



HEALTH PROMOTION

Psychometric Evaluation of Iranian Version of Beliefs about Third-Hand Smoke Scale (BATHS-T) in Pregnant Women

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Keywords

Beliefs • Third-hand smoke • Passive smoking • reliability and validity • Smoking prevention • Pregnant women

Summary

Introduction. Exposure to third-hand smoke (THS) is hazardous for human health, especially for pregnant women. This study aimed at psychometric evaluation of the Iranian version of “Beliefs about Third-Hand Smoke Scale” (BATHS-T) in pregnant women.

Aims & Methods. The data collected from 364 pregnant women referring to Yazd health centers. The BATHS scale was translated into Persian, and the stages of adaptation of the BATHS scale in Persian were evaluated with CVR=0.87 and CVI=0.88. Confirmatory factor analysis (CFA) was performed to analyze the construct validity of the scale. Besides, the correlation test was used to evaluate the correlation of categories and subcategories of the scale.

Results. The BATHS structural equation model showed a favorable fit as RMSEA value was less than 0.05 and χ^2/df varied between 2 to 5. Moreover, other indices such as CFI and NFI were more than 90%, indicating the optimal fit of the present model. The correlation between the overall scale of BATHS and its two subcategories was 0.843 ($p < 0.001$) and the correlation between

health and stability subcategories was 0.886 ($p < 0.001$). Since there was a positive and highly significant correlation, the fitted BATHS scale was considered to be structurally consistent with its subcategories. The reliability of the whole scale was 0.86 using Cronbach's alpha coefficient.

Conclusion. The Iranian version of the BATHS scale is reliable and valid. This scale provides the required prerequisites for further research and education on third hand smoke exposure. It can also be possibly used in similar studies.

Implications. The BATHS scale has innovative aspects based on the real beliefs of participants concerning third-hand smoke. The favorable validity and reliability of the scale makes it possible to use it in similar studies. Hence, a reliable scale of THS beliefs may be a criterion for measuring the desire to reduce exposure to SHS and THS at homes or other private spaces such as cars. Additionally, examining the results among different populations may be useful in identifying high-risk groups to ward off exposure to THS, and groups that are likely to respond positively to interventions that emphasize THS damage.

Introduction

Smoking is an important risk factor for health and development, and humans are never safe from cigarette smoke [1, 2]. In addition to the high prevalence of smoking as a health problem, the threats caused by cigarette smoke for people exposed to it is a double problem to be contemplated on. Contact with second-hand cigarette smoke (SHS) includes inhalation of cigarette smoke caused by the burning of the cigarette itself and inhalation of smoke exhaled by the smoker [3, 4]. The term Third Hand Smoke is a relatively new concept. This term, first used in 2006, was introduced by Winickoff et al. in 2009 [5]. Third-hand smoke is the residue of nicotine and other chemicals that remain on surfaces and dust for a long time after smoking and are released into the air through reactions with oxidants and other

compounds inhaled into the body [6, 7]. Although third-hand smoke has a lower concentration than second-hand smoke, it remains on surfaces for a longer time [7, 8]. In this way, a person is also exposed to third-hand smoke through the skin [9]. Exposure to third-hand smoke is caused by dust and surfaces, inhalation, ingestion, digestion, and dermal absorption of cigarette residues in addition to air inhalation [10, 11]. Dermal absorption is another important method of exposure to dust-bound pollutants [10]. Neonates and young children are more exposed to the effects of third-hand smoke due to playing, crawling, and touching surfaces and floors and touching their mouth [12, 13]. More than 40% of children, 33% of male non-smokers and 35% of female non-smokers are exposed to cigarette smoke round the globe [14-16]. In Iran, exposure to second-hand cigarette smoke was reported as 23% in Mazloumi et al.'s study [17]. In the

