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Original Research

Perceived effectiveness of cigarette warning labels in reducing household smoking: A mixed-methods study with Japanese smokers

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ABSTRACT

Objectives: This study aimed to examine the influence of warning-label content and smokers' individual differences on perceived label effectiveness in the reduction of household smoking.
Study design: Cross-sectional online questionnaire study conducted between June 28 and July 2, 2025.
Methods: Adult Japanese smokers rated self- and family-oriented risk text warnings. Multiple regression analysis was utilized to test how warning content and individual characteristics could predict the perceived effectiveness in reducing overall and household smoking. Content analysis explored open-ended questions regarding reasons regarding smoking at home and attitudes toward warning labels.
Results: Responses from 170 participants were analyzed. Family- and self-oriented warnings were perceived to be similarly effective (B = −0.10, 95 % CI [-0.39, 0.19], p = .50). However, smokers with more cohabitants and those living in detached houses (vs. multi-unit housing) viewed warning labels as more effective in reducing overall smoking (B = 0.43, 95 % CI [0.07, 0.77], p = .02). Smokers who smoked more at home perceived the labels as less effective at controlling household smoking (B = −0.26, 95 % CI [-0.47, −0.04], p = .02). Content analysis showed that smoking at home was mainly attributed to stress relief, addiction, and designated smoking areas at home. Many smokers reported feeling nothing when seeing the labels. While some participants said that the labels made consider smoking cessation, some also stated that they believed the labels had no effect.
Conclusions: In Japan, the residential environments of smokers shape how effectively they perceive warning labels. This calls for the tailoring of antismoking policies according to individual differences.

1. Introduction

Secondhand smoke (SHS)—also referred to as passive smoking or involuntary tobacco inhalation—is linked to an elevated risk of respiratory cancer, diabetes mellitus, and ischemic heart disease.[1] Globally, tobacco (smoked tobacco, second-hand smoke [SHS], and chewing tobacco) accounted for 8.71 million deaths in 2019.[2] SHS exposure was estimated to cause approximately 690,000 deaths among women and 610,000 among men,[3] and about 50 % children were exposed to SHS.[4]

Household smoking behavior is a major determinant of SHS exposure risk.[4–6 6–8] However, public smoking bans have produced a "shadow effect," prompting some smokers to shift their smoking from public spaces into the home. Therefore, family members spend more time exposed to SHS inside the home.[9,10] Japan is no exception. Although public smoking restrictions in Kanagawa and Hyogo prefectures have successfully reduced smoking in public spaces, they have concurrently increased monthly home-based SHS exposure by 2.64 days.[11] These findings suggest that smoking and SHS exposure within households remain difficult to regulate, highlighting the urgent need for interventions that reduce smoking at home.

Given the limitations of public smoking bans, cigarette package warning labels may provide an alternative strategy for reducing household smoking. The World Health Organization Framework Convention on Tobacco Control (FCTC) is the first global public health treaty aimed at reducing tobacco use and exposure to tobacco smoke.[12] Under the FCTC, member states are legally required to display

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prominent health warnings on cigarette packages and adhere to recommendations regarding label size, pictorial content, and rotation frequency. These warnings are intended to communicate both the health risks of smoking and the dangers associated with of SHS exposure.[12] Unlike public health messages displayed briefly in retail or public spaces, cigarette package warnings remain visible every time a product is used, allowing them to reach smokers with the household environment.

As an FCTC member state, Japan mandates warning labels that cover 50 % of the main display area, use high-contrast black or white text, and prohibit misleading descriptors such as "mild."[13] Nevertheless, the deterrent potential of Japan's text-only warnings in reducing SHS exposure has not been fully realized. A survey conducted among elementary, junior high, and high school students in Wakayama Prefecture revealed that 60–70 % of students living with smokers reported that family members smoked indoors.[14] Similarly, government statistics indicate that approximately 5 % of respondents experience daily SHS exposure inside the home.[15]

One possible explanation is that Japan's text-based warnings fail to clearly convey the dangers of household SHS exposure. Current warnings employ vague phrasing—such as advising pregnant women not to smoke, suggesting that cigarettes be kept away from children, or asking smokers to "be considerate of those around you."[13] These messages do not explicitly identify family members as primary victims of SHS and therefore may downplay the severity of associated risks. To prevent smokers from underestimating the harms household SHS, the content of cigarette package warnings required urgent improvement.

