Abstract

Background: Thirdhand smoke (THS) exposure is linked to lung cancer, asthma, and chronic diseases, especially in children. The parental risk perception of THS exposure in children has rarely been reported. The objective of this study was to test the association between sociodemographic factors and parental risk perceptions of child exposure to thirdhand smoke (PRPCETS) in residential homes with a child or children aged from one to five years old.

Methods: This study used secondary data from the Smoke Free Home intervention trial. 336 participants were included and analyzed. PRPCETS was assessed by self-administered questionnaire. Multiple logistic regression was used to test the factors related to parental risk perception to the harm of thirdhand smoke.

Results: The overall prevalence of disagreement that THS might be harmful to children was 22.02% (95% CI: 17.59%, 26.45%). Factors associated with PRPCETS were being over 50-years-old (OR: 2.15; 95%CI: 1.05, 4.41); attending school for more than six years (OR: 2.08; 95%CI: 1.07, 4.08); being unemployed (OR: 6.98; 95% CI, 1.41, 34.71); and the number of smokers in the home ≥2 persons (OR: 2.48; 95%CI: 1.41, 4.36).

Conclusions: Our findings show the factors related to PRPCETS as follows; aged over 50, duration of school attendance less than six years, no job status, and having ≥2 smokers in the home. Further studies should investigate parental knowledge of and attitude towards thirdhand smoke exposure.

Keywords
thirdhand smoke exposure, parental risk perception, risk factors, child health
Introduction
Third hand smoke (THS) means residual smoke emitted from tobacco products that is inhaled by a third party. Smoke from tobacco products, secondhand smoke, will become embedded on the surface of walls, carpets, furniture, clothing, flooring, vehicles or toys. Exposure to THS induces health problems such as lung cancer development and asthma. Exposure to THS happens in a place that a smoker has previously smoked, such as in houses or cars. A study reported that the home is one of places that THS can occur if there is smoking in the home. Evidence shows that some homes remain contaminated with THS for six months. The results show that infants or children stay, play and climb in the home, and they have a chance to be exposed to THS.

Reviews show few studies have been conducted to test factors related to parental risk perception concerning the harm to the child of THS exposure. Therefore, this study tested factors related to parental risk perceptions of child exposure to thirdhand smoke (PRPCETS).

Methods
Ethical approval and informed consent
The Mahasarakham University Institutional Review Board (IRB) approved the study. The study identification number is 113/2561. Written consent forms were distributed and provided to all participants, and they signed these consent forms.

Design and data collection
This study used secondary data from the Smoke Free Home study project. This project aimed to give smoke-free home information to parents of children aged 1–5 years that reside in the home. A cluster randomized controlled trial was carried out from February 2019 to October 2019 in Roi-Et province, Thailand. The trial was registered at the Thai Clinical Trials Registry (TCTR) with the code TCTR20190213001. Briefly, four primary health care facilities were randomly recruited. Of those, all 47 villages within each of the four health care facilities were selected to be part of the study setting. The targeted settings were screened using the Health Data Center (HDC), the health information database that collects data from the community and hospitals in Thailand. In the HDC, we recruited families according to the following criteria; families with a child aged 1–5 years, where the parent does not smoke, with a smoker in their home. The baseline characteristics and smoking behavior was collected by trained research teams using self-administered questionnaire at participant’s home. The trained research teams interviewed a parent of children or a child about their smoke-free home status, exposure to secondhand smoke, THS risk perception, and smoking behavior in the home. If the eligibility criteria (healthy child aged 1–5 years, the parent is a non-smoker, and a smoker smoked in their home) were met, they were invited to the intervention study. In total, we screened 336 households. Of those, 305 were included in the intervention study. In this cross-sectional study, we use the screening data of 336 participants to explore the parental risk perceptions of child exposure to thirdhand smoke.

