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Published

2021

Journal Title

Public Health

Version

Accepted Manuscript (AM)

DOI

10.1016/j.puhe.2021.04.026

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Using the Health Beliefs Model to explore children's attitudes and beliefs on air pollution

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Public Health; Volume 196, July 2021, Pages 4-9

https://doi.org/10.1016/j.puhe.2021.04.026

ABSTRACT

Background: Traffic-related air pollution (TRAP) negatively impacts children's health. Self-protective measures are available, but population uptake is variable. It is essential to understand human beliefs and behaviours related to air pollution in order to understand the lack of self-protection in communities.

Objectives: As a prelude to undertaking a comprehensive assessment of children's attitudes and beliefs on the health effects of TRAP exposure, we sought to develop and validate an appropriate instrument.

Study design: This study used exploratory sequential mixed methods.

Methods: This instrument, based on the constructs of the Health Belief Model (HBM), aimed to determine factors predicting wearing a mask to protect against TRAP exposure. An initial literature-based questionnaire was modified using in-depth interviews, focus group discussions, and a quantitative survey pilot. This study included 121 school students and nine professional experts in Vietnam. The questionnaire was tested for content validity, agreement, test-retest reliability, and internal consistency.

Results: The concordance of questionnaire items between two repeated assessments ranged from 47.2% to 78.3%, intraclass correlation coefficients ranged from 0.16 to 0.87 and Cronbach's internal reliability coefficient for the instrument was 0.60.

Conclusion: The self-administered instrument, based on the HBM, is suitable to understand health attitudes and beliefs related to self-protective behaviours to reduce TRAP exposure.

Introduction

Air pollution is a major environmental concern globally. According to the recent Lancet Commission, pollution killed three times more people in 2016 than AIDS, tuberculosis, and malaria combined. [1] World Health Organization (WHO) data show that air quality levels in major cities in low and middle-income countries (LMICs) frequently do not meet air quality guidelines. [2] Traffic-related air pollution (TRAP) is a particular problem, especially in mega-cities in LMICs. [3,4] TRAP exposure during childhood is associated with an increased risk of respiratory infections of greater severity, [5,6] lower lung function, and reduced lung growth, [7,8] wheezing illnesses, incident asthma, and asthma exacerbations. [9,10]

The epidemiological links between TRAP exposure and adverse health mean that reducing exposure is a public health necessity. Pollution mitigation to reduce exposure at the population level works [11] and is more cost-effective than treating pollution-associated adverse health. [1] However, reductions in pollution levels through legislation or regulation takes decades to flow through to improved health outcomes, especially in children. [11] As such, interventions at the individual level have been encouraged. [12] One of the self-protective actions commonly observed in polluted urban streets is wearing various types of facial masks. [12] Public health authorities, including WHO, recommend staying indoors with closed windows on days of hazardous air quality. [13-15] However, such suggestions are impractical for people who need to be outdoors to travel to and from work or school, especially where that travel involves the use of open vehicles such as motorbikes and scooters in LMICs. [16,17] Under these circumstances, individuals are left with little alternative to wearing face masks to try to limit exposure and avoid poor health outcomes.

While the dangers of daily exposure to hazardous air quality are well-known, the relative invisibility of air toxicants (apart from on very bad days) and familiarity (it happens every day) may lead to a false sense of security amongst exposed populations. Prior to efforts to increase the uptake of self-protective practices in populations, it is essential to understand human beliefs and behaviours related to TRAP and adverse health outcomes. An appropriate framework for gaining such an understanding is the Health Belief Model (HBM). [18] The HBM is one of the most well-known and widely used frameworks to understand health behaviour and has been applied to explain and predict the extent individuals adopt preventive health behaviours. [18] The model is a useful framework for investigating cognitive determinants of health behaviour [18]. It has been used successfully in school settings [19,20] and in developing health promotion activities and interventions. [18,19] The advanced HBM includes six constructs covering the perception of susceptibility, severity, barriers, benefits, self-efficacy, and internal or external cues to action.

