

## **Title**

Changes in the use of green spaces by citizens before and during the first COVID-19 pandemic: A big data analysis using mobile-tracking GPS data in Kanazawa, Japan

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## **Abstract**

With COVID-19, people have been forced to adapt their behaviors to various social distancing measures set in place worldwide. The restrictions on people's behavior under a state of emergency in Japan were voluntary (a request), not mandatory as in many countries (e.g., China, Europe, and the US). Nevertheless, many people and businesses in Japan complied.

Considering green spaces including parks as valuable green infrastructure that provide various socio-ecological benefits, including health, we aimed to explore how people's outing behaviors changed before and during the first emergency declaration in Kanazawa, Japan. We were particularly interested in investigating how the use of green spaces may have changed during the COVID-19 pandemic.

The study area, Kanazawa City in Ishikawa Prefecture, is a regional city facing the Sea of Japan with many green spaces. We used locational data of over 5,000 mobile phones of Kanazawa citizens, covering 15 days each from May 1 to 15 in 2019 and 2020, to quantitatively analyze changes in activity including the use of green spaces.

The results showed that the declaration of a state of emergency in April-May 2020 changed the outing behavior of Kanazawa citizens, and there was a strong tendency for them to avoid going out, with a decrease in the number, time, and distance of outings. On the other hand, while the citizens refrained from going out, the rate of decrease in the number of visits to green spaces was smaller compared to commercial areas, and the number of walks increased slightly from 2019. The distance traveled to green spaces was generally shorter in 2020 and the number of visits to green spaces near one's home (within

1000 m) increased in 2020. These findings suggest that those who have green spaces around their homes were able to use them for maintaining their health and refreshment during the COVID-19 pandemic, adding to the increasing evidence for the value of urban green spaces as part of nature-based solutions.

**Keywords:** Behavioral change, COVID-19, Green space, Public health, GPS data