 13–19 in Kyoto Prefecture (1–2; 86.58–1272.59) and in the week of July 20–26 in Tottori Prefecture (1–2; 136.38–1180.29). On the other hand, the number of observed emergency transportations fell below the 95% lower bound in 15 prefectures in the mild level, three prefectures in the moderate level, and five prefectures in the severe level. They were most frequently observed during the week of September 1–6 at moderate levels, and during the week of August 10–16 at mild and severe levels.

4. Discussion

We found that, at the national level, the number of heat illness emergency transports did not significantly increase or decrease from the annual trend in 2020. By prefecture, on the other hand, there were some prefectures in which the number of heat illness emergency transports was less than the average year, and most of them were in the week of August 10–16. By age group, the number of heat illness emergency transports in the 0–17 and 18–64 age groups was particularly low in some prefectures, and by severity, those in mild cases was particularly low. This means that the cause and place of heat illness occurrence have changed in some prefectures since the COVID-19 pandemic, especially among children and adolescents as well as for moderate cases.

The results of this study suggest that while there is no statistical evidence suggesting a change in the number of emergency transportations due to heat illness in the ‘new normal’ in which the wearing of masks as a measure against COVID-19 has become the norm, subgroup-specific numbers were sometimes less than previous years. In particular, the decline in children and adolescents in August—the summer vacation season in Japan—might be partially due to cancellation or postponement of various public events (such as cultural, sports and festivals) associated with the COVID-19 epidemic and/or restrictions on outdoor activities at schools/universities, including school club activities. Indeed, the proportion of heat illness cases occurring indoors in public places in August was 8.62%, 9.65% and 9.43% between 2017 and 2019, respectively, compared with 6.98% in 2020; and those occurring outdoors in public places accounted for 13.16%, 13.96% and 11.63%, respectively, between 2017 and 2019, compared with 9.58% in 2020 (Fire and Disaster Management Agency, n.d.). In addition, those at educational facilities were 7.05%, 6.41%, 5.19%, and 4.38% for 2017–2020, respectively (Fire and Disaster Management Agency, n.d.). Data on human mobility patterns, which are affected by social distancing and other public health measures during the COVID-19 pandemic, if taken into account in our analytical models, could further support this interpretation, but unfortunately there are no such data available that have been monitored over the long term prior to the pandemic and could be included in the models.

Cancellation of sporting and traditional events due to COVID-19 countermeasures may have revealed a very significant heat illness risk for children and working generations, which is evident from the significant reduction in heat illness related transportations in these age groups in one specific week in August. The number of heat illness patients transported to emergency departments has been on an upward trend every year (Supplementary table 2), and the results of this study suggest that in this warming trend the practice of holding sporting

---

**Fig. 1.** Weekly observed and 95% upper and lower bound of the expected weekly number of emergency transportations due to heat illness in Japan from 2017 to 2020. Gray: observed; Black: expected; Red: upper bound; Blue: lower bound; circle symbols indicate weeks with the observed exceeding or falling the 95% upper or lower bounds. Note that the timeline connects July to September of each year, and the week is based on the epidemiological week of the National Institute of Infectious Diseases’ Infectious Diseases Weekly Report (National Institute of Infectious Diseases, n.d.). The dates shown are the first date of each year based on the epidemiological week.
and cultural events in the middle of summer may carry a large toll of avoidable heat illness. As Japan continues to warm, this toll is likely to grow and suggests the need to mitigate the health consequences of holding various summer events at the same time every year in accordance with tradition. Municipalities, schools and community organizations in Japan may need to consider taking measures to reduce this toll, including staggering the holding time to earlier or later in summer.