Children are especially susceptible to adverse health consequences of air pollution. Globally, the collective impact of ambient and household air pollution caused approximately 600,000 deaths in children under 5 years in 2016.[21] In Vietnam, the 2012 burden of disease assessment identified that outdoor air pollution was responsible for approximately 30,000 deaths and 60,000 years of life lost for children aged less than 5-years.[21] Recent studies amongst Vietnamese populations have found strong evidence that exposure to air pollutants is associated with hospitalization for respiratory diseases.[22-24] Children are often exposed outdoor polluted environment during travelling. In Vietnam, children are often ridden on motorbikes on the road. A study demonstrated that motorcyclists had much higher air pollution exposure compared to passengers inside buses and cars.[17] This emphasizes that interventions are needed to reduce exposure to traffic-related air pollution so as to improve Vietnamese children's health. In order to create an effective intervention strategy, it is essential to understand children's beliefs and attitudes related to TRAP and how it effects their health. To address this need, we plan to survey secondary school children to determine what they understand about TRAP impacts on respiratory health, what self-protection measures they adopt, and their attitudes and beliefs about TRAP exposure. The present study was undertaken to develop and evaluate a self-report questionnaire, based on the constructs of the HBM, to examine children's attitudes, beliefs and understanding of health consequences of TRAP exposure and about self-protective measures to reduce such exposures.

