

Association between health literacy and current smoking among middle-aged Japanese ever smokers

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ABSTRACT

INTRODUCTION Previous studies suggest that low health literacy is associated with current smoking. In this study, we assessed the association between health literacy and current smoking among middle-aged Japanese ever smokers.

METHODS A cross-sectional mail survey using a self-administered questionnaire was conducted from October 2020 to March 2021. A convenience sample involved all community residents with National Health Insurance, aged 40–64 years, in five cities of three areas of Osaka Prefecture, Japan. We received 12446 (36.7%) responses from people who agreed to participate in the mail survey. After we excluded non-smokers and those with missing data, a total of 4751 ever smokers were included in the analysis. Health literacy was measured using the Japanese Communicative and Critical Health Literacy scale. The statistical methods

included chi-squared tests, analysis of variance, and logistic regression analysis.

RESULTS Of the 4751 ever smokers, 2389 (50.3%) were current smokers, and 2362 (49.7%) were ex-smokers. After adjusting for confounding factors, multivariable adjusted odds ratios for current smoking were calculated for the medium health literacy group (AOR=1.11; 95% CI: 0.97–1.28) and the low health literacy group (AOR=1.40; 95% CI: 1.20–1.64), with the high health literacy as reference group. Further analysis revealed that the association was significant, even when stratified by educational level.

CONCLUSIONS Low health literacy was positively associated with current smoking among middle-aged Japanese ever smokers. These results suggest that improving health literacy may help middle-aged smokers to quit smoking.

INTRODUCTION

The tobacco epidemic kills more than 8 million people worldwide each year and is one of the most severe public health threats internationally. Of these deaths, more than 7 million are the result of direct tobacco use, and approximately 1.2 million are the result of non-smokers being exposed to secondhand smoke¹. In this context, clarifying the factors associated with smoking behaviors may be useful to determine appropriate interventions to promote smoking cessation. Numerous previous studies have investigated factors associated with smoking behaviors such as smoking initiation^{2,3}, smoking cessation^{4,5}, and smoking relapse^{6,7}. In addition, previous systematic reviews have grouped these factors into conceptually similar categories^{8–10},

such as social, environmental, and individual factors⁸.

Recently, health literacy has come to be considered an important factor associated with smoking behaviors^{11–14}. The concept of health literacy was initially introduced in the 1970s, and was defined as the ability to read, understand, evaluate, and use health information necessary to make reasoned, health-related decisions¹⁵. In the last several decades, there has been extraordinary growth in interest in health literacy worldwide in healthcare and in the context of public health¹⁶. Previous studies have reported that low health literacy was significantly positively associated with high possibility of smoking compared with never smoking^{13,17,18}, current smoking compared with former smoking among ever smokers (those that had ever smoked)¹¹

and smoking relapse¹⁹, and low possibility of smoking cessation¹². On the other hand, previous studies have also reported that the associations between health literacy and smoking behaviors were not significant^{20,21}.

Of these, a previous study in England reported that low health literacy was positively associated with current smoking among middle-aged and older ever smokers, compared with adequate health literacy¹¹. In addition to health literacy, the study also reported that low education level was positively associated with current smoking compared with high education level¹¹. Additionally, previous studies reported a significant association between education level and health literacy^{22,23}. In this context, further research is necessary to clarify the association between health literacy and current smoking in various countries and regions, stratified by education level.

In Japan, smoking is one of the two leading behavioral risk factors²⁴. The smoking prevalence in adults aged ≥ 15 years is 19%, and approximately 21 million people still smoke²⁵. In two previous studies, Suka et al.²⁶ reported that health literacy was significantly associated with smoking behaviors among respondents aged 20–64 years²⁶, while Sudo and Kuroda²⁷ reported that interactive health literacy was negatively associated with adolescents' susceptibility to future smoking. To our knowledge, no previous studies have assessed the association between health literacy and current smoking among ever smokers in Japan. In the current study, we assessed the association between health literacy and current smoking among middle-aged Japanese ever smokers.