study by Ozmir et al., the belief about third-hand smoke in pregnant smokers was weaker than non-smoker pregnant women, and high education level reduced exposure to third-hand smoke. Believing in third-hand smoke is an important factor in pregnancy [9]. Exposure to cigarette smoke can predispose to ischemic heart disease, respiratory infection, asthma, and lung cancer [15]. Exposure to cigarette smoke is associated with adverse pregnancy outcomes, *i.e.*, complications that attenuate their lifelong health [18]. Chemicals in second-hand smoke damage DNA and contain carcinogens. Animal studies indicated a link between exposure to environmental second-hand smoke and conditions such as prediabetes, asthma, attention deficit hyperactivity disorder (ADHD), asthma, metabolic syndrome, and low birth weight. Third-hand cigarette smoke can cause harmful effects at the gene level and is dangerous for neonates [9]. Pertinent studies have suggested that smoking indoors for just one day exposes people to tobacco toxins for days or even months [19, 20]. THS accumulated in smokers' homes was able to persist even after these homes were left empty for 2 months and then cleaned [21, 22]. The existence of a smoker among the family members [23], lack of knowledge about the effects of contact with cigarette smoke on the fetus and false beliefs are important factors of exposure of pregnant women to cigarette smoke [24]. Studies have demonstrated that education concerning exposure to environmental tobacco smoke is effective in increasing health beliefs in pregnant women and their husbands and reducing exposure to environmental tobacco smoke [25, 26]. Having accurate information regarding THS and its adverse effects can help create a smoke-free environment [27-29]. Nonetheless, there are still very few studies that have examined awareness and attitudes about THS. It is assumed that the "Beliefs about Third-Hand Smoke Scale", *i.e.*, BATHS, can assess the belief in the harmful effects of THS more accurately, and this assessment may be effective in smoking cessation [28]. Haardorfer et al. (2017) conducted a study entitled: "The development of instruments concerning the third-hand smoke beliefs (BATHS). They designed and psychometrically evaluated the 9-item BATHS scale and presented it to researchers as a valid and reliable tool to evaluate THS beliefs [28]. Pregnant women are among the most vulnerable populations when it comes to tobacco smoke exposure, including third-hand smoke (THS). The physiological sensitivity of the fetus, combined with the mother's increased health awareness during pregnancy, makes this group uniquely important. Exposure to THS during pregnancy has been linked to adverse outcomes such as low birth weight, preterm delivery, and developmental disorders [30, 31]. Additionally, pregnancy is recognized as a window of opportunity for behavior change, making this stage ideal for interventions that aim to raise awareness and reduce tobacco-related risks." Since this questionnaire has not been investigated in Iran so far and pregnant women are considered one of the high-risk groups against cigarette smoke, hence, this study aimed at translating and

psychometrically assessing properties of Beliefs about Third-Hand Cigarette Smoke Scale on the population of pregnant women as one of the vulnerable groups to promote public and community health in Yazd.

Methodology

The ethical approval of this study (IR.SSU.REC.1402.072) was obtained from the Committee of Ethics in Human Research in School of Health at Shahid Sadoughi University of Medical Sciences.

PARTICIPANTS

The study sample in this methodological study consisted of pregnant women referring to the health centers of Yazd. This study aimed at adapting the THS scale to the Iranian community. Participants were selected with convenient sampling method. The sample size is recommended to be 10 times the number of items in factor analysis [32]. The BATHS scale consists of 9 items. Considering possible subject attrition, data gleaned from 364 people were considered as sufficient for data analysis. After explaining the purpose of the study and obtaining informed written consent, the qualified participants entered the study based on the inclusion criteria. Participants were selected using a convenience sampling method from health centers in Yazd. While this approach facilitated access to the target population, it may have introduced selection bias. Therefore, the findings should be interpreted with caution, as they may not be fully generalizable to all pregnant women in Iran.

INCLUSION CRITERIA

These were: referring to Yazd health centers, absence of smoking cigarettes or tobacco, being in the second trimester of pregnancy onward (This cutoff was chosen for two key reasons: (1) the higher rate of spontaneous miscarriages in the first trimester increases the risk of sample loss, and (2) pregnant women typically begin more regular prenatal care visits during the second trimester, which facilitates participant access and follow-up. This stage also reflects a more stable psychological and physical condition for questionnaire completion), absence of risky pregnancy, residence in Yazd, being a Persian speaker, absence of any speech and hearing disorder, and a willingness to participate in the study.