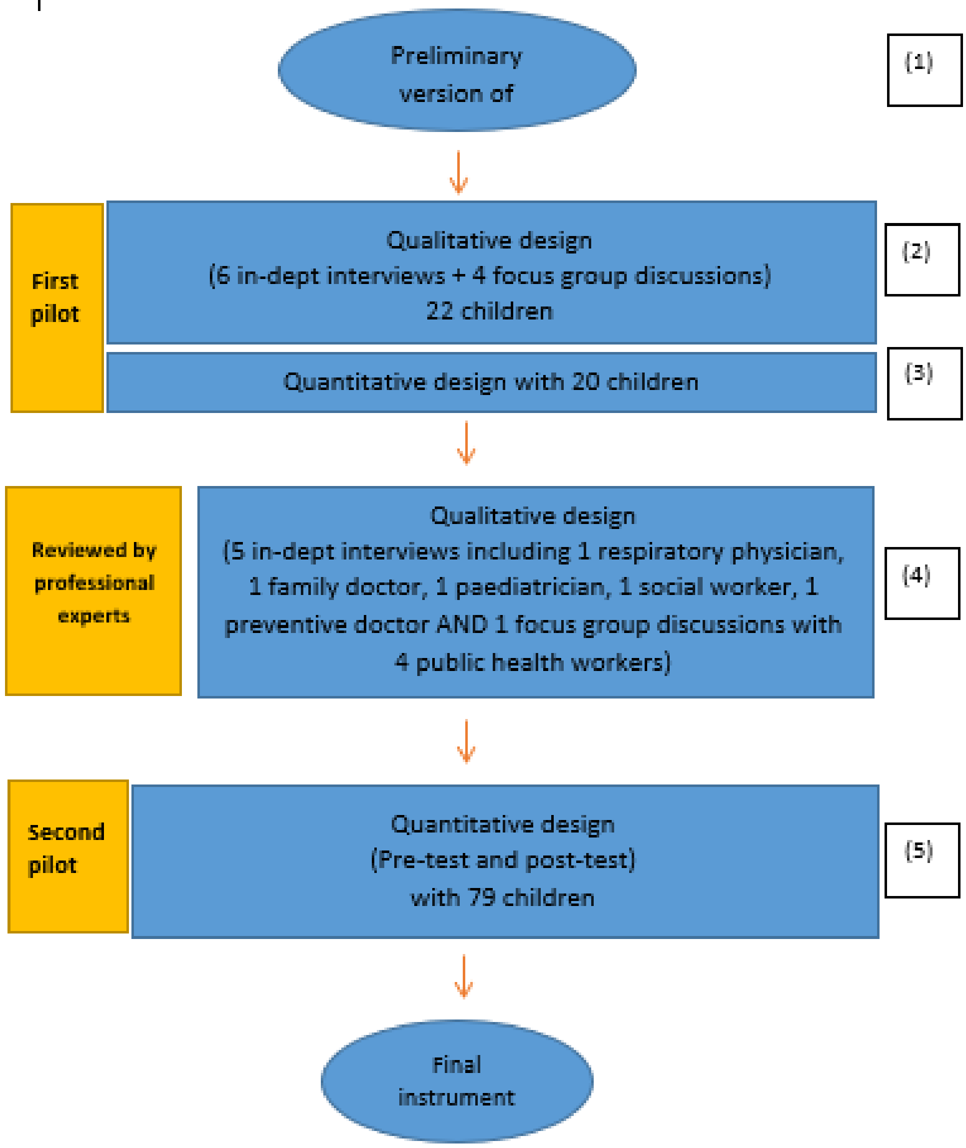
Methods

We used exploratory sequential mixed methods to develop and evaluate a self-report questionnaire instrument that aimed to determine factors predicting wearing a mask to prevent TRAP exposure according to the constructs of the HBM. School-aged children in grades 7 and 8 at secondary schools in Vietnam were recruited to develop the instrument. Separate groups of children participated in different phases of development. Approval for the study was obtained from the University Board of Ethics in biomedical research (342/UMP-BOARD), local education authorities and principals of the selected schools. Parents were informed of the study by a newsletter one week before the survey occurred and had the opportunity to decline the participation of their children. [25] No sensitive personal or identifiable data were collected. Children gave assent of their involvement in the study. All interviews and surveys were under the supervision of the children's teachers.

Instrument development

The processes used in instrument development are shown in figure 1. An initial questionnaire, including items related to air pollution exposure, respiratory symptoms, self-protective activities, and health beliefs, was developed from existing literature to measure attitudes, behaviour and how children's health was affected by TRAP exposure. The study questionnaire was contemporaneously developed in both Vietnamese and English. Three developers (HL, PT, DP) who are all experienced environmental health professionals and native Vietnamese speakers checked the consistency meaning of both versions. The Vietnamese version was used in the pilot study.

Figure 1: Flow chart describing the steps involved in instrument development



A qualitative study, including focus groups and in-depth interviews, was undertaken to explore suitable terms and health belief themes. Each student took approximately 30-45 minutes to discuss the themes with an interviewer. The facilitation was conducted by the trained research team, who had no relationship with participants. To ensure that the questions were framed in a way that children in the target age range understood, the qualitative face validity method was used. Particularly, recommendations of the target group, children, were adopted to check the understanding of question-wording. The content was validated by testing the use of appropriate and correct words, the order of words in items, constructs of health beliefs, and score appropriateness. There were six in-depth interviews and four focus group discussions with twenty-two children. A drawing method was used to initiate conversation. Each child was provided with a sheet of white paper and colourful pens to produce a drawing of a mask. All interviews and discussions were recorded and then transcribed into words. Data were coded using Nvivo 12 and analysed with a content, thematic approach. [26] Data were then sorted into patterns that addressed the aims of the study.

Content and face validity were considered by expert review of the questionnaire after modifications arising from the initial pilot were made. In-depth interviews were conducted with a respiratory physician, a family doctor, a paediatrician, a social worker, and a preventive medicine doctor. A focus group discussion was conducted with four public health workers.

A second pilot was undertaken, with 79 children divided into two groups. Each group answered the questionnaire twice, three days apart. One group had the same facilitators, and the other had different facilitators for the repeat test. Data were entered via EpiData 3, and a quantitative assessment was used to test the reliability of the instrument.