METHODS

Study participants and procedure

A cross-sectional mail survey using a self-administered questionnaire was conducted from October 2020 to March 2021. The time for completing the questionnaire was approximately ten minutes. To improve the response rate, a reminder postcard was sent one week after a self-administered questionnaire was mailed out. A convenience sample involved all community residents ($n=33902$) with National Health Insurance aged 40–64 years in five cities of three areas of Osaka Prefecture, Japan. Of these, 12446 (36.7%) responded that they agreed to participate in the mail survey. Furthermore, we excluded non-smokers and those with missing data. Finally, a total of 4751 ever smokers were included in the analysis.

The study protocol was written in accordance with the Declaration of Helsinki and was approved by the Institutional Review Boards of Osaka Prefecture University (date of approval 5 October 2020; approval no. 2020–28). Additionally, in Japan, any research involving human subjects must follow the Ethical Guidelines for Medical and Biological Research Involving Human Subjects²⁸. In this study, the informed consent was given in accordance with the Ethical Guidelines. We explained the study in the research request document including the protection of anonymity and the free

will of individuals cooperating. Moreover, we confirmed the subject's consent in the checkbox on the front cover of the questionnaire. In accordance with the Ethical Guidelines, those who checked the 'I agree' checkbox were considered to be in agreement.

Outcome

Information on smoking status was obtained using a self-administered questionnaire. Ever smokers were classified into current smokers and former smokers. Those who selected 'I have been smoking habitually' were classified as current smokers. Those who selected 'I have given up smoking' were classified as former smokers.

Exposure factors and potential confounding factors

Factors obtained using the self-administered questionnaire included age, sex, education level (≤ 12 years or >12 years), living alone (yes or no), occupation (presence or absence), economic status (very good and good, average, or poor and very poor), drinking status (regular drinkers, or occasional drinkers and non-drinkers), regular exercise (presence or absence), obesity (presence or absence), subjective physical and mental health (very good and good, average, or poor and very poor), and regular visits to medical institutions (presence or absence). Body mass index was also calculated (kg/m^2).

Health literacy was measured by the Communicative and Critical Health Literacy (CCHL) scale²⁹. This scale is based on an established model of health literacy³⁰, and the reliability and validity of this scale have been previously confirmed²⁹. Participants were asked whether they had the ability to do the following: 1) collect health-related information from various sources; 2) extract the information they wanted; 3) understand and communicate the obtained information; 4) consider the credibility of the information; and 5) make decisions based on the information, specifically in the context of health-related issues. Each item was rated on a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Scores for the items of each scale were summed and divided by the number of items in that scale to yield a scale score (theoretical range: 1–5)²⁹. The Cronbach alpha of the scale in this study was 0.88. In the present study, participants were classified into three groups (low, medium, and high health literacy groups) by the score tertiles of the CCHL scale: low health literacy group with 1.0–3.1 points, medium health literacy group with 3.2–3.8 points, and high health literacy group with 3.9–5.0 points.

Statistical analysis

Differences in factors among those with low, medium, and high health literacy scores were determined by analysis of variance for continuous normally distributed data, and chi-squared tests for dichotomous and categorical data. The proportions of current smokers in the low, medium, and high health literacy groups were compared using the chi-squared test. Logistic regression models were used to estimate the age

adjusted odds ratios (AORs) and 95% confidence intervals (CIs) for current smokers (response variable: 1 = current smoker and 0 = ex-smoker) according to low, medium, and high health literacy groups. Additionally, logistic regression models were used to estimate the multivariable AORs and 95% CIs for current smokers (response variable: 1 = current smoker and 0 = ex-smoker) according to low, medium, and high health literacy groups. Age, sex, education level (≤ 12 years or >12 years), occupation (presence or absence), economic status (very good and good, average, or poor and very poor), regular exercise (presence or absence), and subjective physical health and mental health (very good and good, average, or poor and very poor) were included in the model. Furthermore, participants were stratified by education

level, and the same analysis was performed.