EXCLUSION CRITERIA

These were: termination of pregnancy, smoking cigarettes or tobacco, unwillingness to continue participation in the study, and lack of Iranian citizenship.

ADAPTATION OF BATHS SCALE TO PERSIAN

The Belief about Third-Hand Smoke Scale was developed and standardized by Haardörfer et al. [28]. The Turkish version of this scale has been psychometrically evaluated by Çadırcı et al. [33]. The questionnaire entails 9 items designed with a 5-point Likert scale

(completely disagree, disagree, indifferent, agree, & completely agree). The 9-item scale was confirmed with excellent internal consistency using factor analysis. The BATHS scale offers a valid and reliable instrument to the researchers for evaluating THS beliefs (28). The first step in the protocol is translation. Nine items in BATHS have two categories (health and stability) and use a 5-point Likert scale. First, the instrument was translated into Persian by two English and Persian language experts who were blind to each other; subsequently, the two translations were converted to one version via comparing and adapting them and selecting the most appropriate diction and wording. In the second stage, *i.e.*, the back-translation, the Persian translation was translated again into English by two fluent English native speakers who were blind to each other without knowing the original version of the scale. Then, the two versions were compared and adapted. The best diction and wording were selected to convert them to one version. In the third stage, a collective review was performed where in the review and investigation of the final translation was carried out through consulting with professionals who were skilled in the field of instrument development, psychometric evaluation, obstetric health and midwifery, tobacco, health education and promotion, reproductive health, and addiction studies to better understand the original instrument. After the translation process was completed, the face validity and content validity of the tool were established. For the qualitative (psychometric stage) face validity, the tool was given to 10 pregnant women; of course, these women cooperated with the study only to establish validity. They expressed their opinions on grammar, eligibility, and understanding the items. The required corrections were made. The quantitative and qualitative content validities were established by 20 experts familiar with psychometric evaluation of instruments. To determine the quantitative content validity, the questionnaire was provided to the panel of experts. They were asked to give their opinions concerning content validity ratio (CVR) in three options (it is necessary; it is useful but not necessary, and it is not necessary) and also concerning the qualitative content validity index (CVI) of the questionnaire in four options (not relevant, somehow relevant, relevant, and completely relevant) based on the research goals. Moreover, the qualitative content validity (observance of grammar, the use of appropriate diction and wording, *etc.*) was also examined by 10 experts and finally CVR = 0.87 and CVI = 0.88 were obtained. To evaluate the qualitative face validity, the questionnaire was provided to 10 experts and 20 pregnant women similar to the target group to study it and to assess the items in terms of “simplicity and fluency”, “relevance or specificity”, and “clarity or transparency”. For the content validity stage, a panel of 20 experts was selected using purposive sampling. These experts were selected based on their academic background and research experience in fields such as psychometric evaluation, obstetrics and midwifery, tobacco control, health education and promotion, and addiction studies. They were asked to evaluate each item

in terms of necessity (for CVR) and relevance (for CVI) using standard rating scales. For the face validity stage, two groups were involved: **10 pregnant women** from the target population were consulted for qualitative face validity to assess clarity, simplicity, and comprehension of the items. **10 experts** with backgrounds in health education and psychometrics were also asked to review items qualitatively for fluency, clarity, and cultural appropriateness. All suggestions and feedback were integrated before the confirmatory factor analysis stage.

CONFIRMATORY FACTOR ANALYSIS OF BATHS

Confirmatory factor analysis was used to determine the construct validity of Beliefs about Third-hand Smoke Scale (BATHS) using AMOS-24. Furthermore, the correlation between the overall scale of BATHS and its two subcategories and correlation between the subcategories ‘health and stability’ were also assessed. Then, the reliability coefficients of all scales and categories were calculated with IBM-SPSS22 in terms of internal consistency using Cronbach’s alpha for reliability analysis.