A point to be noted in the interpretation of this analysis is that the decrease in the number of heat illness in public places due to the self-restraint of public events, etc. or at schools, as mentioned above, may offset the possible increase in heat illness cases in other places due to the thorough wearing of masks (Yokobori, 2020; Johnson, 2016; Samannan et al., 2020), and as a whole, the excess may not be observed. In fact, the incidence on public roads such as general roads and sidewalks between July and September may have increased in 2020: 13.17%, 13.19%, the incidence on public roads such as general roads and sidewalks be-
tween July and September may have increased in 2020: 13.17%, 13.19%,
set the possible increase in heat illness cases in other places due to the
restraint of public events, etc. or at schools, as mentioned above, may off-
crease in the number of heat illness in public places due to the self-

There was concern about increasing risks of heat-related illness at home among the elderly, as maintenance of essential health services be-
came challenging in Japan due to the COVID-19 pandemic (Han et al., 2020; World Health Organization, 2020). Interrupted access to outpatient long-term day care, short-stay admission services, home-visit long-term care, home-visit nursing, etc., may have resulted in older people spending more time at home, making their health worse (Japan Federation of Kaigo Business Providers, 2020). In this context, it is worth noting that the number of heat illness emergency transports among the older adults group did not significantly increase this summer. However, efforts to improve the behavior and knowledge of elderly people to prevent heat-related illness remain important, such as use of air conditioners at night, adequate fluid intake, reduced summer activities, use of hats and parasols, etc., through heat-health warnings and targeted interventions (Takahashi et al., 2015).

Other limitations of our study include that there was no data aggregated by both age group and severity level. Under the COVID–19 pandemic, identifying the risk of heat illness by severity and age (and additionally, by location) can provide important policy lessons. In addition, the heat illness cases analyzed in this study are only those transported to emergency departments and do not include cases in which patients visited the hospital or clinic in person, complained of feeling ill, and were diagnosed with heat illness. However, they are very different in terms of clinical severity and we do not believe that this limitation is significant enough to affect the implications of this study.