Measurements
The outcome, PRPCETS, was assessed by asking the parent of children the question “Are you aware that breathing in a room that has had someone smoking in it previously, can affect the health of babies and children?” The response to the question was ranked from 1 to 4 (1: absolutely disagree, 2: disagree, 3: agree, 4: absolutely agree). We divided the answers into ‘Agree’ (which included; 3: agree and 4: absolutely agree) and ‘Disagree’ (which included 1: absolutely disagree, 2: disagree).

We also collected demographic data as follows; age in years, gender, duration of school attendance in years, occupation, marital status, income (Thai Baht, THB/month), number of smokers in the home, number of children in the home (under five years), and co-use of smoking and drinking alcohol. The age of the children’s parents was categorized as 18–40 years, 40–50 years, and >50 years. Duration of school attendance was categorized as 0–6 years, and >6 years. Occupation was categorized as agricultural, merchant, government officer, and no job. Marital status was categorized as married and divorced/other. Income (THB) was assessed and categorized as <10000THB/month, and ≥10000THB/month. Data on the number of smokers in the home was also collected and categorized as one person and ≥2 persons. Number of children in the home aged one to five years was categorized as one person and ≥2 persons. In addition, co-use of drinking alcohol in the home was assessed by a sequence of two questions; “In the past 1 month, has there been alcohol drinking in the home?” Responses were no or yes. If they answered yes, they were asked “During alcohol drinking, was there smoking?”. The answers were ‘yes, every time’, ‘yes, sometimes’, and ‘no, not at all’. We categorized this variable as alcoholic drinking but no smoking (when they answered yes to alcoholic drinking but reported no smoking at all), co-use (alcoholic drinking and smoking), and no (no alcohol drinking).

Statistical methods
All factors were presented as frequencies and percentages. For univariate analysis, we tested the association between factors and PRPCETS using the chi-square statistic. We also used multiple logistics regression in the multivariate analysis, and the final model was adjusted for candidate confounder factors. All statistics were performed in R version 3.6.1 and epiDisplay version 3.5.0.1 package.

Results
The overall prevalence of ‘Disagree’ answers to the PRPCETS question was 22.02% (95% CI: 17.59%, 26.45%). Of 336 participants included and analyzed in this study, 60.4% were aged 18–40 years, 92.3% were female parents, 77.1% worked in agriculture, 79.2% were married, and 67.3% had one person smoking at home. Regarding the number of children in the home, 82.7% had ≥2 children, and 53.6% reported that tobacco was smoked during alcohol drinking in the home. We compared the distribution of the prevalence of PRPCETS for each factor. There was a statistically significant difference
between factors and PRPCETS as follows; age (p value: 0.012), the number of years of school attendance (p value: 0.009), occupation (p value: 0.002), and the number of smokers in the home (p value: <0.001). Table 1 shows the results of the univariable analysis and prevalence distribution among factors.

In Table 2, results of the multiple logistic regression analysis is shown after adjustment for potential confounders. The group aged over 50 years had an increased risk of disagreement with the PRPCETS question (OR: 2.15; 95%CI: 1.05,4.41). Parents who had attended a school for more than six years had an increased risk of disagreeing with the PRPCETS question (OR: 2.08; 95%CI: 1.07, 4.08). Being unemployed (OR: 6.98; 95% CI, 1.41,34.71) was positively associated with disagreement with the PRPCETS question. In addition, having ≥2 smokers in the home (OR: 2.48; 95%CI: 1.41, 4.36) was positively associated with disagreement with the PRPCETS question.