ANALYSIS OF DEMOGRAPHIC VARIABLES BASED ON BATHS SCALE

Using the BATHS scale, data collected from 364 participants were explored based on the demographic variables. The correlation between demographic variables and belief and categories was examined. Given the significant correlation between demographic variables and these categories, the homogeneity of the sample for the validity and reliability of the questionnaire was evaluated. Considering the researcher’s goals, the score obtained from the BATHS scale was the dependent variable and the “socio-demographic characteristics of participants” was considered as independent variable. Also, participants’ beliefs about third-hand smoke were investigated according to independent variables. Given that the socio-demographic variables consist of two groups, independent sample t-tests were used. Additionally, in cases where independent variables consisting of more than two groups were classified, one-way analysis of variance (ANOVA) was performed. Since these analyses are based on parametric tests, parametric test assumptions were examined.

To assess the construct validity of the BATHS scale, confirmatory factor analysis (CFA) was conducted using AMOS 24. The model fit was evaluated using multiple indices including RMSEA, CFI, NFI, and χ^2/df . According to widely accepted criteria, an RMSEA value less than 0.08 indicates an acceptable fit, and values below 0.05 suggest a good fit. Similarly, CFI and NFI values greater than 0.90 are generally considered indicative of a good model fit [32, 34]. In the current study, the RMSEA was 0.076, and both CFI and NFI were above 0.90, indicating that the model demonstrated an acceptable to good fit based on these thresholds. During the CFA, modification indices suggested correlating some of the error terms between items within the same subscale. Such modifications were made cautiously and

Tab. I. Comparison of BATHS scores (Persistence, Health, Total) across demographic variables.

Demographic Variable	Subgroup	Outcome Variable	Mean $\pm$ SD	p-value
Education (Women)	Literacy	Persistence	14.88 $\pm$ 2.35	0.137
		Health	17.59 $\pm$ 3.04	
		Total Score	32.47 $\pm$ 4.55	
	Diploma	Persistence	14.73 $\pm$ 2.41	0.024
		Health	18.08 $\pm$ 2.51	
		Total Score	32.81 $\pm$ 4.27	
	College and above	Persistence	15.31 $\pm$ 2.72	0.031
		Health	18.67 $\pm$ 3.18	
		Total Score	33.99 $\pm$ 5.16	
Education (Men)	Literacy	Persistence	14.91 $\pm$ 2.32	0.015
		Health	17.70 $\pm$ 2.68	
		Total Score	32.61 $\pm$ 4.75	
	Diploma	Persistence	14.58 $\pm$ 2.58	0.001
		Health	17.61 $\pm$ 2.63	
		Total Score	32.18 $\pm$ 4.56	
	College and above	Persistence	15.43 $\pm$ 2.56	0.001
		Health	19.00 $\pm$ 2.97	
		Total Score	34.43 $\pm$ 4.68	

only when theoretically justified. Specifically, error co-variances were added between items that shared similar content or wording, reflecting possible overlap in meaning or participant interpretation. According to Byrne (2010) and Kline (2016) [32, 35], correlating error terms is acceptable if items measure closely related constructs or if the shared variance is due to similar phrasing or content proximity, which is often the case in psychometric tools assessing attitudes or beliefs. In our model, these adjustments improved overall fit without violating the underlying theoretical structure of the BATHS scale, which consists of two conceptually coherent subscales (“persistence” and “health”).

ETHICAL APPROVAL

Ethics approval for this research was granted by Research Ethics Committees of School of Public Health- Shahid Sadoughi University of Medical Sciences, Yazd-Iran (Approval ID: IR.SSU.SPH.REC.1402.072).

