Public Risk Perception and Response to Air Pollution

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Abstract. In recent years, as people pay more and more attention to environmental quality, many environmental problems have gradually become the focus of people's concern, especially those with greater risks. Air pollution is one of the major risk factors of death worldwide and is also the cause of the increased risk of chronic diseases. Therefore, the purpose of this paper is to understand the correlation between factors affecting air pollution risk perception and the level of risk perception, and whether they can affect coping behaviour. The results showed that among the demographic variables, only marital status and average monthly income were correlated with air pollution risk perception. In addition, the public satisfaction with the air pollution to the air of the negative correlation between perceived risk, and air pollution information knowledge and the positive correlation between perceived risk of air pollution, can confirm air satisfaction and understanding information about air pollution caused by the risk perception of people have a certain influence, and in the case of the higher the risk perception could prompt them to take more coping behaviour, such as wearing a mask, avoid being outdoors for a long time, and so on.

1. Introduction
Taiwan is no exception that air pollution is a growing global concern. With the emergence of the "anti-air pollution movement" in Taiwan in 2010, the discussion and attention of air pollution issues in Taiwan were further expanded and spread, which not only brought people's perception and understanding of air pollution, but also led to the revision of the air pollution law by government departments. Therefore, the air pollution policy became one of the key projects of national governance. In addition, more than 50 percent of Taiwan's public are basically dissatisfied with air quality, according to a 2016 survey conducted by foresight magazine. What is most noteworthy is that, according to the monitoring data, although the air quality in south central Taiwan is generally poor, the people in the central region are the most pessimistic in Taiwan, with over 70% of the people expressing bad views on the air quality in the next three years.

In such a low degree of environmental satisfaction, Health Belief Model (HBM) was used in this study to explore the Risk perception of people in central Taiwan towards air pollution, the influencing factors of air pollution perception, and whether their response to air pollution is relevant.

2. Literature review

2.1. Air pollution and environmental behavior
Air pollution is an environmental health issue of great concern, and many studies have shown that exposure to air pollution has adverse effects on human health. Based on past empirical studies, the
World Health Organization (WHO) declared outdoor air pollution to be the primary environmental factor and the primary human carcinogen of cancer death [1], which means that there is sufficient evidence that exposure to outdoor air pollution will increase the risk of cancer. In the past, many environmental behaviour studies have shown that people's environmental cognition and attitude can produce different instinctive needs and activity patterns. Environmental cognition is based on the understanding of the environment, while attitude can be reflected through people's feelings on environmental problems. In addition, according to the health belief model, people's perceived vulnerability and severity, as well as determinants such as the benefits of follow-up actions, may lead to changes in their intentions and behaviour. Based on the above research, people's response behaviour and motivation in air pollution environment may depend on their assessment of the threat of air pollution (risk perception). These assessments reflect people's basic attitudes about air pollution and thus determine their response.

2.2. Air pollution risk perception and its factors
Risk perception is about the characteristics of the Risk and severity of subjective judgment, and often used to evaluate the threat of natural disasters and environmental or health, it mainly has three dimensions, the sense of possibility, the possibility of a person could imperil), perceived susceptibility (individual vulnerability to hazards organization) and perceived severity (hazard may cause damage) [2]. Health belief model is regarded as the derivation of risk perception, which is mainly composed of three factors, including:

2.2.1. Self-efficacy. It includes perceived susceptibility, perceived severity, perceived benefits and perceived behavioral impairment, which may affect the individual's perception of the threat of the disease.

2.2.2. Cues to action. The factors that contribute to people's ability to take preventive measures (e.g. mass media, advice from others, postcard reminders from health care workers, illness of family members or friends, newspaper and magazine reports, etc.)

2.2.3. Modifying variables. Demography (age, gender, race, place of origin), psychosocial (personality, social class, peer pressure, reference group), structure (knowledge of the disease, whether or not you have suffered from the disease).
Such as Canada in 2012 by the health belief model construction factors influencing the AQHI USES and health behavior of cross sectional investigation and study, found that demographic variables (gender, age, education level, and residential area), knowledge and personal risk perception (the health effects of air quality) as if people refer to adopt air quality important predictors of health index [3]. Based on the above theories, this study can infer that people's risk perception of air pollution may have a certain degree of correlation with correction factors such as personal background attributes, and explain the possibility of Health Belief Model (HBM) being applied to environmental behavior. Therefore, this study will explore whether there is a certain degree of correlation between behavioral modification factors and action clues or intentions on the risk perception of air pollution.