All data were analyzed using SPSS statistical software (version 26; IBM SPSS Japan, Tokyo, Japan). All reported p-values were two-tailed, and values <0.05 were considered statistically significant.

RESULTS

Differences in characteristics among health literacy groups

Of 4751 ever smokers, the mean age was 54.0 years and more than half (60.7%) were men; 1343 (28.3%), 1850 (38.9%) and 1558 (32.8%) individuals were classified into the low, medium, and high health literacy groups, respectively. Table 1 shows the differences in characteristics

Table 1. Differences in characteristics among low, medium and high score groups of health literacy among ever smokers (N=4751)

Factors	All	Health literacy*			p
	n	Low score (tertile 1) n (%)	Medium score (tertile 2) n (%)	High score (tertile 3) n (%)	
Total, n	4751	1343	1850	1558	
Score, Mean \pm SD	3.5 \pm 0.8	2.5 \pm 0.5	3.5 \pm 0.2	4.2 \pm 0.3	
Age (years), Mean \pm SD	54.0 \pm 6.7	54.3 \pm 6.8	53.9 \pm 6.7	54.0 \pm 6.6	0.362
Men	60.7	65.3	58.4	59.4	< 0.001
Education level (≤ 12 years)	60.3	68.5	60.2	53.3	< 0.001
Living alone (yes)	16.1	17.3	15.9	15.3	0.307
Occupation (presence)	73.4	71.1	72.9	76.0	0.010
Economic status					< 0.001
Very good and good	15.7	11.3	13.4	22.3	
Average	21.3	20.7	22.8	20.1	
Poor and very poor	62.9	68.0	63.8	57.6	
Drinking status (regular drinkers)	37.2	37.7	37.1	36.7	0.866
Regular exercise (presence)	28.9	23.5	26.3	36.5	< 0.001
Obesity (presence)	30.4	31.5	29.7	30.3	0.559
Subjective physical health					< 0.001
Very good and good	31.6	21.3	30.2	42.1	
Average	44.6	47.6	45.9	40.6	
Poor and very poor	23.8	31.1	23.8	17.3	
Subjective mental health					< 0.001
Very good and good	30.4	20.6	28.1	41.7	
Average	43.8	47.0	45.3	39.2	
Poor and very poor	25.8	32.5	26.6	19.1	
Regular visits to medical institutions (presence)	64.6	63.6	63.6	66.6	0.125

*Participants were classified into three groups by the score tertiles of the CCHL scale. CCHL: communicative and critical health literacy. Continuous data were analyzed with analysis of variance and shown as mean \pm standard deviation (SD). Dichotomous and categorical data were analyzed using the χ^2 test, and are shown as %. Obesity was defined as BMI ≥ 25.0 kg/m².

Table 2. Multivariable adjusted odds ratios for current smoking according to health literacy among ever smokers

Health literacy	Current smokers % (n/N)	p	AOR (95% CI) ^a	Multivariable AOR (95% CI) ^b
Score group*				
High (Ref.)	46.1 (719/1558)	<0.001	1	1
Medium	49.7 (919/1850)		1.15 (1.01–1.32)	1.11 (0.97–1.28)
Low	55.9 (751/1343)		1.50 (1.29–1.73)	1.40 (1.20–1.64)

*Participants were classified into three groups by the score tertiles of CCHL scale. CCHL: communicative and critical health literacy. AOR: adjusted odds ratio. ^a Adjusted for age and sex. ^b Adjusted for age, sex, education level, occupation, economic status, regular exercise, subjective physical health and mental health.