Results

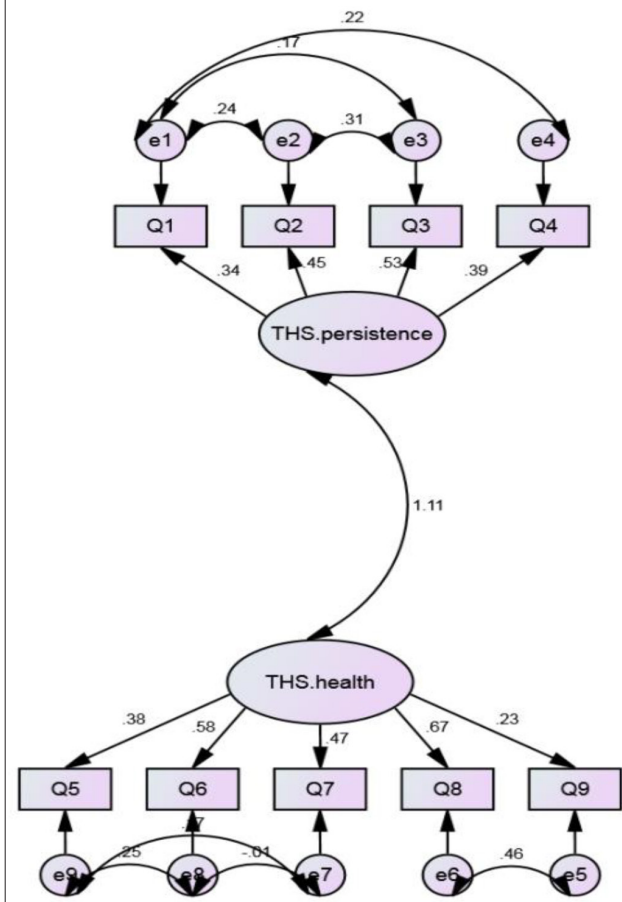
In this study, 364 pregnant women aged 14-54 years were examined with the mean age of 28.26 years and a standard deviation of 6.423. The mean and the standard deviation of the age of their husbands was 32.84 $\pm$ 6.871. The correlation between “demographic variables” and “belief and its categories” was examined. Due to the absence of any significant correlation between most demographic variables and these categories, it was inferred that a homogeneous sample was intended for establishing the validity and reliability of the questionnaire (Tab. I). The information on the amount of exposure to indirect cigarette smoke is displayed in Table II. Subsequently,

Tab. II. The amount of exposure to indirect cigarette smoke.

Items		n = 364	
		n	%
Do you allow others to smoke in your home?	Full ban	164	45.1
	No ban	71	19.5
	Partial ban	129	35.4
Do you smoke yourself?	Yes	31	8.5
	No	333	91.5
Does your spouse smoke?	Yes	86	23.6
	No	278	76.4
How many cigarettes does he smoke in a day and night?	Null	38	10.4
	1	16	4.4
	2-5	54	14.8
	6-10	29	8.0
	>10	30	8.2
How many cigarettes does he smoke in a day and night inside the house or in the car and near you?	Null	28	7.7
	1	17	4.7
	2-5	18	14.9
	6-10	15	4.1
	>10	51	14.0

confirmatory factor analysis was used to determine the construct validity of Beliefs about Third-hand Smoke Scale (BATHS) using Amos24. Based on the information presented in Table III, it is observed that in all correlations, the determined loads are approved on the general factor. All regression weights of the items were significant. Examination of the model fit indices suggested that some indices have obtained the required quota for the model's fit; yet some of the indices did not obtain the required quota with very subtle difference. Although the software suggests the correlating of the items error without considering the subscale, nonetheless, to observe the factorial structure of the questionnaire, only the common items and a subscale were correlated, reasoning that some of these items may share and assess common concepts (Fig. 1). Thus, due to the model modification indices and the addition of some covariance statements between the error variables, all indices obtained the required quota for the model fit, and the modified factor analysis model acquired good fit. Based on the results, the BATHS structural equation model showed good fit because the RMSEA value was less than 0.05 and the χ^2/df was between 2 to 5. Besides, other indices such as CFI and NFI should be more than 90%, indicating the favorable fit of the present model (Tab. III). The results revealed that the correlation between the overall BATHS scale and its two subcategories was 0.843 ($p < 0.001$) and the correlation between the subcategories of health and the stability was 0.886 ($p < 0.001$). Since there was a positive and significant statistical correlation, the BATHS scale was structurally consistent with its subcategories. The total reliability of the scale was 0.86 using Cronbach's α coefficient. The internal correlation of the first category was 0.745 and that of the second category was 0.81. The values obtained were above 0.70 and showed a statistically positive and significant correlation ($p < 0.001$).