Statistical analyses

All statistical analyses were performed using Stata v16.0 (StataCorp, College Station, TX, USA), and statistical significance was defined at the 5% level. Data from the quantitative study was used to evaluate the reproducibility of the questionnaire, including agreement and reliability parameters. The agreement was reported by the percentage intrarater (student) concordance between the two-time points. The test-retest reliability and stability of the measures were assessed using intraclass correlation coefficients (ICC), which are the most appropriate methods for ordinal scales [27]. We calculated a two-way mixed-effects ICC model (known as an 'ICC (3,1)' model), and report ICC estimates and their 95% confident intervals. Values less than 0.5 are indicative of poor reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability. [27] Internal consistency reliability was evaluated using Cronbach's coefficient alpha. Cronbach's alpha typically ranges from 0 to 1. This study calculated Cronbach's alpha in the repeated test. Minimally acceptable value of Cronbach's alpha was set at 0.5 for exploratory research. [28,29]

RESULTS

In total, 121 children provided input into instrument development, 22 participated in the qualitative process by attending focus groups, and in-depth interviews and 20 completed the initial questionnaire. An additional 79 children completed the modified questionnaire twice, 3 days apart to determine test-re-test reliability.

A preliminary instrument was developed that included 28 items covering the six constructs of the advanced HBM were created by the research team (Table 1). Each question was answered using a 5-point Likert - type scale, ranging from "strongly disagree" to "strongly agree". Following the piloting of this instrument with children, the number of questions was reduced to 18. The reasons questions were retained or removed are outlined in Table 1. The wording of questions was also influenced by the expert review.

Table 1: Initial questionnaire items selected from the literature addressing the constructs of the health belief model.

Construct	Initial items	Barrier or enabler	Fate	Comments
Severity	1. During the last month, the air quality in my area is acceptable	Barrier	Retained	Understood and answered appropriately by children
	2. Breathing polluted air while I am on the street is not really dangerous for my health	Barrier	Deleted	Ideas of item 2, 3, and 4 were similar ideas. Item 2 and 3 were deleted, choosing item 4.
	3. Respiratory symptoms caused by breathing polluted air while I am on the street are not medically serious	Barrier	Deleted	
	4. Breathing polluted air while I am on the street can lead to dangerous diseases such as cancers or deaths.	Enabler	Retained	
Susceptibility	5. My lung is healthy, so I won't be affected by air pollution.	Barrier	Retained	Some children could have this thought.
	6. I am easy to get sneezing, or runny, or blocked nose when I breathe polluted air from traffic	Enabler	Retained	Retrieved from qualitative results
	7. The current illness of someone can be worsened by breathing polluted air from traffic.	Enabler	Deleted	Was an unclear question. The situation was not related directly to the subjects.
Benefits	8. Wearing a paper facemask/normal medical masks cannot protect me against air pollution while I am on the street.	Enabler	Retained	Relevant to the study aims

	9. Wearing respirators such as N95 can protect me against air pollution while I am on the street.	Enabler	Retained	Although minor children know about respirators such as N95, this item should be kept due to being linked with the parent study's aims.
	10. I will be healthier for most of my life if I wear a facemask while on the street.	Enabler	Deleted	Children were confused about the meaning.
Barriers	11. The price of a facemask suits my pocket	Enabler	Deleted	Children did not pay for the masks they wear.
	12. Washing a facemask frequently will waste my time	Barrier	Retained	Was common sense from children who wearing washable masks.
	13. I often forget to bring a facemask with me as going out	Barrier	Retained	Was common sense from children who were wearing masks
	14. I feel discomfort or hard to breathe if I am wearing a facemask.	Barrier	Retained	Popular reasons to refuse masks
	15. If I am wearing a facemask, I cannot breathe	Barrier	Deleted	Duplicated item 14.
	16. People think I am weird if I am wearing a facemask.	Barrier	Retained	Possible feelings of wearing masks
	17. My self looks weaker if I am wearing a facemask.	Barrier	Retained	Possible feelings of wearing masks
	18. People think I am sick if I am wearing a facemask.	Barrier	Retained	The common sense of wearing masks
Self-efficacy	19. I can always wear a facemask even I don't know if it can protect me	Enabler	Retained	This idea was good to evaluate self-efficacy.

