The Mediating Roles of Smoking-related Perception: Smoking, Education and Awareness

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ABSTRAK

Peningkatan mendadak dalam kelaziman merokok dalam kalangan remaja merupakan satu kebimbangan serius dalam kesihatan awam. Kajian ini merupakan antara yang terawal dalam literatur yang mengkaji kesan pengantaraan persepsi terhadap risiko merokok dalam hubungan antara tabiat merokok dengan faktor pendidikan dan kesedaran dalam kalangan remaja. Data yang digunakan dalam kajian diperoleh daripada Global Youth Tobacco Survey Timor-Leste. Model regresi probit digunakan untuk menilai pengaruh faktor demografi, pendidikan dan kesedaran terhadap kebarangkalian merokok. Peranan pengantaraan persepsi terhadap risiko merokok dianalisis menggunakan pemodelan persamaan struktur. Bertentangan dengan penemuan umum, persepsi terhadap risiko merokok didapati mempunyai hubungan positif dengan kebarangkalian merokok. Remaja yang peka terhadap mesej kawalan tembakau di media massa, menerima pendidikan berkaitan risiko merokok dan terlibat dalam perbincangan keluarga mengenai penggunaan tembakau, mempunyai tahap persepsi terhadap risiko merokok yang lebih tinggi berbanding remaja lain, dan faktor ini berkemungkinan mempengaruhi tingkah laku merokok mereka. Namun begitu, hubungan antara tabiat merokok dengan pendedahan kepada amaran grafik atau teks pada kotak rokok, serta pembacaan teks sekolah yang mengandungi topik tentang merokok tidak dimediasi oleh persepsi berkaitan merokok. Sebagai kesimpulan, persepsi terhadap risiko merokok bertindak sebagai pengantara dalam hubungan antara tabiat merokok dengan beberapa faktor pendidikan dan kesedaran tertentu dalam kalangan remaja.

Kata kunci: *Kesedaran; merokok; pendidikan; persepsi; remaja*

ABSTRACT

A sharp increase in the prevalence of smoking among adolescents is a significant public health concern. This study is among the first in the literature to explore the mediating effect of perceptions of smoking-related risks on the relationships between smoking and educational and awareness factors among adolescents. Data from the Global Youth Tobacco Survey Timor-Leste were analysed. Probit regression models were utilised to evaluate the impacts of demographic, educational and awareness factors on the

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likelihood of smoking. The mediating role of smoking risk perception was examined using structural equation modeling. Contrary to common findings, the perception of smoking-related risks was positively linked to the likelihood of smoking. Adolescents who were aware of tobacco control messages in mass media, received education on the risks of smoking and engaged in family discussions about tobacco use had higher perception of smoking-related risks than others, which in turn could impact adolescents' smoking behaviour. However, the relationships between smoking and exposure to graphic or text warnings on cigarette packs, as well as reading school texts that included topics about smoking were not influenced by smoking-related perceptions. In summary, the perception of smoking-related risks mediates the associations between smoking and particular educational and awareness factors among adolescents.

Keywords: Adolescents; awareness; education; perception; smoking

INTRODUCTION

Smoking is a growing and significant public health concern, closely associated with multiple neurological, cardiovascular and pulmonary diseases (Das 2003). Smoking can even lead to premature deaths in adolescents (Chung & Joung 2013). Not only people who smoke, but also non-smokers' health can be affected due to exposure to passive smoking (Cheah et al. 2018). Despite the alarming fact that smoking has serious adverse effects on health outcomes, data show a continuing rising trend in the prevalence of smoking. Each year, smoking is responsible for around 8 million deaths worldwide (World Health Organisation 2023). It is abundantly apparent that people who smoke in developing countries outnumber those in developed countries (World Health Organisation 2023). The majority of smokers initiate smoking during youth, with 83% beginning smoking at ages 14–25 years (Martins et al. 2023).

Although policymakers have made concerted efforts to curb smoking globally, the number of adolescents who smoke in Southeast Asian (SEA) countries remain high (Kishun et al. 2022). Timor-Leste, one of the low-income countries in SEA, exhibits a high prevalence of smoking in the adolescent population. A recent study found that 32.2% of adolescents aged 13-15 years smoked cigarettes, and up to 29% reported habitual smoking in the past 30 days (Martins et al. 2023). In Timor-Leste, raising the legal age of smoking, banning tobacco advertisements, and increasing tobacco taxes are among the existing policies aimed at preventing and controlling smoking among adolescents (Cheah 2024).

An in-depth understanding of smoking-related risks plays a crucial role in discouraging cigarette use (Song et al. 2009; Spijkerman et al. 2007). Educating adolescents about the adverse effects of smoking and improving their awareness of tobacco-associated health risks can be seen as one of the promising measures aimed at safeguarding adolescents from indulging in smoking. Previous studies often found educational and awareness factors to be associated with the perception of smoking-related risks. For instance, Bekalu et al. (2019) found that individuals who always discussed health-related issues with their family members were more likely to believe that smoking elevated the risk of diseases than those who did not. This finding was shared by de Graaf et al. (2016), who found that students possessed a more unfavourable attitude towards smoking if they had seen videos containing smoking-related educational content. In the study by Minh Dao et al. (2019), being aware of messages about the risk of smoking in mass media and pictorial warnings on cigarette packs raised smoking-related risk perception. Research findings of Chudech and Janmaimool (2021) likewise showed that students who were aware of graphic warning labels perceived a greater harm of smoking compared to those who were not.