Fig. 1. Confirmatory factor analysis of a scale assessing Beliefs about Third-Hand Smoke (BATHS).



Summary of Psychometric Properties of the BATHS Scale:

- **Internal Consistency:** the Cronbach's alpha coefficient for the overall scale was 0.86, indicating good internal consistency. The alpha values for the two subscales were 0.745 (Persistence) and 0.81 (Health), both above the acceptable threshold of 0.70;
- **Factor Structure:** Confirmatory Factor Analysis (CFA) supported the two-factor model of the BATHS scale (Persistence and Health). The model

demonstrated acceptable fit indices: RMSEA = 0.076, CFI = 0.941, NFI = 0.918, and $\chi^2/df = 3.10$, all within recommended thresholds (34,35);

- **Inter-correlations:** the correlation between the two subscales was 0.886 ($p < 0.001$), and the correlation between each subscale and the total score was also high (0.843, $p < 0.001$), indicating strong structural coherence within the scale.

Discussion

Smoke-free air policies are still being implemented in private and public spaces in different communities. Having a proper perception of third-hand smoke and its impact on individual health can play an important role in warding off cigarette smoke damage. Thus, this study aimed at translation and psychometric evaluation of "Beliefs about Third-hand Cigarette Smoke Scale" on the population of pregnant women as one of the vulnerable groups in promoting public and community health in Yazd. While earlier research used a specified item to measure beliefs about third-hand smoke [5, 36-38], yet, based on a review of related literature, it is inferred that BATHS can be used as a valid and reliable document [28]. Haardörfer et al. (2017) conducted a study entitled: "Development of Beliefs about Third-hand Cigarette Smoke Scale". A list of 19 cases related to THS was produced by an expert panel and tested in an experimental study. Based on the results of exploratory factor analysis, two factors emerged: the persistence of THS in the environment and the impact of THS on health; also, the scale was reduced to 9 items, indicating that it made no difference; the BATHS scale offers a valid and reliable tool to the researchers for evaluating THS beliefs [28]. In this study, the authors gave BATHS to pregnant women in the Iranian community to perform its psychometric evaluation and cultural adaptation and then assessed the construct validity of the instrument. The results of construct validity using confirmatory factor analysis demonstrated that the scale developed had a good fit in Iranian community. The study by Çadirci et al. (2021), aimed at determining the validity and reliability of the Turkish version of the BATHS using confirmation factor

Tab. III. Model fit indices and items' regression weight after modification of the model.

			Estimate	Standard Regression Weight	S.E.	C.R.	p	Model Fit Indexes
Q1	→	THS.persistence	1.000	.336				
Q2	→	THS.persistence	1.341	.449	.242	5.534	***	CMIN/DF: 3.102
Q3	→	THS.persistence	1.768	.534	.316	5.600	***	CFI: 0.941
Q4	→	THS.persistence	1.410	.393			***	RMSEA: 0.076
Q9	→	THS.health	1.000	.227	.274	5.143		NFI: 0.918
Q8	→	THS.health	2.793	.668	.713	3.915	***	
Q7	→	THS.health	1.503	.472	.467	3.220	.001	
Q6	→	THS.health	2.111	.582	.633	3.334	***	
Q5	→	THS.health	1.402	.382	.458	3.062	.002	