	20. I always wear a facemask every time I am on the street	Enabler	Deleted	Too general
	21. I can always wear a facemask for a long while even if I feel uncomfortable	Enabler	Retained	This idea was good to evaluate self-efficacy.
Cues to action	22. If I am wearing a mask, it is because I want to protect my facial skin.	Enabler	Deleted	Moved to the question of reasons for mask use
	23. If I am wearing a mask, it is because my parent(s)/ older ask me to do this.	Enabler	Retained	Consistent with the qualitative findings
	24. I believe that wearing a facemask makes me more fashionable.	Enabler	Deleted	Moved to the question of reasons for mask use
	25. Most of my friends are wearing facemasks while they are on the street.	Enabler	Retained	Retrieved from qualitative results
	26. It is easy to find a facemask store in my area	Enabler	Retained	To explore mask accessibility
	27. Are you suffering from an illness which is caused by breathing polluted air from traffic?	Enabler	Combined item 27 and 28 together	To shorten the questionnaire
	28. Is your family member suffering from an illness which is caused by breathing polluted air from traffic?	Enabler		

During the second pilot, children asked many questions about questionnaire items. To ensure consistent responses from facilitators in the main study, we developed a "Standard Operating Procedure" to ensure consistency and determined that the inclusion of the options "unknown" or "no idea" should be included in questions. Piloting also suggested that the 5-point scale was too complex and the scale was changed into a three-point rating scale as follows: "disagree" "agree", and "do not know". The final questionnaire is shown in Table 2.

The intra-subject agreement for each question on the two OCCASIONS are shown is Table 2, together with the test-retest reliability and internal consistency. Intra-subject agreement ranged from 47.2% to 78.3%. For test-retest reliability, ICCs of individual items were in the fair to excellent range (0.49 – 0.87), except for two items (Wearing a paper facemask/normal medical masks cannot protect me against air pollution while I am on the street, ICC= 0.33; and I look weaker if I am wearing a facemask, ICC=0.16). Internal consistency for the total instrument and for each item were above the minimum acceptable level of 0.50. Cronbach's alpha coefficient for the total instrument was 0.60, and ranged from 0.55 to 0.63 (Table 2). Table 3 shows the performance of each construct within the HBM framework.

Table 2: Final questionnaire with test-retest reliability and internal consistency for each item.

Construct	No. items	Content of items	Test-retest reliability				Internal consistency	
			n	Intra-class correlation	CI 95%	P-value	n	Cronbach's alpha
Severity	2	During the last month, the air quality in my area is acceptable	72	0.64	0.42 – 0.77	0.000	75	0.58
		Breathing polluted air while I am on the street can lead to dangerous diseases such as cancers or deaths.	72	0.61	0.37 – 0.75	0.000	75	0.62
Susceptibility	2	My lung is healthy so I won't be affected by air pollution.	69	0.65	0.43 – 0.78	0.000	73	0.58
		I am easy to get sneezing, or runny, or blocked nose when I breathe polluted air from traffic	71	0.55	0.28 – 0.72	0.001	75	0.57
Benefits	2	Wearing a paper facemask/normal medical masks cannot protect me against air pollution while I am on the street.	72	0.33	(-0.07) – 0.58	0.05	75	0.57
		Wearing respirators such as N95 can protect me against air pollution while I am on the street.	71	0.56	0.29 – 0.73	0.000	74	0.63
Barriers	6	Washing a facemask frequently will waste my time	72	0.50	0.20 – 0.69	0.002	75	0.58
		I often forget to bring a facemask with me as going out	71	0.72	0.54 – 0.82	0.000	75	0.58