Table 3. Multivariable adjusted odds ratios for current smoking according to health literacy among ever smokers stratified by education level

	Current smokers % (n/N)	p	AOR (95% CI) ^a	Multivariable AOR (95% CI) ^b
Education level >12 years				
Health literacy score*		<0.001		
High (Ref.)	37.6 (273/727)		1.0	1.0
Medium	42.9 (316/737)		1.24 (1.00–1.53)	1.25 (1.01–1.55)
Low	50.6 (214/423)		1.69 (1.33–2.16)	1.71 (1.33–2.20)
Education level ≤12 years				
Health literacy score*		0.084		
High (Ref.)	53.7 (446/831)		1.0	1.0
Medium	54.2 (603/1113)		1.03 (0.86–1.24)	1.01 (0.84–1.22)
Low	58.4 (537/920)		1.24 (1.03–1.50)	1.23 (1.01–1.50)

*Participants were classified into three groups by the score tertiles of CCHL scale. CCHL: communicative and critical health literacy. AOR: adjusted odds ratio. ^a Adjusted for age and sex. ^b Adjusted for age, sex, education level, occupation, economic status, regular exercise, subjective physical health and mental health.

according to low, medium, and high health literacy groups. Sex, education level, occupation, economic status, regular exercise, and subjective physical health and mental health differed significantly among the three groups.

Association between health literacy and current smoking

Of the 4751 ever smokers, 2389 (50.3%) were current smokers, and 2362 (49.7%) were ex-smokers. Table 2 shows multivariable adjusted odds ratios (AORs), adjusted for age and sex, and 95% CIs, for current smoking according to low, medium, and high score groups of health literacy among middle-aged Japanese ever smokers. The proportions of current smokers differed significantly among low (55.9%), medium (49.7%), and high (46.1%) health literacy groups ($p < 0.001$). After adjusting for age, sex, education level, occupation, economic status, regular exercise, and subjective physical health and mental health, AOR was 1.11 (95% CI: 0.97–1.28) in the medium health literacy group and 1.40 (95% CI: 1.20–1.64) in the low health literacy group, compared with the high health literacy reference group.

Table 3 shows multivariable AORs and 95% CIs for current smoking according to health literacy among ever smokers stratified by education level. After adjusting for age, sex, occupation, economic status, regular exercise, and subjective physical health and mental health: for education level ≤12 years, the AOR was 1.23 (95% CI: 1.01–1.50) in the low health literacy group; and for education level >12 years, the AOR was 1.25 (95% CI: 1.01–1.55) in the medium health literacy group and 1.71 (95% CI: 1.33–2.20) in the low health literacy group, compared with the high health literacy reference group.

Additional analysis revealed that low health literacy was positively associated with current smoking, even stratified by age and sex (Supplementary file Tables 1 and 2).

DISCUSSION

This large-scale, community-based study revealed a significant association between health literacy and current smoking among middle-aged Japanese ever smokers. The main finding in the current study was that low health literacy was positively associated with current smoking

among middle-aged Japanese ever smokers even stratified by educational level after adjusting for confounding factors.

Our results revealed that the proportion of current smokers in the low health literacy group was significantly higher than that in the high health literacy group (55.9% vs 46.1%). Further analysis revealed that those in the low health literacy group were significantly (1.40 times) more likely to be current smokers after adjusting for confounding factors, compared with those in the high health literacy group. This result is consistent with the findings of a previous study in England, which reported that among ever smokers aged ≥ 50 years, limited health literacy was associated with greater odds of being a current smoker compared with adequate health literacy¹¹.

The current results also revealed that the proportion of current smokers in a combined group of individuals with education level ≤ 12 years and low health literacy scores was higher than the proportion of current smokers in a combined group of individuals with education level >12 years and high health literacy scores (58.4% vs 37.6%). This result suggests that health literacy and educational level might be both important factors for current smoking among ever smokers. Further analysis revealed that those with low health literacy were 1.71 times more likely to be current smokers with education level >12 years, and those with low health literacy were 1.23 times more likely to be current smokers with education level ≤ 12 years after adjusting for confounding factors, compared with participants in the high health literacy group. The results indicate that low health literacy is positively associated with current smoking, irrespective of the education level (>12 years and ≤ 12 years). Overall, these results suggest that smokers with lower health literacy are less likely to quit smoking.

