

[Short Report]

Secondhand Smoke from a Veranda Spreading to Neighboring Households

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Abstract : Secondhand smoke (SHS) caused by smoking on apartment verandas is a severe social problem in Japan. If someone smokes on a veranda, SHS drifts into other residents' rooms through their windows. Most non-smoking residents are annoyed by this, but they do not confront the person responsible. To study this situation, we burned cigarettes and measured the spread of SHS in terms of fine particle (PM_{2.5}) concentrations. Cigarette smoke generated on a lower veranda spread to upper and horizontal neighboring verandas and into rooms through windows, reaching a maximum concentration of 139 µg/m³. The Health Promotion Act that was revised in 2018 and enacted in 2019–2020 requires all smokers to avoid producing SHS, even outdoors and at home. It is expected that combining the measurement of SHS from verandas to other verandas and rooms with the revised Health Promotion Act could create a national consensus on “no smoking on apartment verandas.”

Keywords : secondhand smoke, PM_{2.5}, Health Promotion Act, apartment house.

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Introduction

Tobacco control in Japan is still behind the world standard in almost all respects, particularly in terms of protecting non-smokers from secondhand smoke (SHS). The Japanese government revised the Health Promotion Act in 2018, aiming to eliminate “unwanted” SHS [1]. This Act was enacted in three stages. First, starting in January 2019, smokers had to be aware of their surroundings when smoking outdoors and at home. Secondly, starting in July 2019, schools, universities, and government and municipal offices had to implement a total ban on smoking on the premises (designated outdoor smoking areas/rooms are al-

lowed). Thirdly, as of April 2020, smoking became prohibited inside private businesses, including restaurants and bars (designated smoking rooms are allowed). The countermeasures against SHS in public places have been gradually improving in Japan.

On the other hand, SHS in private situations is another problem, especially smoking on apartment verandas. Non-smokers who live in apartment houses complain about the smell of tobacco smoke, but it is difficult to confront the person responsible because of the risk of trouble starting. This problem attracted social attention in 2020 because of remote work and the government's request that people stay home due to COVID-19. Smokers started spending longer hours at

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home and the consumption of cigarettes on verandas increased.

We measured the concentration of tobacco smoke that spread from a lower veranda to upper and horizontal neighboring verandas, and to the inside of rooms. Our purpose was to obtain objective data on SHS spreading from verandas to other households and explore the likelihood of public opinion shifting to support “no smoking on apartment verandas.”

Materials and Methods

Experimental measurement was done using the second and the third floors of a typical 3-floor apartment house (Figure 1) in October 2015. We used five digital dust monitors (TSI, Sidepak, AM510). Figure 2 shows the situation of the measurement in a typical apartment house in Japan. Five dust monitors were set up, as



Figure 1. External appearance of the apartment and the five measurement points of fine particulate matter ($PM_{2.5}$).

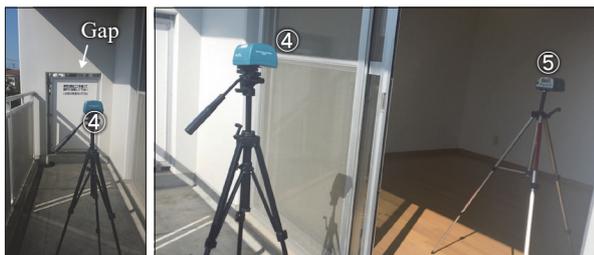


Figure 2. Measurement of $PM_{2.5}$ on the neighboring veranda and inside the room on the same floor.

follows:

- ① : Veranda where cigarettes were burned
- ② : Veranda of the upper floor
- ③ : Inside of the upper room
- ④ : Neighboring veranda on the same floor
- ⑤ : Inside of the neighboring room on the same floor

The weather was clear and a weak breeze blew toward the apartment. A total of 5 cigarettes were continuously lit one by one and a side-stream of smoke was generated by a researcher wearing personal protective equipment. The concentration of fine particulate matter ($PM_{2.5}$) was simultaneously measured at the five points.