This study, conducted in Japan, aimed to investigate the efficacy of warning labels on cigarette packages in reducing household smoking using the following two factors. First, we examined how variations in warning target framing (self-focused vs. family-focused health consequences) affect smokers' perceptions of label effectiveness. Although smokers generally recognize personal health risks, warnings that emphasize harm to family members may be more persuasive. For example, parents of young children may be more likely to discuss SHS exposure and to attempt smoking cessation.[14,16] Second, we evaluated how individual differences in smoking status influence perceived warning effectiveness. Individual sociodemographic attributes contribute to antismoking attitudes; for example, older adults report a higher likelihood of quitting than younger individuals, while those with lower income or education face greater challenges in cessation.[16–18] Because living environments also shape smoking behaviors,[19] we included participants' residential settings to more accurately characterize household smoking patterns.

2. Methods

2.1. Data collection

We created a questionnaire and recruited Japanese participants through the Japanese online platform Freeasy using a convenience sampling approach. All participants were registered with Freeasy. Smokers aged ≥18 years whose native language was Japanese were eligible to participate. Completing the questionnaire took approximately 8 min, and all participants who completed the questionnaire received monetary compensation. The data collection period spanned from June 28 to July 2, 2025. All study materials used in this study and data are publicly available via the Open Science Framework (OSF) at https://osf.io/dny6a/?view_only=c81fc8234f954d2cbd6ef754a5f4f428.

2.2. Measures

2.2.1. Dependent variable

Including perceived effects on overall smoking allows for a direct comparison with household smoking, thereby highlighting the unique deterrent impact of warning labels within the household. The two dependent variables were as follows:

Perceived efficacy of overall smoking reduction. This construct was measured through three revised items used in a previous study (for example, 'This message makes me want to stop smoking'),[20] with responses recorded using a 6-point Likert scale (1 = do not agree at all to 6 = totally agree). These items showed good internal consistency in both conditions (self: α = .776; family: α = .773), so we used the mean thereof to represent the perceived efficacy of overall smoking reduction.

Perceived efficacy of household smoking reduction. This construct focused on the effect on household smoking behavior and was measured through the same three items and scale as a measure of overall smoking behavior, except that each item was modified to specify that smoking behavior occurred within the household (for example, 'This message makes me want to stop smoking at home'). We also found that these items were internally consistent across both conditions (self: α = .777; family: α = .823) and used the mean to represent perceived efficacy of household smoking reduction.

2.2.2. Independent variables

Health warning target manipulation. The warning labels presented either self-oriented (smoker health risks) or family-oriented (family health risks) messages: "[Smoking/Cigarette smoke] increases the risk of diseases such as lung cancer and heart attacks for [you/your family]. Will you continue making choices that harm the health of [yourself/your family]?"

Smoking status. We asked the participants about their smoking status, including how many cigarettes they smoked on average per day and the number of cigarettes they smoked at home on average per day.

Residential settings. We asked participants about their residential settings: a) Is there a designated smoking area in your home? (Yes, No); b. How many people do you live with, including yourself? (1. I live alone to 6. 6 or more); c. Do anyone in your home need special care? (No, everyone in your home is a healthy adult; Yes, someone in your home needs special care [for example, older adults, minors, pregnant women, people recovering from illness, etc.]; d. housing type (multi-unit dwelling or detached house); and e. housing tenure (rented vs. owner-occupied). Housing type and tenure were automatically supplied through an agreement between Freeasy and its users; therefore, we did not create any items for these.

Demographic information. The participants' basic demographic information (age, sex, and annual household income) was automatically provided by Freeasy. We only asked about participant education, "What is the highest level of education you have completed?" (1. High school to 6. Graduate school). We added the option "7. None of the above applies." However, none of the participants selected this option.