Regarding the mechanisms underlying this effect, health literacy is defined as the ability to read, understand, evaluate, and use health information necessary to make reasoned, health-related decisions¹⁵. A previous study suggested that low health literacy reduces people's understanding of both written and oral information related to cancer screening, particularly written materials³¹. These may imply that those with low health literacy may be unable to adequately extract, understand, and utilize information related to smoking. Additionally, in a US study, Stewart et al.¹⁴ reported that those with lower health literacy significantly had higher nicotine dependence, more positive smoking outcome expectancies (e.g. social facilitation), less negative smoking outcome expectancies (e.g. health risks), less knowledge about smoking health risks, and a lower level of perceived risk. Overall, smokers with lower health literacy may face various difficulties in quitting smoking.

Conversely, improving health literacy may be useful for smoking cessation among middle-aged smokers. A previous study reported that high health literacy was positively associated with stages of behavior change for smoking cessation among employees of educational health centers in

Iran¹².

Regarding methods for improving health literacy, a randomized controlled trial in a Japanese rural community indicated that health education through a weekly 90-minute active learning program that included exploratory learning, group work, and self-planning for behavioral change, was effective for enhancing comprehensive health literacy in older adults³². In addition to providing health education, improving people's access to health information is also considered to improve health literacy³⁰. For example, the U.S. Department of Health and Human Services developed and published guidelines called 'A Guide for Creating Easy-to-Understand Materials (poster, pamphlet, municipal public relations magazines, etc.)' and 'A Guide for Simplifying the User Experience' to improve people's access to health information^{33,34}. Overall, health education and easy-to-understand materials may be two useful methods to improve smokers' health literacy, and subsequently help smokers to quit smoking.

In the future, there are two suggestions for further research. On the one hand, longitudinal research design is needed to further clarify the association between health literacy and current smoking among ever smokers. On the other hand, intervention research is necessary to develop effective health education programs and create easy-to-understand materials to improve smokers' health literacy.

Strengths and limitations

An important strength of the present study is that we examined a large sample of community residents with NHI aged 40–64 years, which included individuals from five cities in Osaka Prefecture, Japan. However, this study also involved several limitations that should be considered. First, a cross-sectional design cannot prove causality. Second, we could not exclude the possibility of selection bias because the response rate was 36.7%. Third, other potential confounding factors that were not considered in this study, such as time when to start smoking, length of smoking period, number of cigarettes smoked per day, number of years passed after smoking cessation, and history of respiratory and cardiovascular disease, may have influenced the results, as these factors may affect current smoking. Despite these potential limitations, the present findings support the conclusion that improving health literacy is important for supporting smokers to quit smoking, among middle-aged Japanese community residents with NHI.

CONCLUSIONS

We assessed the association between health literacy and current smoking among middle-aged Japanese ever smokers. This mail survey using a self-administered questionnaire was conducted in 2020, and included 33902 community residents with NHI aged 40–64 years in five cities in Osaka Prefecture, Japan. A total of 4751 ever smokers were included in the analysis. Low health literacy was positively associated with

current smoking compared with high health literacy after adjusting for confounding factors. Further analysis revealed that this association was significant even stratified by education level. These results suggest that improving health literacy may help middle-aged smokers to quit smoking.

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CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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ETHICAL APPROVAL AND INFORMED CONSENT

The study was approved by the Institutional Review Boards of Osaka Prefecture University (Approval No. 2020-28; Date: 5 October 2020). All participants provided informed consent.

DATA AVAILABILITY

The data supporting this research are available from the authors on reasonable request.

PROVENANCE AND PEER REVIEW

Not commissioned; externally peer reviewed.