Results

Before the experiment, the ambient $PM_{2.5}$ concentration was 7 to 12 $\mu\text{g}/\text{m}^3$, which is categorized as “good” according to the Air Quality Index by the U.S. Environmental Protection Agency [2]. Then, 5 cigarettes were continuously lit one by one from 9:55 to 10:23. Figure 3A shows the $PM_{2.5}$ concentrations on the veranda where the cigarettes were burned (dust monitor ①), the veranda on the upper floor (dust monitor ②), and inside an upper room (dust monitor ③) with open windows. $PM_{2.5}$ spread to the upper veranda, then inside the room. The peak of $PM_{2.5}$ was 89 $\mu\text{g}/\text{m}^3$ at 10:13 on the upper veranda. Every time the authors sensed the smell of cigarette, the concentration of $PM_{2.5}$ had increased.

Figure 3B shows the spread of cigarette smoke from the veranda where the cigarettes were burned (dust monitor ①) to the neighboring veranda on the same floor (dust monitor ④) and inside the room (dust monitor ⑤) with open windows. It was also confirmed that cigarette smoke spread horizontally with a peak $PM_{2.5}$ of 139 $\mu\text{g}/\text{m}^3$ at 9:58.

Discussion

The problem of SHS in apartments has been argued about for decades, especially in developed countries, prompting some cities to implement smoke-free policies for apartments [2–4]. The same social trend also appeared in Japan. The health risks of SHS became common knowledge in the late 1990s. As the Health

Promotion Act (2003) required the managers of all facilities to take effective countermeasures against SHS, indoor smoking became prohibited in most public places and private offices, except in designated smoking rooms. This trend also spread to private homes. Smokers (mostly husbands) became forced to smoke outside in order to protect their family members. Many smokers started to smoke on apartment verandas, and they are sometimes called *hotaru-zoku* (firefly persons). In this way, veranda smokers cause trouble for neighboring residents, a problem often appears in the news media. In 2012, the district court of Nagoya made an order of compensation of 50,000 yen (approximately US\$ 500) for damages caused by SHS from the lower floor to upper neighboring residents.

It is easy to understand that cigarette smoke spreads from the lower veranda to the upper veranda, as shown in Figure 3A, but, importantly, cigarette smoke also

spreads horizontally to the same floor (Figure 3B). Verandas of apartments are evacuation passages. The separation between verandas consists of an easily-broken board so that there is a gap around the board, as shown in Figure 2. In this study, we considered that the cigarette smoke congested in the space of the veranda spread to the neighboring verandas through the gap around the evacuation-board when the weak wind blew toward the apartment. The reason for the higher concentrations inside the room than on the veranda (Figure 3B) could be explained as the smoke spreading through the gap and moving along the wall then into the room on the weak wind that was blown toward the apartment.

Recently, some apartment houses have prohibited smoking on verandas, but this is rare and most non-smokers living in apartments still suffer from SHS. Since January 2019, the revised Health Promotion