Smoking risk perception is not only affected by educational and awareness factors but also has

impacts on the decisions of adolescents to smoke. Andrews et al. (2014) devoted their attention to the adolescent population and found smoking-related perception to be a strong protective factor against smoking. Netemeyer et al. (2016) observed that negative attitudes toward smoking acquired from graphic health warning labels on cigarette packs could safeguard adolescents from engaging in smoking behaviour. Similar findings were evidenced by Nurumal et al. (2021), who pointed out that Malaysian adolescents with a better perception of smoking-related risks were less likely to use cigarettes than those with poor perception.

In light of the findings from previous studies, the perception of smoking-related risk is expected to act as a potential pathway to the associations between smoking and education and awareness. The selection of the outcome, explanatory and mediating variables in the present study was based on empirical justification. Firstly, considering the evidence that education is an important determining factor of tobacco use among adolescents in Timor-Leste, educational and awareness factors were chosen as the explanatory variables (Foon & Cheah 2022). It was hypothesised that these variables might have direct and indirect impacts on smoking behaviour. Secondly, adolescents who were aware or had received adequate information about smoking tend to have a higher perception of smoking-related risks than those who did not because they possessed good knowledge on the disadvantages of smoking (Bekalu et al. 2019; Chudech & Janmaimool 2021; Minh Dao et al. 2019; de Graaf et al. 2016). Hence, the present study proposed smoking risk perception as the mediator and expected it to be influenced by educational and awareness variables. Thirdly, smoking-related risk perception might alter adolescents' preference for tobacco, thereby affecting smoking behaviour in adolescents (Andrews et al. 2014; Netemeyer et al. 2016; Nurumal et al. 2021). As such, smoking behaviour was used as the outcome variable and was expected to be influenced by the mediator. Although the mediating role of smoking-related perception in the relationships between smoking

and educational and awareness factors seems plausible, it has yet to be assessed in previous studies. Research conducted in the past only focused on examining the mediating effect of fear on the association between pictorial health warnings and smoking (Andrews et al. 2014; Netemeyer et al. 2016), how psychological reactance explained the correlation between pictorial warnings and domineeringness (LaVoie et al. 2017), as well as the mediating role of health beliefs in the relationship between health information seeking behaviour and smoking cessation (Upadhyay et al. 2019).

The objective of the present study was to examine whether the perception of smoking-related risks mediated the associations between smoking and educational and awareness factors among adolescents. The present study was among the first in the literature to conduct this kind of analysis. Another contribution of the present study was extension of existing literature which focused on the adolescent population in Timor-Leste, a low-income country where empirical studies were lacking. Even though the literature related to adolescent smoking spans the globe, studies conducted in Timor-Leste are nearly non-existent. The studies by Martins et al. (2023), Foon and Cheah (2022) and Cheah (2024) were among a few published articles that focus on adolescents in Timor-Leste. While they provided insightful evidence on factors associated with knowledge of smoking and smoking behaviour, they did not include particular consideration to the mediating role of smoking risk perception.

MATERIALS AND METHODS

Data

This study was conducted using data derived from the Global Youth Tobacco Survey (GYTS) Timor-Leste 2019 (World Health Organisation 2020). It was a cross-sectional, nationwide study of school adolescents in Timor-Leste. The main objective of the survey was to obtain comprehensive data on adolescent smoking behaviour. The targeted respondents were adolescents attending high

schools (Grades 7 to 11). Two-stage stratified sampling was used to recruit respondents. All high schools in Timor-Leste with at least 40 students per class were included in the first-stage sampling unit. Then, the survey used probability proportional to the size of the school sampling to select schools. Next, systematic equal probability sampling was used to choose classes. Eligible respondents were students in the selected classes. A total of 4150 students were qualified for the survey, but only 3474 took part, which was roughly equal to a response rate of 83.7%.

Standard questionnaires used in the GYTS were adopted. However, additional country-specific questions were added to the questionnaires to obtain extra details regarding smoking in Timor-Leste. These included the accessibility of tobacco products near schools and exposure to second-hand smoke in public areas. The questionnaires covered topics about tobacco use, knowledge of smoking, awareness of the harmful effects of tobacco use, as well as attitudes toward smoking. They were written in English and distributed to respondents for self-administration. Respondents were asked to provide written consent before they received the questionnaires. Those without written consent were not permitted to participate. To minimise social desirability bias, respondents were informed that their profiles and responses were confidential and used for research and intervention planning purposes only. The WHO's Ethical Committee and Ministries of Education and Health in Timor-Leste provided ethical approval.

Outcome Variable

The outcome variable used in this study was smoking behaviour, a categorical variable with dichotomous outcomes. It was assessed by asking respondents whether they had smoked cigarettes in the past 30 days. Those who answered 'Yes' were identified as adolescent smokers.