**Table 1. Characteristics of the participants.**

| Variables                        | Total (n=336) | Disagree to harms THS exposure (n=74) | Agree to harms THS exposure (n=262) | P value |
|----------------------------------|--------------|--------------------------------------|------------------------------------|--------|
| **Age (years)**                  |              |                                      |                                    |        |
| 18-40                            | 203 (60.4)   | 36 (48.6)                            | 167 (63.7)                         | 0.012  |
| 40-50                            | 78 (23.2)    | 18 (24.3)                            | 60 (22.9)                          |        |
| >50                              | 55 (16.4)    | 20 (27.0)                            | 35 (13.4)                          |        |
| **Gender**                       |              |                                      |                                    |        |
| Female                           | 310 (92.3)   | 244 (93.1)                           | 66 (89.2)                          | 0.263  |
| Male                             | 26 (7.7)     | 18 (6.9)                             | 8 (10.8)                           |        |
| **Duration of school attendance (years)** |            |                                      |                                    |        |
| 0-6                              | 140 (41.7)   | 21 (28.4)                            | 119 (45.4)                         | 0.009  |
| >6                               | 196 (58.3)   | 53 (71.6)                            | 143 (54.6)                         |        |
| **Occupation**                   |              |                                      |                                    |        |
| Agricultural                     | 259 (77.1)   | 62 (83.8)                            | 197 (75.2)                         | 0.002  |
| Merchant                         | 63 (18.8)    | 6 (8.1)                              | 57 (21.8)                          |        |
| Government officer               | 6 (1.8)      | 1 (1.4)                              | 5 (1.9)                            |        |
| No job                           | 8 (2.4)      | 5 (6.8)                              | 3 (1.1)                            |        |
| **Marital status**               |              |                                      |                                    |        |
| Married                          | 266 (79.2)   | 56 (75.7)                            | 210 (80.2)                         | 0.402  |
| Divorced/Other                   | 70 (20.8)    | 18 (24.3)                            | 52 (19.8)                          |        |
| **Income (Thai Baht)**           |              |                                      |                                    |        |
| <10000                           | 161 (47.9)   | 35 (47.3)                            | 126 (48.1)                         | 0.904  |
| ≥10000                           | 175 (52.1)   | 39 (52.7)                            | 136 (51.9)                         |        |
| **Number of smokers in the home**|              |                                      |                                    | < 0.001|
| 1                                | 226 (67.3)   | 38 (51.4)                            | 188 (71.8)                         |        |
| ≥2                               | 110 (32.7)   | 36 (48.6)                            | 74 (28.2)                          |        |
| **Number of children in the home (under 5 years)** |            |                                      |                                    | 0.937  |
| 1                                | 278 (82.7)   | 61 (82.4)                            | 217 (82.8)                         |        |
| ≥2                               | 58 (17.3)    | 13 (17.6)                            | 45 (17.2)                          |        |
| **Concurrent alcohol and smoking (co-use)** |          |                                      |                                    | 0.122  |
| No                               | 139 (41.4)   | 23 (31.1)                            | 116 (44.3)                         |        |
| Alcohol drinking but no smoking  | 17 (5.1)     | 4 (5.4)                              | 13 (5)                             |        |
| Both alcohol drinking and smoking| 180 (53.6)   | 47 (63.5)                            | 133 (50.8)                         |        |
Discussion

Our results show the association between age, the number of years school attendance, occupation status, the number of smokers in the home and PRPCETS. However, statistical significance was not observed for gender, marital status, income per month, the number of children in home, and concurrent smoking and drinking in home.

PRPCETS was correlated with the age of parents. Our results show that older parents tended to disagree with the statement that THS might be harmful to children. This effect might be because older parents have received little information on the harms of THS exposure. In addition, the major tobacco control strategies included little information on THS exposure in the promotion of tobacco control.

Several studies show that high education level might protect against exposure to second-hand smoking, but there is little evidence to support this. Our results reveal that a high level of education protected against disagreement with the PRPCETS question. Parents who had the opportunity to study at a high level at school who were exposed to tobacco control campaigns at school or on the internet, radio, or television might have increased knowledge of or more positive attitudes towards the risk of THS exposure.

Occupation status is one of socioeconomic factors that is associated with tobacco control research. Our analysis showed that parents who have no job tended to disagree with the statement concerning the harms of THS exposure to their children. The effect described, usually, the parents who stayed at home to look after their child or children and had no job.

In households with smokers, our results show that households with more than one smoker were at greater risk of parents who disagreed with the PRPCETS question. Home is a one place that THS occurs because people have previously smoked inside. Our hypothesis is that in households that have many smokers and have children, there is a chance that a smoker smoked in their home or close to home such as by a wall or door. When this event has occurred frequently, parents might think that THS is not an important matter when they cannot smell tobacco smoke.