3. Research methods
This study was based on the structure of health belief model and the components of environmental risk perception identified after the above literature review. The design of the measurement items of each latent variable refers to the measurement items [4] and the environmental behavior measurement items [5] related to the perceived risk and coping behavior of air pollution in the past, and takes into consideration the current focus of public attention on air pollution and various protective measures taken based on the actual situation of Taiwan. For example, the perceived risk of air pollution is mainly evaluated from the aspects of severity, susceptibility and correlation, while the coping behaviors of air pollution include wearing masks, reducing outdoor activities, planting green plants, opening air purifiers indoors, and persuading others to take protective measures.
This study was conducted by means of electronic questionnaire. The target sample included residents of different ages living in central Taiwan. In order to investigate the public's perception of air pollution and environmental behavior, whether it is related to personal basic background information, the way of receiving information about air pollution, their living habits and health conditions. The questionnaire was constructed from three major factors of health belief model (individual cognition, action clue or intention, behavior modification factor), which were divided into five aspects and involved 21 specific items (see table 1). The "air pollution risk perception" as an individual cognitive said, "information receiving" of air pollution as clues or intention of action factor, the "personal information", "itself, living habits and health" as a gesture of behavior modification factors, while "behavioral response for air pollution" as the basis of action. In order to measure the degree of air quality satisfaction and air pollution risk perception, likert-style five-point scale was used for the questions. The low level (1) indicated "strongly disagree" and the high level (5) indicated "strongly agree". All the questions were scored positively. After the questionnaire was collected, SPSS software was used as the data analysis tool. The main statistical methods used in this study include descriptive statistical analysis, bivariate analysis and linear regression analysis.

Table 1. Independent variables and survey question.

| Five Title                        | Survey Questions                                                                 |
|----------------------------------|---------------------------------------------------------------------------------|
| Personal Information             | 1-1 gender, 1-2 marital status, 1-3 age, 1-4 education, 1-5 working environment, 1-6 average monthly income, 1-7 air quality satisfaction 1-8 understanding of air pollution information. |
| Habits and health conditions     | 2-1 Do you often exercise in outdoor space? , 2-2 Does your body condition respond to air pollution? , 2-3 Do you think air pollution has affected your health? |
| Reception of air pollution       | 3-1 How do you usually know the quality of air quality? 3-2 Would you take the initiative to share air pollution information? |
| Risk perception of air pollution | 4-1 I am concerned about air pollution, 4-2 I think the air pollution problem is very serious, 4-3 I think air pollution may be harmful to health, 4-4 I can judge the difference in air quality, 4-5 I think air pollution has a negative impact on local development, 4-6 I think air pollution in midland is better than before. |
| Behavioural response to air pollution | 5-1 What preventive actions will you take in the face of air pollution?, 5-2 Whether you will determine the activity intensity according to the air quality of the day?, 5-3 What behaviour measures will you take in the face of different air index levels when you are outdoors today? |

4. Results and discussion

4.1. Sample characteristics

The study was conducted between August 17, 2019, and August 30, 2019, with 204 samples collected. Table 2 summarizes the sample distribution by social population characteristics. Among them, 58.8% were female and 41.2% were male. In terms of marriage, 81 were married, accounting for 39.7% and 123 were unmarried, accounting for 60.3%. There were 78 (38.2%) from 21 to 30 years old, 37 (18.1%) from under 20 years old, 36 (17.6%) from 41 to 50 years old, 27 (13.2%) from 51 to 60 years old, 15 (7.4%) from 31 to 40 years old, and 11 (5.4%) from 61 years old or above. In terms of education, higher education is the main group of students, among which 138 (68.6%) are from universities, 40 (19.6%) are from high schools, 20 (9.8%) are from research institutes, and 4 (2%) are from junior high schools. In addition, most participants' monthly income is 20,000 to 40,000 yuan, which is consistent with the situation in central Taiwan (Taiwan labor ministry, 2017).
Table 2. Sample characteristics.

| Category               | Items         | Amount | Percentage |
|------------------------|---------------|--------|------------|
| Gender                 | Male          | 120    | 58.8%      |
|                        | Female        | 84     | 41.2%      |
| Marital status         | Married       | 81     | 39.7%      |
|                        | Unmarried     | 123    | 60.3%      |
| Age                    | Under 20 years| 37     | 18.1%      |
|                        | 21-30 years old| 78    | 38.2%      |
|                        | 31-40 years old| 15   | 7.4%       |
|                        | 41-50 years old| 36   | 17.6%      |
|                        | 51-60 years old| 27   | 13.2%      |
|                        | 61 years old and above | 11 | 5.4% |
| The degree of education| Primary school (inclusive) below | 1 | 0.5% |
|                        | Junior high school | 3 | 1.5% |
|                        | High school    | 40    | 19.6%      |
|                        | University (major) | 138   | 67.6%      |
|                        | Institute (inclusive) above | 20 | 9.8% |
|                        | Missing values | 2     | 1.0%       |
| The work environment   | Indoor        | 98    | 48%        |
|                        | Outdoor       | 10    | 4.9%       |
|                        | Both          | 92    | 45.1%      |
|                        | Missing values| 4     | 2.0%       |
| Average monthly income | None          | 33    | 16.2%      |
|                        | Under the 20000| 29  | 14.2%      |
|                        | 2-30000       | 47    | 23.0%      |
|                        | 3-40000       | 52    | 25.5%      |
|                        | 4-60000       | 16    | 7.8%       |
|                        | More than 60000| 25 | 12.3%      |
|                        | Missing values| 2     | 1.0%       |
| Conscious air quality satisfaction | Very unsatisfied | 51 | 25.0% |
|                        | Unsatisfied   | 106   | 52.0%      |
|                        | Ordinary      | 44    | 21.6%      |
|                        | Satisfied     | 1     | 0.5%       |
|                        | Very satisfied| 2     | 1.0%       |
| Awareness of air pollution information | Know very well | 16 | 7.8% |
|                        | Okay          | 94    | 46.1%      |
|                        | Ordinary      | 67    | 32.8%      |
|                        | So so         | 21    | 10.3%      |
|                        | Don’t understand| 4 | 2.0% |