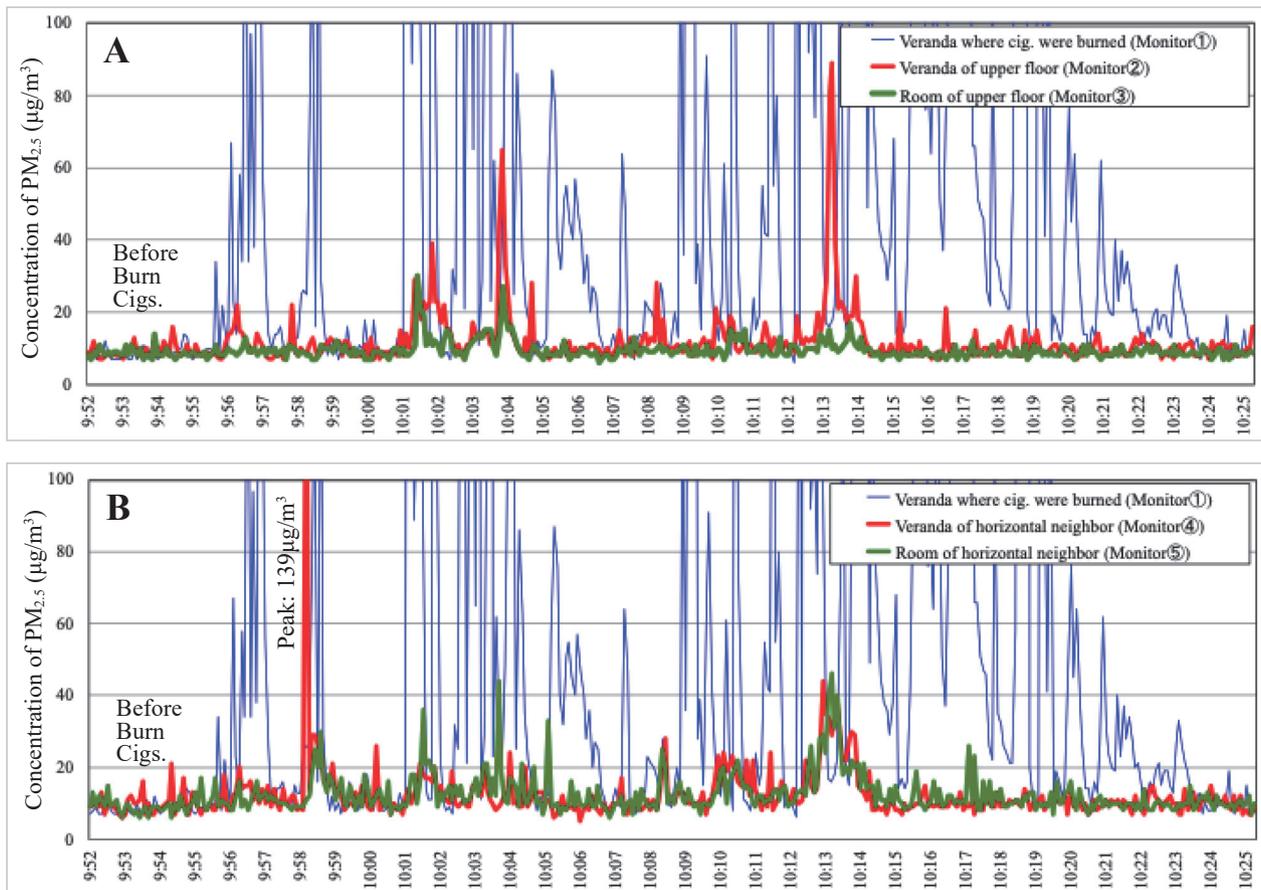


Figure 3. A: Spread of cigarette smoke from the veranda where cigarettes were burned to upper veranda and inside the room. **B:** Neighbor veranda and inside the room on the same floor. Cigs: cigarettes

Act has required all smokers to reduce SHS, even outdoors. Basically, the veranda of an apartment is a common space for all of the residents of the building, and it is prohibited to do anything that bothers other residents. A combination of the revised Health Promotion Act and the objective data in this study may be able to create a national consensus on “no smoking on apartment verandas.”

Finally, it is expected that attempts to quit smoking could increase because smokers will not be able to smoke in public or private places.

Conclusions

We measured the spread of SHS in terms of the concentration of PM_{2.5}. Cigarette smoke generated on a veranda spread to horizontal and upper neighboring verandas and then to rooms through windows. Apartment verandas are a common space for all of the residents. We should create a national consensus on “no smoking on apartment verandas.”

Conflicts of Interest

The authors declare no conflicts of interest.

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