5. Conclusions

The ‘new normal’ which requires thorough mask wearing for preventing COVID-19 infection was introduced in Japan. While there is no statistical evidence suggesting a change in the number of emergency transportsations due to heat illness in the summer of 2020, subgroup-specific numbers were sometimes less than previous years. It should be noted that the decrease in the cases possibly associated with COVID-19 measures, such as, outdoor activity restrictions at schools/universities and cancellation of public events, may offset the possible increase in heat illness cases occurring elsewhere associated with wearing masks. Since the burden on the health system is still increasing due to the COVID-19 response and there has been an annual upward trend in
| Week ending date | Observed | Excess | Percent excess | Exiguous | Percent deficit |
|-----------------|----------|--------|----------------|-----------|----------------|
| All             | 12-Jul   | 994    | 0.00           | 0.00      | 0.00           |
|                 | 19-Jul   | 1337   | 0.00           | 0.00      | 0.00           |
|                 | 26-Jul   | 3073   | 0.00           | 0.00      | 0.00           |
|                 | 2-Aug    | 3426   | 0.00           | 0.00      | 0.00           |
|                 | 9-Aug    | 6664   | 0.00           | 0.00      | 0.00           |
|                 | 16-Aug   | 12804  | 0.00           | 0.00      | 0.00           |
|                 | 23-Aug   | 12799  | 0.00           | 0.00      | 0.00           |
|                 | 30-Aug   | 12080  | 0.00           | 0.00      | 0.00           |
|                 | 6-Sep    | 4331   | 0.00           | 0.00      | 0.00           |
|                 | 13-Sep   | 2453   | 0.00           | 0.00      | 0.00           |
|                 | 20-Sep   | 690    | 0.00           | 0.00      | 0.00           |
|                 | 27-Sep   | 228    | 0.00           | 0.00      | 0.00           |
| Children and adolescents, aged 0–17 | 12-Jul | 100 | 0.00 | 0.00 | 0.00 |
|                 | 19-Jul   | 193    | 0.00           | 0.00      | 0.00           |
|                 | 26-Jul   | 253    | 0.00           | 0.00      | 0.00           |
|                 | 2-Aug    | 309    | 0.00           | 0.00      | 0.00           |
|                 | 9-Aug    | 604    | 0.00           | 0.00      | 0.00           |
|                 | 16-Aug   | 903    | 0.00           | 0.00      | 0.00           |
|                 | 23-Aug   | 811    | 0.00           | 0.00      | 0.00           |
|                 | 30-Aug   | 1242   | 0.00           | 0.00      | 0.00           |
|                 | 6-Sep    | 487    | 0.00           | 0.00      | 0.00           |
|                 | 13-Sep   | 293    | 0.00           | 0.00      | 0.00           |
|                 | 20-Sep   | 120    | 0.00           | 0.00      | 0.00           |
|                 | 27-Sep   | 34     | 0.00           | 0.00      | 0.00           |
| Working age adults, aged 18–64 | 12-Jul | 284 | 0.00 | 0.00 | 0.00 |
|                 | 19-Jul   | 383    | 0.00           | 0.00      | 0.00           |
|                 | 26-Jul   | 984    | 0.00           | 0.00      | 0.00           |
|                 | 2-Aug    | 1163   | 0.00           | 0.00      | 0.00           |
|                 | 9-Aug    | 2224   | 0.00           | 0.00      | 0.00           |
|                 | 16-Aug   | 3987   | 0.00           | 0.00      | 0.00           |
|                 | 23-Aug   | 4908   | 0.121         | 0.00      | 0.00           |
|                 | 30-Aug   | 4117   | 0.00           | 0.00      | 0.00           |
|                 | 6-Sep    | 1425   | 0.00           | 0.00      | 0.00           |
|                 | 13-Sep   | 796    | 0.00           | 0.00      | 0.00           |
|                 | 20-Sep   | 189    | 0.00           | 0.00      | 0.00           |
|                 | 27-Sep   | 66     | 0.00           | 0.00      | 0.00           |
| Older adults, aged 65– | 12-Jul | 610 | 0.00 | 0.00 | 0.00 |
|                 | 19-Jul   | 761    | 0.145         | 0.00      | 0.00           |
|                 | 26-Jul   | 1836   | 0.290         | 0.00      | 0.00           |
|                 | 2-Aug    | 1954   | 0.00           | 0.00      | 0.00           |
|                 | 9-Aug    | 3836   | 0.00           | 0.00      | 0.00           |
|                 | 16-Aug   | 7914   | 0.00           | 0.00      | 0.00           |
|                 | 23-Aug   | 7080   | 0.00           | 0.00      | 0.00           |
|                 | 30-Aug   | 6721   | 0.275         | 0.00      | 0.00           |
|                 | 6-Sep    | 2419   | 0.00           | 0.00      | 0.00           |
|                 | 13-Sep   | 1364   | 0.00           | 0.00      | 0.00           |
|                 | 20-Sep   | 381    | 0.00           | 0.00      | 0.00           |
|                 | 27-Sep   | 128    | 0.00           | 0.00      | 0.00           |
| Mild cases      | 12-Jul   | 612    | 0.00           | 0.00      | 0.00           |
|                 | 19-Jul   | 848    | 0.14          | 0.00      | 0.00           |
|                 | 26-Jul   | 1880   | 0.00           | 0.00      | 0.00           |
|                 | 2-Aug    | 2110   | 0.00           | 0.00      | 0.00           |
|                 | 9-Aug    | 3958   | 0.00           | 0.00      | 0.00           |
|                 | 16-Aug   | 7189   | 0.00           | 0.00      | 0.00           |
|                 | 23-Aug   | 7581   | 0.00           | 0.00      | 0.00           |
|                 | 30-Aug   | 7428   | 0.00           | 0.00      | 0.00           |
|                 | 6-Sep    | 2659   | 0.00           | 0.00      | 0.00           |
|                 | 13-Sep   | 1541   | 0.00           | 0.00      | 0.00           |
|                 | 20-Sep   | 429    | 0.00           | 0.00      | 0.00           |
|                 | 27-Sep   | 152    | 0.00           | 0.00      | 0.00           |
| Moderate cases  | 12-Jul   | 338    | 0.00           | 0.00      | 0.00           |
|                 | 19-Jul   | 429    | 0.80          | 0.00      | 0.00           |
|                 | 26-Jul   | 1062   | 0.148         | 0.00      | 0.00           |
|                 | 2-Aug    | 1174   | 0.00           | 0.00      | 0.00           |
|                 | 9-Aug    | 2430   | 0.00           | 0.00      | 0.00           |
|                 | 16-Aug   | 4922   | 0.00           | 0.00      | 0.00           |
|                 | 23-Aug   | 4632   | 0.148         | 0.00      | 0.00           |
|                 | 30-Aug   | 4238   | 0.239         | 0.00      | 0.00           |
|                 | 6-Sep    | 1534   | 0.00           | 0.00      | 0.00           |
|                 | 13-Sep   | 837    | 0.00           | 0.00      | 0.00           |
|                 | 20-Sep   | 242    | 0.00           | 0.00      | 0.00           |
|                 | 27-Sep   | 65     | 0.00           | 0.00      | 0.00           |
| Severe cases    | 12-Jul   | 29     | 0.00           | 0.00      | 0.00           |