analysis, is consistent with the results of the present study [33]. In this study, Cronbach's α coefficient was reported for the whole scale as 0.9, indicating that the internal validity of the Persian version of BATHS was high. The results indicated that regarding the correlation between the whole scale of BATHS and its two subcategories and correlation between subcategories "health and stability", the BATHS scale was structurally consistent with its subcategories, since there was a statistically very positive and very significant correlation. The correlation values between the categories "health and stability" were over 0.70 and were statistically positive and significant ($p < 0.001$). This instrument has been used in various studies due to its validity. For instance, in the study by Özpınar et al. (2022) aimed at investigating pregnant women's beliefs about third-hand smoke and exposure to tobacco smoke in Turkey, the mean score of the BATHS-T scale was 859.0 ± 79.3 . There was a significant relationship between the mean score obtained from the BATHS-T scale and variables such as education and smoking status. As the level of education increased, exposure to third-hand smoke decreased ($p < 0.05$). The mean score of pregnant female smokers obtained from the BATHS-T scale was less than non-smoker pregnant women [9]. In the present study, it is concluded that most of the participating samples were homogeneous due to absence of any significant correlation between demographic variables with categories of BATHS scale. As it is displayed in Table I, merely education level of husbands showed a significant correlation with BATHS categories; this is consistent with the results of other studies [9, 28]. Furthermore, the results of a descriptive cross-sectional study by Xie et al. (2021) aimed at determining the beliefs and behaviors of elementary children's parents about third-hand smoke using BATHS in Shanghai, China, showed that women, younger people, and people with higher income and higher education believed more than others that third-hand smoke exerted some effects on the health and continued smoke in the environment. Participants whose children suffered from respiratory diseases in the past six months gained higher scores of BATHS scale. The results also showed that when smokers lived together more frequently, they gained a lower score than BATHS [39]. In a cross-sectional descriptive study by Köksoy et al. (2023) aimed at investigating the views of parents with disabled children and parents with healthy children about third-hand smoke, the results revealed a statistically significant difference in the mean BATHS Health and BATHS Persistence between the two groups. The mean scores of BATHS Health and BATHS Persistence in parents with disabled children were lower than parents with healthy children. Presence of laws banning smoking in the environment in which they live was such that there was law for 62 people (63%), there was relatively law for 10 people (10%), and there was no law for 27 people (27%). More than half of the research community observed the laws of the use of tobacco in their place of residence. The

authors stated that, in particular, the opinions of parents with disabled children about THS should be integrated with basic public health approaches and sufficient information on this issue ought to be provided to them [40]. Previous studies have shown that THS is present on the clothing, skin and hair of smokers as well as on home surfaces such as walls, beds, benches, rugs and tables. Therefore, exposure to THS is not without risk. In addition to non-smoker adults, children are more susceptible to THS because they spend more time indoors and hand-to-mouth behavior increases leading to their enhanced chances of exposure [41]. In this regard, the results by Shehab et al. (2021) aimed at exploring parents' beliefs about cigarette smoke and its association with home smoking laws in Kuwait suggested that most participants believed that being exposed to THS damages children (67.2%) and adults (60.6%) and that the THS residue can remain in the environment for days (58.9%). The prevalence of severe cigarette ban at home increased with total increase in THS (APR_{q4} vs $Q1=1.48$; 95% CI: 1.12-1.96), Health (APR_{Q4} vs $Q1 = 1.22$; 1.02-1.45), and persistence (APR_{q4} vs $Q1=1.55$; 1.17-2.05) [42]. Based on results of the above studies, it is important to note that pregnant women's awareness of this issue has been increased and that training measures to promote smoke-free homes are designed and implemented. This is because understanding the vulnerability and constant beliefs of parents about THS is accompanied by a severe ban on cigarette smoking at home, thereby providing a safer environment for children and non-smokers. People's beliefs about second-hand and third-hand smoke in Iran are influenced by several cultural, social, and religious factors. In recent years, Iran has implemented strict regulations to reduce tobacco consumption, including bans on cigarette advertising and restrictions on smoking in public places. These policies can increase public awareness of the dangers of tobacco smoke and influence people's perceptions (2). Smoking is considered an accepted behavior in certain social groups, while among others – especially women – it is less common. These social differences can affect the level of acceptance of the risks associated with second-hand and third-hand smoke. Some Islamic teachings emphasize the importance of individual and public health and regard smoking as a harmful practice. This perspective can contribute to reducing tobacco consumption and increasing sensitivity to the dangers of second-hand and third-hand smoke. The concept of third-hand smoke is still unfamiliar to many people; however, studies have shown that public awareness is gradually increasing. The expansion of research and awareness campaigns can help change people's beliefs over time [43].