4.2. Personal basic information and air pollution risk perception level

The likert-style five-point scale was scored positively, with a total score of 30. 1-17 was classified as low perceived risk, 18-24 as medium perceived risk, and 25-30 as high perceived risk. According to the research analysis, the average score of perceived air pollution level of the tested person is 22.86, which is moderate risk perception. The descriptive statistics of personal characteristics perception score are shown in table3. In the bivariate analysis, the risk perception of air pollution has a low degree of correlation with marital status and average monthly income.
Table 3. Descriptive summary of the perceived scores by individual characteristics.

| Category                  | N  | Mean   | SD    | Sig.  | Pearson |
|---------------------------|----|--------|-------|-------|---------|
| Gender                    |    |        |       |       |         |
| Male                      | 84 | 22.93  | 2.46  | 0.760 | -0.022  |
| Female                    | 120| 22.82  | 2.64  |       |         |
| Marital status            |    |        |       |       |         |
| Married                   | 81 | 23.41  | 2.36  | 0.013 | -0.173*|
| Unmarried                 | 123| 22.50  | 2.63  |       |         |
| Age                       |    |        |       |       |         |
| ≦20 years old             | 37 | 22.32  | 2.37  |       |         |
| 21-30 years old           | 78 | 22.62  | 2.80  |       |         |
| 31-40 years old           | 15 | 24.07  | 2.01  | 0.096 | 0.117  |
| 41-50 years old           | 36 | 23.22  | 2.45  |       |         |
| 51-60 years old           | 27 | 23.04  | 2.71  |       |         |
| ≧60 years old             | 11 | 23.18  | 1.54  |       |         |
| The degree of education   |    |        |       |       |         |
| Primary school            | 1  | 21.00  | -     |       |         |
| Junior high school        | 3  | 23.00  | 2.00  |       |         |
| High school               | 40 | 23.20  | 1.96  | 0.919 | -0.007 |
| University (major)        | 138| 22.77  | 2.74  |       |         |
| Research institute        | 20 | 23.15  | 2.53  |       |         |
| Average monthly income    |    |        |       |       |         |
| None                      | 33 | 22.64  | 1.87  |       |         |
| ≦20000                    | 29 | 22.45  | 2.61  |       |         |
| 2-30000                   | 47 | 22.47  | 2.69  | 0.042 | 0.144* |
| 3-40000                   | 52 | 23.21  | 2.70  |       |         |
| 4-60000                   | 16 | 23.06  | 2.95  |       |         |
| ≧60000                    | 25 | 23.72  | 2.42  |       |         |

4.3. Air satisfaction, air pollution information understanding and air pollution risk level

According to the analysis of the research data, up to 77% of the respondents were dissatisfied with the current air quality, only 1% were satisfied with the current air quality, and over 85.2% of the respondents did not think the air quality had improved. In terms of air pollution information, only 7.8 percent thought they knew it very well, while most of the rest thought they knew it only moderately. Through linear regression, it was found that there was a significant correlation between air satisfaction and air pollution information understanding, as shown in table 4. It can be concluded that the lower the air satisfaction is, the higher the risk perception of air pollution will be. The higher the degree of information understanding, the higher the risk perception.