2.2.3. Open-ended question

We added two open-ended questions at the end of the questionnaire to complement and explain the statistical patterns identified in the quantitative analyses, allowing for a more integrated understanding of smokers' perceptions and behaviors. The two questions were as follows: *Give reasons why you smoke or quit smoking at home. What impressions or thoughts did you have when you read the warning message on the cigarette package in your daily life?*

2.3. Sample size

An a priori power analysis was conducted using G*Power to determine the required sample size for the regression models. Assuming a medium effect size ($f^2 = 0.15$), α = .05, and power (1 − β) = 0.80, the analysis indicated that approximately 127 participants were needed. To account for potential data exclusion, 200 respondents were recruited. Participants who failed the attention check or did not provide their complete characteristics were excluded from the study. After screening, 170 valid responses were retained for the quantitative analysis.

2.4. Data analysis

All quantitative analyses were conducted using R version 4.3.2. Categorical variables were dummy-coded as factors. Two multiple linear regression models were estimated using ordinary least squares with the lm(.) function, and the same 12 predictors were entered simultaneously in each model. Multicollinearity was assessed using variance inflation factors (VIFs) from car packages. Regression assumptions, including the linearity, homoscedasticity, and normality of residuals, were evaluated using diagnostic plots and statistical tests, and no major violations were detected.

A conventional content analysis was conducted using two open-ended questions. Each question was analyzed separately using sentence- or clause-level idea units as coding units. Long responses with greater content were coded multiple times. Two trained coders independently coded, and disagreements were resolved using a third coder. All 200 responses were collected, but non-interpretable responses like "13ty" were excluded, leaving 191 responses for Q1 and 189 for Q2. The codes developed from inductive coding were managed and consolidated into two tables. We summarized the results as participant-level prevalence (n, %), provided representative quotations translated into English by a bilingual author, and checked the translations through a native speaker.

3. Results

3.1. Descriptive statistics

In total, 170 smokers were included in the final analysis, with a mean age of 54.94 years (SD = 11.45) and an average use of 13.51 cigarettes per day (SD = 7.63), with 8.71 cigarettes smoked at home (SD = 6.28). Other categorical characteristics are presented in Table 1.

Most participants were male, university graduates, and had household incomes of 3–4, 4–5, 6–7, and 8–10 million JPY. The number of smokers with and without designated smoking areas was similar. Most lived with one or two cohabitants, and had no cohabitants requiring special care. A marginally higher number of participants lived in detached houses than in multi-unit dwellings, and most owned their homes rather than rented them.

Table 1
Categorical participant characteristics and residential environment.

Variables	Individual items	*N*	%
Sex			
	Biologically male	135	79.4
	Biologically female	35	20.6
Education			
	Junior high school	2	1.2
	High school	39	22.9
	Vocational school	20	11.8
	Junior college/Technical college	5	2.9
	University	97	57.1
	Graduate school	7	4.1
Household Income			
	Under 2 million yen	16	9.4
	2–3 million yen	13	7.6
	3–4 million yen	21	12.4
	4–5 million yen	17	10.0
	5–6 million yen	16	9.4
	6–7 million yen	17	10.0
	7–8 million yen	12	7.1
	8–10 million yen	24	14.1
	10–12 million yen	16	9.4
	12–15 million yen	6	3.5
	15–20 million yen	8	4.7
	Over 20 million yen	4	2.4
Designated Smoking Area			
	No	87	51.2
	Yes	83	48.8
Co-habitants Number			
	1 (live alone)	32	18.8
	2	58	34.1
	3	51	30.0
	4	16	9.4
	5	7	4.1
	6 or more	6	3.5
Special Care			
	No, all cohabitants are healthy adults	139	81.8
	Yes, someone requires special care (such asolder adults, minors, pregnant women, or people under medical treatment)	31	18.2
Housing Type			
	Multi-unit dwelling	71	41.8
	Detached houses	99	58.2
Housing Tenure			
	Own (self-owned property)	127	74.7
	Rent	43	25.3

3.2. Multiple regression analysis

Table 2 presents the results of the two multiple regression models, with the perceived efficacy of overall smoking reduction and household smoking reduction as dependent variables. Both models demonstrated a medium to large explanatory power (overall smoking, adjusted R^2 = 0.155; household smoking, adjusted R^2 = 0.193).