(continued on next page)
the incidence of heat illness in Japan, the risk of heat illness in the summer after next year cannot be underestimated at all. As the end of the COVID-19 pandemic is not expected yet, continuous and appropriate awareness-raising activities are necessary.

Ethics statement

Ethical approval was not required for this secondary analysis of publicly available data.

CRediT authorship contribution statement

Shinya Uryu: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Yuta Tanoue: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Shuhei Nomura: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Kazuki Shimizu: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Stuart Gilmour: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Koji Makiyama: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Yumi Kawamura: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Akifumi Eguchi: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Yumiko Kawamura: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. Haruka Sakamoto: Writing – original draft, Writing – review & editing. Kazuki Shimizu: Writing – original draft, Writing – review & editing. Chris Fook Sheng Ng: Methodology, Software, Validation, Writing – review & editing, Supervision. Masahiro Hashizume: Methodology, Software, Validation, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

Kentaro Matsuura reports personal fees from Chugai Pharmaceutical Co., Ltd., outside the submitted work. All other authors declare no competing interests.

Acknowledgments

The present work was supported in part by a grant from the Ministry of Health, Labour and Welfare of Japan.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2020.144723.

References

Fire and Disaster Management Agency. Heat stroke information – emergency transportation status [Japanese]. (n.d.) https://www.fdma.go.jp/disaster/heatstroke/post1.html (accessed November 2, 2020).

GBD 2019 Risk Factors Collaborators. 2020. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet 396 (10258), 1223–1249.

Han, E., Tan, M.M.J., Turk, E., et al., 2020. Lessons learnt from easing COVID-19 restrictions: an analysis of countries and regions in Asia Pacific and Europe. Lancet 396 (10261), 1525–1534.

Japan Federation of Kaigo Business Providers, 2020. Survey results about the changing financial status under COVID-19 as of the end of March. http://kaiziren.or.jp/wp/wp-content/uploads/2020/04/kinkyusyousa20200422.pdf (accessed November 11, 2020).

Japan Meteorological Agency. Past weather data [Japanese]. (n.d.) https://www.data.jma.go.jp/gmd/risk/obsid/index.php (accessed November 2, 2020).

Johnson, A.T., 2016. Respirator masks protect health but impact performance: a review. J. Biol. Eng. 10, 4.

LINE Corporation. 2020. The 5th National Survey on COVID-19 Measures [Japanese]. https://research-platform.line.me/nationalsurvey/archives/35785304.html?utm_source=lg&utm_medium=link&utm_campaign=covid19_survey. (Accessed 12 November 2020).

