A Study on Public Environmental Risk Perception and Environmental Behavior of Urban Space - A Case Study of the East District of Taichung City

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Abstract. The contemporary living environment in Taiwan is affected by traffic, industry, and seasonal air pollution. Wearing masks outside the home environment has become a daily habit for a number of people. The Taiwanese government encourages people to wear masks when using the mass transit system and in public spaces, to impose social distancing, and prohibits large-scale activities to reduce exposure to environmental risks after the outbreak of COVID-19. By April 13th 2020, no new local cases of COVID-19 had been reported for more than 30 consecutive days. This study examines open and semi-open spaces using non-participatory observation method to understand public mask-wearing of environmental behavior. The results of the study show that the proportion of people wearing masks in open spaces is only 16.8%, and that the proportion of those wearing masks in semi-open spaces is 61.1%. This shows that the public continues to maintain a cautious attitude towards COVID-19 and that their perception of the environmental risks and environmental behavior differs across different spatial environments.

1. Introduction

1.1. Research background and purpose
In November 2019, a new form of pneumonia broke out in Wuhan, China. This disease was later named as the "COVID-19", which was caused by a novel coronavirus that spread rapidly across the world and led to the closure of Wuhan on January 23rd, 2020. On January 21st, 2020, the first confirmed case of COVID-19 appeared in Taiwan in a female Taiwanese businesswoman who returned to Taiwan from Wuhan. According to the World Health Organization (WHO) announcement, common symptoms of the new coronavirus include fever, cough, fatigue, sputum production, smell and taste abnormalities, and diarrhea [1]. The incubation period between infection and presentation of symptoms is up to 2 weeks. This led governments to impose restriction, announce social distancing measures, ban large-scale gatherings, and restrict other activities.

The Taiwan Centers for Disease Control believes that wearing masks can reduce the risk of infection. As a result, it lists masks as anti-epidemic materials, allows the public to purchase 9 pieces of masks every two weeks, and regulates the use of masks on public transportation systems. As of June 1st 2020, by which time the spread of the epidemic had been controlled for more than 4 months, there were 443 confirmed cases of COVID-19 in Taiwan [2]. Since April 13th, there have been no new local cases in Taiwan, but the situation in Europe, the United States, Brazil and Russia remains precarious. This could potentially trigger a second wave of infection, and means that epidemic prevention unit must continue in its efforts to control the spread of infection. The question as to whether the public will...
lower their awareness of environmental risks as the epidemic slows remains unanswered at present. This study aims to address this question through its focus on the wearing of masks. Mask-related research focuses on topics such as mask comfort, design, materials, and tightness (Li, 2019; Hung, 2018) [3-4], but no relevant information is currently available about the mask in environmental spaces and on behavior in public environments. Research on environmental risk perception mainly discusses public facilities and neighboring facilities (Wu, 2014; Chao, 2019) [5-6], and public awareness and attitude towards environmental risks. Research focusing on the behavior of people wearing masks in different environmental spaces and for different activities is rarely discussed. This study focuses on the cognitive behavior associated with wearing masks in different environmental spaces. Before it is not clear of environmental risk of associated with COVID-19 and over 30 days there is no confirmed local case, the purpose is to find out whether people change their behaviors when they precept environmental risks. Non-participant observation was used to explore the behavior of people wearing masks in the open (park) and semi-open (market) spaces of people in the east district of Taichung City.

1.2. Research scope and basic information
The population of the East District of Taichung City is 75,878 (May 2020). The population density is 8,123 (person/km²). Major sources of employment are industry (manufacturing) and the service industry (wholesale and retail) [7]. The geographic scope of the research is shown in Figure 1.

![Figure 1. Location map of Taichung East District.](image)

2. Literature review
2.1. Definition of environmental risk perception
Risk forms a part of our lives and cannot be completely avoided. Therefore, everyone must face degree of unknown risk that they must estimate at some point during the course of their lives (Franklin, 1998) [9]. Risk refers to the opportunity and strength of using the effect of balance, or to describe the probability and consequences of harmful results (Lowrance, 1980) [10]. Flin et al. (1996) pointed out that risk perception refers to the fact that human beings may assess risks in daily life, not by rational and scientific methods, but by subjective quantitative assessment and by engaging in various activities based on their perceived results [11]. Many studies argue that risk perception refers to an individual's subjective evaluation and attitude to risk, as based on their understanding of risk (Wang, 2004) [12].

2.2. Definition of environmental behavior
Hungerford et al. (1985) defined the environmental behavior as an individual or group's attempt to solve a certain environmental problem [13]. Zhang (2006) showed that environmental behavior is that people have some basic patterns in order to interact with the environment, or react to the environment (Chen, 2006) [14-15].

3. Method
In light of the characteristics of the research theme, non-participant observation was the method utilized in order to conduct the research (Chang et al. 2013; Wang et al., 2014) [16-17]. Data collection involved making on-site observation records and photography and focused on whether the behavior of mask-wearers varied when entering the different spaces and whether differences could be observed in terms of age or gender.

3.1. Research object, time and field
The study was undertaken to observe mask-wearing behavior according to genders (male, female) and age group (0-17 years old, 18-64 years old and over 65 years old). Observations were undertaken on May 17th 2020, and each site was observed for an hour. Three spaces were chosen as case-study sites in the East District of Taichung City. These consisted of an open space (Lecheng Park) and two semi-open spaces (SunKong Twilight Market and Jianguo Market). Field observations were made of the behaviors of people wearing masks when entering these different spaces. Photographs were also taken of each of the scene spaces, as shown in Figure 2.