Regarding overall smoking reduction, smokers who had more people living together significantly perceived higher efficacy of the warning labels in reducing overall smoking behavior. Compared with those living in multi-unit dwellings, smokers residing in detached houses perceived warning labels to be more effective in reducing their overall smoking behavior.

Regarding household smoking, participants who smoked more cigarettes at home perceived warning labels as less effective at reducing household smoking. The effect of the housing type was marginally significant. Compared with smokers living in multi-unit dwellings, those residing in detached houses tended to perceive warning labels as more effective in discouraging smoking at home.

No other predictors, including the manipulated warning label (self- vs. family-oriented), significantly influenced smokers' perceived effectiveness of either overall or household smoking.

3.3. Content analysis

Table 3 shows the reasons the participants mentioned smoking or not smoking at home. One hundred and ninety-one participants provided clear answers. Many mentioned reasons for their living environment, such as having a designated smoking area at home, avoiding disturbing people around, having no places to smoke outside, and family acceptance of their smoking. Many participants mentioned reasons not directly related to household smoking such as smoking for relaxation or nicotine addiction.

Table 4 shows smokers' opinions on warning labels. Approximately half of the 189 participants said they had no opinion on warning labels. Some participants affirmed the effectiveness of warning labels; for example, they would think of health hazards or feel negative emotions such as fear after seeing the labels. Some participants believed that labels had no effect or they did not care about them at all. A small number of participants also said that they noticed that the labels were contrary to the business practices of tobacco companies.

4. Discussion

This study aimed to examine the influence of warning-label content and smokers' individual differences on perceived label effectiveness in the reduction of household smoking. Our results show that, while the content of the warning label had little impact, smokers' living environments and smoking frequency significantly affected the perception of participants regarding their smoking behavior. Participants viewed self-

Table 2
Multiple regression model results.

	Perceived Effectiveness (overall)				Perceived Effectiveness (household)			
	B	95 %CI	*t*	*p*	B	95 %CI	*t*	*p*
(Intercept)	2.74	−0.70–0.18	4.70	0.00	−0.17	−0.60–0.25	5.38	0.00
Condition (family-oriented)	−0.10	−0.39–0.19	−0.68	0.50	−0.05	−0.34–0.23	−0.36	0.72
Cigarettes (per day)	−0.01	−0.30–0.13	−0.79	0.43	−0.02	−0.23–0.19	−0.16	0.88
Cigarettes (per day at home)	−0.02	−0.37–0.08	−1.30	0.20	−0.26	−0.47–0.04	−2.36	0.02
Sex (male)	0.00	−0.41–0.40	−0.02	0.98	−0.04	−0.43–0.36	−0.19	0.85
Age	0.00	−0.18–0.17	−0.03	0.98	−0.07	−0.24–0.10	−0.80	0.42
Education	0.03	−0.12–0.20	0.48	0.63	0.08	−0.08–0.24	1.02	0.31
Household Income	0.04	−0.06–0.29	1.29	0.20	0.08	−0.09–0.25	0.90	0.37
Smoking Area (yes)	0.02	−0.27–0.30	0.12	0.90	0.05	−0.23–0.33	0.33	0.74
Co-habitants Number	0.16	0.01–0.38	2.03	0.04	0.11	−0.07–0.29	1.20	0.23
Special Care (yes)	0.13	−0.29–0.54	0.60	0.55	0.27	−0.13–0.68	1.32	0.19
Housing Type (detached)	0.43	0.07–0.77	2.38	0.02	0.30	−0.04–0.64	1.72	0.09
Housing Tenure (rent)	0.14	−0.26–0.54	0.69	0.49	−0.06	−0.46–0.33	−0.31	0.76

Note. “CI” refers to the confidence interval. All calculable variance inflation factors (VIFs) were below 3, indicating no strong multicollinearity among the variables.