		I feel discomfort or hard to breathe if I am wearing a facemask.	72	0.87	0.79 – 0.92	0.000	75	0.54
		People think I am weird if I am wearing a facemask.	71	0.62	0.40 – 0.77	0.000	75	0.55
		My self looks weaker if I am wearing a facemask.	71	0.16	(-0.35) – 0.48	0.234	75	0.55
		People think I am sick if I am wearing a facemask.	69	0.74	0.58 – 0.84	0.000	75	0.56
Self-efficacy	2	I can always wear a facemask even I don't know if it can protect me	71	0.72	0.55 – 0.83	0.000	75	0.57
		I can always wear a facemask for a long while even if I feel uncomfortable	71	0.73	0.57 – 0.83	0.000	74	0.58
Cue to action	4	If I am wearing a mask, it is because my parent(s)/ older ask me to do this.	71	0.68	0.48 – 0.80	0.000	75	0.58
		Most of my friends are wearing facemasks while they are on the street.	70	0.59	0.34 – 0.75	0.000	75	0.61
		It is easy to find a facemask store in my area	70	0.49	0.17 – 0.68	0.003	73	0.59
		Are you/your family members suffering from an illness that can be caused by breathing polluted air from traffic?	71	0.69	0.50 – 0.81	0.000	74	0.56

Table 3: Test-retest reliability coefficients and internal consistency for constructs of the Health Belief Model

Construct	No. items	Test-retest reliability				Internal consistency	
		n	Intra-class correlation	CI 95%	P-value	n	Cronbach's alpha
Severity	2	72	0.65	0.44 - 0.78	0.000	75	0.45
Susceptibility	2	68	0.61	0.37 - 0.76	0.000	73	0.46
Benefits	2	71	0.46	0.14 - 0.67	0.005	75	0.43
Barriers	6	68	0.77	0.63 - 0.86	0.000	74	0.53
Self-efficacy	2	70	0.80	0.67 - 0.87	0.000	74	0.47
Cue to action	4	67	0.58	0.32 - 0.74	0.000	72	0.49

DISCUSSION

The present study was the first effort to develop and validate a reliable questionnaire exploring the health beliefs and attitudes of secondary school children toward the use of face masks as self-protection against the adverse health consequences of TRAP exposure. This study used an approach of exploratory sequential mixed-method research to explore factors of health perspectives. The content of the survey and the process of data collection were reinforced through steps of validation. The reproducibility of test-retest and internal consistency reached an acceptable level for health research.

Questions on wearing masks were created using the 6 HBM constructs to determine “barriers” or “enablers” to mask-wearing behaviours. *Perceived severity* addresses awareness of the consequences and seriousness of experiencing an adverse health event, such as an infection, disability, and even death related to TRAP exposure. *Perceived susceptibility* in the HBM is an indispensable construct that predicts an individual's likelihood of undertaking self-protective behaviours. It determines the extent to which one thinks he or she is susceptible to a health risk. The qualitative interviews suggested that children knew of some respiratory symptoms such as a runny or blocked nose associated with TRAP exposure. Within the HBM constructs, perceptions of benefits and barriers are elements that determine likelihood of maintaining positive health-related behaviours. *Perceived benefits* indicate that children believe that wearing masks could prevent air pollution and reduce its impacts. A common view amongst young interviewees was that medical masks were effective in protecting them from TRAP exposure. Two unexpected reasons for their beliefs were firstly that medical masks were used by the health workforce and secondly that they were sold in reputable places like pharmacy stores or hospitals. The majority of participants agreed with the perspective of "something better than nothing." They believed that wearing any mask, even one only covering the mouth and not the nose could reduce TRAP exposure. Few children had knowledge of respirators such as N95 masks. *Perceived barriers* were investigated to explore factors that inhibited children's mask-wearing, such as inconvenience, expense, ineffectiveness, hygiene discomfort, emotional upset, or personal image. The results of the qualitative survey revealed that children wore masks at the request of parents or senior relatives. Additionally, as almost all masks were provided by their parents or relatives, cost did not concern the children and was not identified as a barrier. Finally, questions on specific barriers included time spending washing a face mask, remembering to carrying a mask, discomfort, and perceptions of being weird, weaker, or sick while using a mask. The theory of the advanced HBM emphasizes that to move from desiring to take action to actually taking action, people need *cues or triggers*. These may be internal and/or external stimuli. An internal trigger identified for mask-wearing was a personal experience of adverse effects, such as suffering from an illness caused by breathing TRAP. External factors included events or information from others, mask availability and social trends. The pilot study showed that mask usage of young students was affected by their parents and friends. Thus, the ultimate cues to action included parental request, peer pressure from friends wearing masks and an easy availability. *Self-efficacy*, the latest construct added to the model, applies to confidence in the ability of children to maintain the desired behaviour. Parent reports about their child's behaviour can be used to examine the extent to which children undertake routine mask use in certain situations.