Ministry of Health, Labour and Welfare. 2020. Analysis of the response to the Novel Coronavirus (COVID-19) and recommendations (May 4, 2020) [Japanese]. https://www.mhlw.go.jp/content/10900000/000629000.pdf (accessed November 2, 2020).

Ministry of Health, Labour and Welfare. Annual number of deaths from heat stroke by age group (five-year-old) (1995–2018) [Japanese]. (n.d.) https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/teikoku/heatstroke18/d/tnrei.pdf (accessed November 2, 2020).

National Institute of Infectious Diseases. Report week correspondence table. (n.d.) https://www.niid.go.jp/niid/ja/calendar.html. (Accessed August 4 2020).

NHK. 2020. Does wearing a mask increase the risk of heatstroke? https://www3.nhk.or.jp/nhkworld/en/news/backstories/1260/ (accessed November 12, 2020).

Nielsen, J., Mazick, A., Andrews, N., et al., 2013. Pooling European all-cause mortality: methodology and findings for the seasons 2008/2009 to 2010/2011. Epidemiol. Infect. 141 (9), 1996–2010.

Nielsen, J., Krause, T.C., Molbak, K., 2018. Influenza-associated mortality determined from all-cause mortality, Denmark 2010/2016:17: the FluMOMO model. Influenza Other Respir. Viruses 12 (5), 591–604.

Samannan, R., Holt, G., Calderon-Candelario, R., Mirsaeidi, M., Campos, M., 2020. Effect of face masks on gas exchange in healthy persons and patients with COPD. Ann. Am. Thorac. Soc. https://doi.org/10.1513/AnnalsATS.202007-812RL.

Takahashi, N., Nakao, R., Ueda, K., et al., 2015. Community trial on heat related-illness prevention behaviors and knowledge for the elderly. Int. J. Environ. Res. Public Health 12 (3), 3188–3214.

World Health Organization. 2018. Heat and Health. https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health (accessed November 2, 2020).

World Health Organization. 2020. Maintaining essential health services: operational guidance for the COVID-19 context: interim guidance, 1 June 2020. CC BY-NC-SA 3.0 IGO. World Health Organization, Geneva.

Yokobori, S., 2020. Heatstroke management during the COVID-19 epidemic: recommendations from the experts in Japan. Acad. Med. Surg. 7 (1).

Table 1 (continued)

| Week ending date | Observed | Excess | Percent excess | Exiguous | Percent deficit |
|------------------|----------|--------|---------------|----------|----------------|
| 19-Jul           | 37       | 0-19   | 0.00-98.04    | 0-0      | 0.00-0.00      |
| 26-Jul           | 72       | 0-20   | 0.00-38.34    | 0-0      | 0.00-0.00      |
| 2-Aug            | 84       | 0-17   | 0.00-25.36    | 0-0      | 0.00-0.00      |
| 9-Aug            | 190      | 0-21   | 0.00-11.90    | 0-0      | 0.00-0.00      |
| 16-Aug           | 540      | 0-0    | 0.00-0.00     | 0-88     | 0.00-13.95     |
| 23-Aug           | 412      | 0-38   | 0.00-10.05    | 0-0      | 0.00-0.00      |
| 30-Aug           | 270      | 0-0    | 0.00-0.00     | 0-44     | 0.00-13.88     |
| 6-Sep            | 83       | 0-0    | 0.00-0.00     | 0-53     | 0.00-38.82     |
| 13-Sep           | 50       | 0-0    | 0.00-0.00     | 0-14     | 0.00-21.12     |
| 20-Sep           | 9        | 0-0    | 0.00-0.00     | 0-9      | 0.00-48.21     |
| 27-Sep           | 4        | 0-0    | 0.00-0.00     | 0-2      | 0.00-22.70     |

A range for excess/exiguous transportations was obtained from the differences between the observed number of transportations and upper/lower bound of the two-sided 95% prediction interval.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2020.144723.