![Lecheng Park, SunKong Twilight Market, Jianguo Market](image)

**Figure 2.** Photos of the field observation case study sites.

3.2 Observation and recording method
Observations made for the purposes of the study were recorded on a pre-made record form where it was noted whether people entering the observations sites wore masks or not, what their gender was, and what age category they represented.

4. Result and discussion
Observations were made in three locations and the total number of observations made was of 1,065 people. The overall rate of those wearing masks was 45.66%. The number of people observed at Lecheng Park was 201, where the percentage of those wearing masks was 15.57%. This was an open outdoor space, where the degree of social distancing between people was relatively farther, and where mask wearing was affected by type of activity. The perception of environmental risks was low, and the mentality was also relaxed. The rate of mask-wearing amongst those under the age of 18 was only 5.66%. However, their mask-wearing behavior changed according to which spatial environment they were in; whether they were using children's playground equipment or engaging in chasing and running activities. The rate of mask-wearing for young and middle-aged people was 24.39%. The field observations showed that the rate of mask-wearing when engaging in walking and chatting activities was higher than the rate of mask-wearing for jogging. The number of people observed in the Shin Kong Twilight Market was 471 and the overall rate of mask-wearing was 58.81%, showing that in semi-open spaces, the public appeared to have a greater awareness of the environmental risks associated with COVID-19. More than 63.35% of young people wore masks. In densely populated areas, awareness and behavior is affected by government policy announcements and news reports about the epidemic. Self-protection awareness is high, and the distance between people is affected by environment behavior and environmental space. The number of people observed in the Jianguo Market, which is also a semi-open space, was 393. The rate of mask-wearing was 62.61%, and the overall rate of wearing masks exceeded 50%. The rate of female mask-wearing was higher than males, regardless of age. The site observations revealed that male smoking or eating betel nuts affected rates of mask-
wearing. These results correspond with the findings of the Taiwan Centers for Disease Control [18]. Mask-wearing behavior of minors was found to be affected by the behaviors of parents and seniors. When minors were observed to be wearing masks, their peers also wore masks. The locations and mask records are shown in Table 1.

| Age groups (Mask wearing) | Location | Lecheng Park | SunKong Twilight Market | Jianguo Market |
|---------------------------|----------|--------------|-------------------------|---------------|
| Age 0-17 (male) | Yes | 1 | 11 | 8 |
| No | 28 | 9 | 6 |
| Age 0-17 (female) | Yes | 2 | 16 | 3 |
| No | 22 | 10 | 3 |
| Mask-wearing ratio | 5.66\% | 58.70\% | 55.00\% |
| Age 18-64 (male) | Yes | 8 | 60 | 51 |
| No | 32 | 63 | 48 |
| Age 18-64 (female) | Yes | 12 | 144 | 118 |
| No | 30 | 55 | 47 |
| Mask-wearing ratio | 24.39\% | 63.35\% | 64.02\% |
| Age over 65 (male) | Yes | 3 | 18 | 25 |
| No | 32 | 28 | 22 |
| Age over 65 (female) | Yes | 8 | 38 | 50 |
| No | 23 | 19 | 12 |
| Mask-wearing ratio | 16.67\% | 54.37\% | 68.81\% |
| Subtotal | | 201 | 471 | 393 |
| Overall mask wearing rate | 15.57\% | 58.81\% | 62.61\% |

This study observes people’s environmental behaviors and perceptions of environmental risks from open and semi-open spaces, and the ratio of people wearing masks can show that because of the epidemic situation, for places with close contact and dense crowds, due to the increase in environmental risk awareness. This in turn affects their behavior of wearing masks to improve self-protection and reduce the risk of infection; however, in open space activities, people are far away from each other, and the air is relatively circulated, and the probability of hand contact with other things is low, and the awareness of environmental risks is reduced, which makes the rate of wearing masks much lower. The public's awareness of risks in different environmental spaces affects their environmental behavior in different spaces. In the context of post-COVID-19 environmental time and space, when it is necessary to travel to a more confined or human contact environment, personal epidemic prevention measures will also be improved to reduce the risk of infection.

5. Conclusion

When a new coronavirus case occurred in Taiwan, the anti-epidemic task force announcements began impose the wearing of masks, use of disinfectant, and frequent hand washing. National policies were announced to increase the production of masks so that the public can purchase a fixed number of masks per week to reduce rates of virus infection. The ongoing epidemic situation abroad and the high risk of a second wave of infection remains. Although no local cases have occurred in Taiwan for over a month, the Taiwan Centers for Disease Control continues to inform the publics to be alert and to continue with epidemic prevention activities. This study is based on field observation records of open and semi-open spaces. The study found that in the open (15.57\%) and semi-open (60.71\%) spaces, the mask wearing rate suggested that people continue to maintain awareness of the risks associated with COVID-19 transmission in different spatial environments. Wearing a mask to reduce the risk of infection remains a daily habit. To enable Taiwan to avoid and reduce the occurrence of community infections, government policy advocacy and public cooperation are indispensable for the maintenance of epidemic prevention activities.
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