The results of pilot interviews revealed that some children were unlikely to wear face masks daily, but would in certain situations, such as during a long journey or on air-conditioned buses. This finding supported the idea that children might believe that masks could be effective against air pollution. However, children showed little knowledge about situations in which the risk was high. They equated high risk with long travel time rather than with pollution levels. This suggests children in the present pilot have a false perception of the surrounding atmosphere and believed that children could be safe on usual daily trips, whereas they may be at increased risk on longer and unfamiliar journeys.

The pilot present study indicated that children were more likely to wear masks if they experienced personal respiratory symptoms. This finding could be confounded by parents being more likely to supply masks to children who have respiratory symptoms. A larger study using a representative sample of school children will be required to verify these findings. The masks used were mainly medical or fabric masks. Evidence of the effectiveness of such masks in protecting wearers against dirty environment is controversial [13]. Further research, therefore, should be undertaken to investigate how effectively different masks lower the risk of TRAP exposure.

Another important result from the pilot was the attitude “something better than nothing” among interviewees. They believed that any face covering could filter out dust. For that reason, children would tend to choose face masks depending on convenience, affordability, or pleasantness rather than efficacy. Particularly, medical masks seem to be widely accepted because of they have been available for decades and have been recommended to prevent transmitting pathogens to others [30]. Children “trusted” medical masks could stop the spread of airborne viruses, which were identified to be more dangerous than dust particles. The common use of medical masks by health care workers reinforced children’s belief in medical masks, as did being supplied from pharmacies and hospitals.

The pilot showed that children’s mask usage was influenced by their parents or elders. Perceptions of children's caregivers, therefore, could impact on the children’s behaviours of mask-wearing. Specifically, the availability and types of masks could be led by the perceptions of parents or older relatives. This result is consistent with data from previous studies, which suggested strong parental influence on children, especially in Asian families [31,32]. Consequently, including the beliefs of parents about mask use on air-pollution prevention would improve modelling of health behaviour motivation among children.

The generalisability of this study to children of all ages may be limited by the ages of the recruited participants, who were all grades 7 and 8 at secondary schools. This is a practical limitation because self-report questionnaires require the ability of children to read and evaluate their own feelings. Consequently, the present study limited the age of participants, and as result findings may not generalise to younger age groups. It is important to note that this study was conducted approximately four months prior to the Covid-19 epidemic. Consequently, results reflect the Vietnamese situation of wearing masks before the epidemic and are a vital reference for Covid-19 post-pandemic research.”

In conclusion, the present study was undertaken to develop and validate a questionnaire to investigate children's attitudes and behaviours of wearing masks to protect against TRAP. The HBM proved to be a useful framework for this purpose and the instrument developed is appropriate for use in school-based surveys of children exposed to TRAP.

Acknowledgments

The authors would like to thank the children, their parents and the professional experts for their participation, the participating educational institutions for their cooperation, and the data collectors for their supports.

Conflict of interest

The authors have no conflicts of interest relevant to this article to disclose.

Funding

This work was supported by a collaborative research project between Vietnam National Foundation for Science and Technology Development [NAFOSTED - Grant ID. NHMRC.108.03-2018.04] and National Health and Medical Research Council [NHMRC - Grant ID. APP1155241].

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