Table 3
Coding results of reasons to smoke or not at home.

Codes	n	%	Example	Reasons to Smoke
Relax/stress relief	53	28 %	I smoke to quickly relieve everyday stress.	Smoking to relax, ease stress, or change one's mood.
Addiction/habit	35	18 %	I can't quit because I'm addicted to nicotine.	Long-standing dependence that prevents quitting.
Designated area at home	27	14 %	I smoke in my garden or on the balcony.	Home balconies, gardens, or ventilated rooms encourage smoking.
Protect others	19	10 %	I smoke outside alone and never in front of family members.	Intent to avoid exposing others to smoke.
No social constraint	16	8 %	I can smoke in my own room without worrying about anyone else.	Living alone or having a private room removes social pressure.
No public smoking space	12	6 %	Because there is no smoking area when I go out.	Lack of outdoor/ public smoking spots pushes smoking indoors.
Enjoyment/ hobby	9	5 %	Because I like cigarettes.	Smoking for entertainment or personal pleasure.
Family acceptance	6	3 %	My family permits me to smoke.	Household members tolerate the behavior.
Electronic cigarettes	5	3 %	Because I smoke heated tobacco, I think it's fine.	Electronic cigarettes (vape) devices viewed as acceptable indoors.
Smell/dirt concern (reason **not** to smoke)	4	2 %	I don't smoke at home; the room would smell of cigarettes and people complain.	Odor or residue makes indoor smoking undesirable.
No stated reason	4	2 %	I'm not particularly aware of any reason.	Respondent gave no concrete motive.
Helps thinking/ concentration	3	2 %	I work from home, so I smoke when I need to think or refresh my mind.	Smoking believed to aid focus or provide a mental break.

Note. The percentages are rounded values.

and family-oriented textual warnings as similarly effective in reducing overall smoking and household smoking. Our content analysis suggested that this may be because smokers tend to avoid smoking near family members or choose well-ventilated areas when smoking at home. This indirectly supports the idea that warning family members about the harm caused by SHS is a feasible and effective theme for cigarette warning labels.[21]

Family-oriented content may not be significantly more effective than self-oriented content because of the inherent limitation that Japanese text-only labels are not effective enough to attract smokers' attention.[22] Many participants explicitly noted that they do not read the content carefully; one even described the labels as “noisy.” This limited impact is consistent with earlier critiques of Japan's text-based warning-label policy, which show that only 15.6 % of smokers notice the labels, and 7.9 % read them closely.[23] In contrast, graphic labels are more effective because they are visually noticeable, evoke stronger emotional responses, such as fear or disgust, and thereby promote behavior change.[24–26] The text-only content likely dampened the power of the labels in our study; therefore, changing the target had little effect on perceived efficacy. Accordingly, future studies should re-examine the impact of variations in warning content on perceived effectiveness by employing graphic labels.

Regarding individual differences, smokers living in detached houses considered labels effective in reducing both overall (significant) and household smoking (marginally significant). This could be due to the high awareness of social norms stemming from Japan's living conditions. Nationally, the average living space per person in Japan is 41.9 m^2 (36.4 m^2 in densely populated areas such as the Kanto region, and 25.9 m^2 for rental apartments),[27] smaller than the United States, France, and Germany.[28–30] Small living spaces force apartment dwellers to share common areas, and even smoking on balconies can disturb neighbors. One participant stated that large families often gather outside, leaving him or her with no choice but to smoke indoors. The awareness of protecting shared environments is consistent with collectivist values that prioritize the public good.[31,32] However, smokers in detached houses can base their decisions on personal considerations, such as perceived health risks, rather than social norms. For these individuals, warning labels may be more effective than public smoking regulations.