Table 4. Air satisfaction, air pollution information understanding and air pollution risk related characteristics.

| Constant                    | Standardization coefficient | t      | Sig.  | Collinear statistics | Gap | VIF |
|-----------------------------|-----------------------------|--------|-------|----------------------|-----|-----|
| Air quality satisfaction    | -0.276                      | -4.093 | 0.000 | 0.981                | 1.019 |
| Understanding of Air pollution information | 0.160 | 2.376 | 0.018 | 0.981                | 1.019 |

4.4 Information reception and risk perception of air pollution

According to the survey, nine receive air pollution medium of information, each volunteer to be exposed to the way only about 3 to 4 (mean = 3.529, sd = 1.884), including distribution in receiving messages as shown in table5, to "direct observation of the surrounding environment and feeling" (23.6%) as the main reception mode, time to "the government of numerical value, such as PM2.5 and AQI index" (19.0%), and through the radio (3.4%), while the lowest current citizens through the dissemination media receive message penetration rate is high, However, the proportion of the public
receiving air pollution information through the media is surprisingly low. In terms of actively sharing air pollution information, only 44.6 percent were willing to actively spread air pollution information.

Table 5. Air pollution information reception distribution.

| Category                                           | N   | Percentage | Percentage of observations |
|----------------------------------------------------|-----|------------|----------------------------|
| Government published figures (such as PM2.5 and AQI) | 123 | 19.0%      | 60.3%                      |
| Direct observation and perception of the surroundings | 153 | 23.6%      | 75.0%                      |
| Direct feeling of physical health effects           | 94  | 14.5%      | 146.1%                     |
| The direct feeling that psychological state affects | 24  | 3.7%       | 11.8%                      |
| Communicate with your network (such as family, friends, peers, colleagues, etc.) | 61  | 9.4%       | 29.9%                      |
| The phone APP                                       | 74  | 11.4%      | 36.3%                      |
| Radio                                               | 22  | 3.4%       | 10.8%                      |
| News media coverage                                 | 98  | 15.1%      | 48.0%                      |

In this study, linear regression analysis was further conducted on the number of ways of receiving air pollution information and the risk perception of air pollution. As shown in table 6, it was found that the number of ways of receiving air pollution information had no correlation with the risk perception, and it could be concluded that the receiving of air pollution information was not an influence factor of the level of risk perception.

Table 6. Air pollution information and risk perception.

| Constant | Standardization coefficient β | t     | Sig.  | Collinear statistics |
|----------|-------------------------------|-------|-------|----------------------|
| Air pollution information reception | 0.117 | 1.678 | 0.095 | 1.000  | 1.000  | 0.117 |

4.5. Risk perception hierarchy and behavioral imagery

According to the survey results, among the 10 prevention behaviors, only 2-3 items (mean = 2.55, standard deviation = 3.59) were expected to be practiced by each respondent, among which "wearing masks when going out" (21.7%), "avoiding staying outdoors for a long time" (20.0%), and replacing old locomotives with electric locomotives was the lowest (4.6%). According to the statistical results, as shown in table 7, it can be found that the practice degree of negative air pollution prevention behaviors with high personal convenience and less cost is higher. Although the air quality of the day is published daily by the Taiwan government, most people do not change their activity intensity due to the air quality of the day when they go out.

Table 7. Air pollution prevention behavior distribution

| Category                                           | N    | Percentage | Percentage of observations |
|----------------------------------------------------|------|------------|----------------------------|
| Avoid spending too much time outdoors               | 144  | 20.0%      | 70.6%                      |
| Use an air purifier                                 | 67   | 9.3%       | 32.8%                      |
| Wear a mask when you go out                        | 156  | 21.7%      | 76.5%                      |
| Close the doors and Windows                         | 84   | 11.7%      | 41.2%                      |
| Avoid making PM2.5 at home (e.g. indoor incense burning) | 47   | 6.5%       | 23.0%                      |
Reduce activities such as incense burning and worship 63 8.8% 30.9%
Plant green plants 69 9.6% 33.8%
Replace an old locomotive with an electric one 33 4.6% 16.2%
Check local air quality before going out 52 7.2% 25.5%
No action was taken 5 0.7% 2.5%

Furthermore, linear regression analysis was conducted on the execution degree of prevention behavior and the risk perception of air pollution, as shown in table 8. It can be found that the degree of execution is positively correlated with risk perception, which can prove that the degree of risk perception will affect the change of behavior.

| Behavioural response and risk perception. |
|------------------------------------------|
| Constant | Standardization coefficient | t   | Sig. | Collinear statistics |
|          | β                      |     |      | Gap | VIF | Pearson |
| Behavioural responses | 0.234 | 3.413 | 0.001 | 1.000 | 1.000 | 0.234** |

5. Conclusion
According to the analysis of the results, people with different marital status and monthly income have significant differences in the degree of risk perception of air pollution. In the part of information receiving, the public's information receiving mainly comes from the data published by the government, so trustworthy government information can help the public to receive information correctly. In addition, according to the results of the analysis, public satisfaction with the air pollution to the air quality information and knowledge will influence the people to the degree of the cognition of air pollution risk, the risk cognition of prevention and cure action enforcement has certain relevance, thus effectively improve the satisfaction and air pollution in the air quality information and knowledge will help people to risk cognition.

6. References
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