Our study has several limitations. Our analysis used the data from a smokefree home intervention project that was carried out in the northeast of Thailand. Therefore, the prevalence observed might not represent parents with a child or children aged under five years in the rest of the country. In addition, our questionnaire did not assess parent’s knowledge of and attitude towards the harms of THS exposure. This measurement might impact the risk perception of harms of THS exposure. The strength of the study is that this might be the first study in Thailand to investigate the factors related to parental risk perception concerning the harms of child THS exposure.

Conclusion

Results show the factors related to parental risk perception of child harm from THS exposure as follows; aged more than

| Factors                              | Crude OR (95%CI) | Adjusted OR (95%CI) |
|--------------------------------------|------------------|---------------------|
| Age (years)                          |                  |                     |
| 18–40                                | 1                | 1                   |
| 40–50                                | 1.39 (0.74, 2.63)| 1.04 (0.52, 2.08)   |
| >50                                  | 2.65 (1.37, 5.11)| 2.15 (1.05, 4.41)   |
| Duration of school attendance (years)|                  |                     |
| > 6                                  | 1                | 1                   |
| ≤ 6                                  | 2.10 (1.20, 3.68)| 2.08 (1.07, 4.08)   |
| Occupation                           |                  |                     |
| Agricultural                        | 1                | 1                   |
| Merchant                             | 0.33 (0.14, 0.81)| 0.50 (0.19, 1.26)   |
| Government officer                  | 0.64 (0.07, 5.54)| 1.08 (0.11, 10.44)  |
| No job                               | 5.30 (1.23, 22.79)| 6.98 (1.41, 34.71)  |
| Number of smokers in the home       |                  |                     |
| 1                                    | 1                | 1                   |
| ≥2                                   | 2.41 (1.42, 4.09)| 2.48 (1.41, 4.36)   |
50 years, duration of school attendance less than six years, having no job, and having many smokers in the home (≥2 persons). Further studies should investigate parents' knowledge of and attitude towards THS exposure.

Data availability
Underlying data
Harvard Dataverse: thirdhand smoke parental risk perception: https://doi.org/10.7910/DVN/N188CL

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

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Entitled: Parental risk perceptions of child exposure to thirdhand smoke and related factors

Reviewer comments:

Minor comments:

1. Measurement section
   Paragraph 2: Please give more information for a variable as Duration of school attendance. What does it mean?

2. Result section
   Paragraph 2: There is number of decimals, 1 or 2. It should be consistency in the hole full text.

3. Table 1
   1. Is it importance for report the p-value for comparison between disagree to harms THS exposure and agree to harms THS exposure? Because of the table 1 for baseline characteristics. Do not need for hypothesis testing.

   2. For continuous variable such as Age, Income should report mean (standard deviation), and median (minimal and maximal) as well.

   3. Heading title, please insert n (%) in each column.

4. Table 2
   Statistics methods, it should describe model fitting strategies such what type of method for fitting model, for example forward or backward method. In additional, the table for demonstrate on Crude analysis still for important that we explore for multiple analysis. Why not report the crude analysis table?
5. Conclusion section
   Please concise conclusion, it is not repeat the result. For instance, which is factor that the most important for PRPCETS.

 Is the work clearly and accurately presented and does it cite the current literature? 
 Yes

 Is the study design appropriate and is the work technically sound? 
 Yes

 Are sufficient details of methods and analysis provided to allow replication by others? 
 Yes

 If applicable, is the statistical analysis and its interpretation appropriate? 
 Yes

 Are all the source data underlying the results available to ensure full reproducibility? 
 Yes

 Are the conclusions drawn adequately supported by the results? 
 Yes

 **Competing Interests:** No competing interests were disclosed.

 **Reviewer Expertise:** I am a instructor in university, which included more than 10 years experiences in public health research and cancer epidemiology.

 I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.
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