We have compared the findings of the Iranian version with the original and Turkish versions of the BATHS scale to assess its compatibility within the Iranian population. In our psychometric and statistical analyses, some minor differences were observed between the Iranian and Turkish versions, which may be attributed

to cultural and linguistic variations. Specifically, certain beliefs regarding third-hand smoke in Iran might be influenced by public health policies, social norms, and religious teachings, which could explain these differences. To analyze these variations, reliability and validity tests were conducted. Additionally, mean score comparisons across different samples were performed to determine whether these differences are statistically significant. Given the observed differences, we suggest further research into the cultural and social influences on beliefs about third-hand smoke in Iran to achieve a more comprehensive understanding of this phenomenon.

Conclusion

Generally speaking, according to the findings of the present study, the BATHS scale has innovative aspects based on the real beliefs of participants concerning third-hand smoke. The favorable validity and reliability of the scale makes it possible to use it in similar studies. Nevertheless, further studies need to be conducted to strengthen the psychometric aspects of the questionnaire. Hence, a reliable scale of THS beliefs may be a criterion for measuring the desire to reduce exposure to SHS and THS at homes or other private spaces such as cars. Additionally, examining the results among different populations may be useful in identifying high-risk groups to ward off exposure to THS, and groups that are likely to respond positively to interventions that emphasize THS damage. Physicians can use this scale to conceptualize intervention experiences to increase understanding of how THS works in smoke-free homes, which can diminish carcinogenic agents in environments where smoking or SHS invasion is still a problem.

Limitations of the Study

The limitations of the present study can be mentioned as follows: since this study was carried out only on pregnant women, so the findings cannot be generalized to other age and sex groups. Moreover, conducting a study in a traditional society makes it difficult to generalize the results to a more modern community. This issue deserves special attention. Another point is that the researcher-made instruments are usually compared with similar available tools to clarify its discriminative and evaluative power. Yet, as there was no similar tool available in this study with acceptable validity and reliability, so the predictive validity and concurrent validity were not established.

The limitations section has been expanded to include a discussion on social desirability bias and the limitations of self-report measures. Since smoking during pregnancy is a sensitive topic, some participants may have adjusted their responses based on social norms or cultural expectations (social desirability bias). This issue has been acknowledged as one of the study's limitations. Self-

reporting tools may lack accuracy, as some individuals tend to underreport their actual smoking behavior. To mitigate this limitation, efforts were made in the study design to create an environment where respondents felt more comfortable and encouraged to provide honest responses. It is suggested that, in addition to self-report questionnaires, biochemical methods such as measuring nicotine levels in saliva or blood be incorporated to obtain more precise data. The use of mixed-method approaches for accurately assessing beliefs and behaviors related to third-hand smoke – especially among sensitive groups such as pregnant women – could lead to more reliable findings. *Due to the use of convenience sampling, the study sample may not represent the broader population of pregnant women in Iran. This limitation could affect the external validity of the results.*

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Ethics approval and consent to participate

Ethics approval for this research was granted by Research Ethics Committees of School of Public Health- Shahid Sadoughi University of Medical Sciences, Yazd-Iran (Approval ID: IR.SSU.SPH.REC.1402.072).

Consent for publication

The manuscript contains no individual person's data in any form.

Data availability statement

Statistical data will be available upon request. The data used in this manuscript are not openly available due to restrictions set by the institutional ethics board. The design and analysis plans for the experiments were not preregistered. The list of questions and coding manuals isn't openly available for download. All materials used in the study aren't openly available for download.

Conflict of Interest statement

None declared.

Authors' contributions

MKH, NY, ZP, ZK: project development, and manuscript writing. SJ: data collection and analysis.

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