In addition, our study suggests that nicotine addiction similarly blunts the influence of text warnings in the domestic context because smokers who reported higher levels of household smoking perceived warning labels as less effective in reducing household smoking. This finding aligns with earlier work showing that warning labels have little impact on purchasing behavior among highly nicotine-dependent smokers, whereas those with weaker dependence are more responsive.[33]

Content analysis offers additional insights into the underlying psychological mechanisms. Several participants questioned the credibility of the messages and claimed that the risks were exaggerated. One respondent described the warnings as “a form of intimidation masquerading as scientific evidence.” Such reactions imply that highly dependent smokers may denigrate or dismiss labels to protect their smoking habits. Thus, they can effectively distance themselves from the health consequences displayed on the package.

Tightening public smoking bans can unintentionally shift smoking to the home, increasing SHS exposure, and endangering public health.[11] Our findings have several policy implications for promoting smoke-free homes in Japan. First, the smoke-free rules should be extended to

Table 4
Coding results of smokers' opinions on warning labels.

Codes	n	%	Example	Perception of Labels
Felt nothing	101	53 %	I don't feel anything in particular.	No reaction reported to labels.
Quit/control smoking	22	12 %	I really have to quit smoking.	Label prompts thoughts of quitting or cutting back.
No effect	18	10 %	It feels like there's no effect.	Labels viewed as powerless to change behavior.
Health risk	15	8 %	I once again realized it is bad for my health.	Label reminds smokers of health damage.
Disregard	13	7 %	I ignore the warning messages.	Smokers pay no attention to labels.
Paradox	13	7 %	It seems like a tobacco-company dilemma.	Conflict seen between warnings and product sales.
Negative emotion	11	6 %	I felt scared.	Smokers report fear or anxiety after seeing the label.
Resigned acceptance	9	5 %	I want to stop, but I can't.	Acknowledge harm yet feel unable to quit.
Social restraint	9	5 %	I'll refrain from smoking in front of others.	Attempt to avoid bothering others.
Design critique	4	2 %	It looks like only text; more striking text or photos would be better.	Existing design seen as weak; suggestions offered.
Stop selling	4	2 %	If warnings are needed, they shouldn't sell it.	Call for banning tobacco sales.
Personal responsibility	2	1 %	Nothing in particular. It's the path I chose.	Smoking framed as individual choice.

Note. The percentages are rounded values.

multi-unit housing. Government bans often cast shadows on private spaces, thereby increasing the incidence of indoor smoking. Smoke-free policies in apartments are associated with lower smoking rates and SHS exposure.[34] Housing managers should be encouraged to adopt building-wide bans and reinforce the message that smoking harms not only smokers but also family members and neighbors, to resonate with Japan's collectivist culture. Second, policymakers should optimize warning-label content for detached house smokers. Although smokers living in detached homes reported greater faith in label effectiveness, many voiced limitations regarding text-only warnings. Instead of a plain warning, the labels should incorporate persuasive, evidence-based messages such as concrete cessation tips and links to quitlines.[20,35–37] Strengthening the use of graphic warnings is also an option, but caution is needed as some graphic images may increase smoking anxiety, which reinforce smoking behavior.[38] Lastly, we encourage policymakers to strengthen public education on the harm of SHS toward others because not all smokers are aware of SHS's risks.[39] In addition, household members often suffer from SHS and are powerless to intervene.[40,41] Enhancing awareness and encouraging active intervention by co-habitants can create additional social pressure on smokers, preventing their indoor smoking behavior, and thus better protecting others from SHS exposure.

This study had some limitations. First, the sample size was determined solely based on the statistical power required for the regression model, resulting in a relatively small sample size. Because participants were recruited and tested online, the sample may have been biased toward individuals from specific platforms or those with higher digital literacy and education levels. Policymakers are encouraged to refer to our findings. However, future studies should validate these findings using larger and more representative samples. Second, the study relied on self-reported data. In particular, the perceived effectiveness of warning labels depended entirely on the participants' subjective evaluations, which may have been influenced by social desirability by overstating the effectiveness of the labels. Future research should incorporate more objective indicators such as actual smoking rates. Longitudinal or field-based studies would also help determine whether improved labels can meaningfully reduce smoking in homes. Finally, because this study was conducted in the legal and social context of Japan, caution is needed when generalizing the results to other societies.

Ethical statement

This study was approved by the institutional review board at the first author's affiliated institution (HB024-168).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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