Mediating Variable

The mediator in this study, perception of smoking-related risks, was a discrete variable defined based on Cheah's study (2024). Three questions related to smoking perceptions were included in the interviews: (i) 'Do you think exposure to second-hand smoke is harmful to you?'; (ii) 'Do you think it is hard for you to quit once you have started smoking cigarettes?'; and (iii) 'Do you think cigarette use has negative effects on your health?'. Response options for these questions were 'Definitely not', 'Probably not', 'Probably yes', and 'Definitely yes', assigned values of 0, 1, 2, and 3, respectively. The summed values ranged from 0 to 9, with a Cronbach's alpha score of 0.78, indicating instrument reliability (Cheah 2024).

Explanatory Variables

Following the methodology used by Cheah (2024), the educational and awareness variables selected in the present study consisted of five factors: (i) awareness of tobacco control messages on mass media; (ii) exposure to graphic or text warnings on cigarette packs; (iii) education regarding the adverse effects of smoking; (iv) family discussion about tobacco use; and (v) reading school texts containing smoking-related topics. They were assessed based on the following questions: (i) 'During the past one month, did you see or hear any tobacco control messages on mass media?'; (ii) 'During the past one month, did you see any graphic or text warnings on cigarette packs?'; (iii) 'During the past one year, were you taught in any of your classes about the adverse effects of smoking?'; (iv) 'Has anyone in your family discussed the negative impacts of tobacco use with you?'; and (v) 'During the past one year, did you read in your school texts regarding the effects of tobacco on health?'. The responses to all these questions were either 'Yes' or 'No'; thus, all the explanatory variables were formatted as dichotomous variables. The present study hypothesised that adolescents who were conscious of tobacco control messages on mass media, were exposed to graphic or text warnings on cigarette packs, received education regarding the adverse impacts of smoking on

health, had household members who discussed the risks associated with smoking, and read school texts containing smoking-related topics held higher smoking risk perception than others, and this perception was associated with smoking behaviour. The control variables considered in this study were demographic characteristics, including age, gender, weekly expenditure and parental employment status. They were chosen based on previous studies concerning adolescent smoking in Timor-Leste (Foon & Cheah 2022; Martins et al. 2023), as well as the data availability from the GYTS Timor-Leste 2019. Weekly expenditure was used as a proxy for income. Respondents were asked, 'On average, how much money do you have that you can spend on yourself in a week?' with the possible answers: United States Dollar (USD) <1, USD 1–2, and USD 3–5.

Statistical Analyses

Due to incomplete information provided by some respondents, only 3,345 observations were used in the statistical analyses. Fisher's exact tests were conducted to assess the associations between smoking and demographic, educational and awareness variables. However, for variables with more than two categories, such as age and weekly expenditure, Pearson's Chi-square tests were used. Probit regression was estimated to explore factors affecting the probability of smoking. Partial effects at the average were calculated and interpreted as changes in percentage points (pp). Since the data used in the present study had a large number of observations, the distribution of sample means approximated a normal distribution, assuming the central limit theorem assumption held. As such, probit regression with a standard normal cumulative distribution function and standard normally distributed residuals was suitable for the present study (Wooldridge 2010).

Three regression models were developed to determine the best model that fit the data used in the current analysis. The baseline model included only age and gender. Model 2 added weekly expenditure and parental employment status. Model 3 was the comprehensive model, which incorporated all the variables, including the educational and awareness variables, as well as the perception of smoking-related risks. Next, these three models were compared using their information on log likelihood, pseudo-R-squared, Akaike's information criterion (AIC) and likelihood ratio (LR) tests.

In addition to probit, this study utilised structural equation modeling to estimate how the perception of smoking-related risks mediated the relationships between smoking and educational and awareness variables. The estimated total effects of explanatory variables were broken down into direct and indirect effects. The models were adjusted for demographic variables. Standard errors were bootstrapped with 1,000 replicates. For all the tests, *p*-values of less than 0.05 were deemed significant. All analyses were performed using the Stata statistical software: Release 16 (StataCorp, College Station, TX, USA) (StataCorp 2019).

RESULTS

Most of the respondents did not smoke cigarettes (83.1%). 71.6% of the respondents were aware of tobacco control messages on mass media, 67.1% of them were exposed to graphic or text warnings on cigarette packs, 50.1% of them did not receive education concerning the dangers of smoking, 59.0% of them had family members who discussed issues about tobacco use and 51.5% of them read school texts containing smoking-related topics. Adolescents who noticed health warnings on cigarette packs (19.8%), engaged in family discussions about the negative effects of smoking (18.1%), and had the opportunity to read school texts that included smoking content (18.4%) were more likely to smoke compared to those who did not (Table 1).

Model 3 was the most suitable regression model as it had the highest log-likelihood and pseudo R-squared, as well as a significant LR chi-square value. Additionally, it did not exhibit multicollinearity because its maximum Variance inflation factor (VIF) was below the

TABLE 1: Summary statistics of variables (n = 3345)

Variables	Total n (%)	Smoking		p-value
		Yes, n (%)	No, n (%)	
Smoking				
Yes	564 (16.9)	–	–	–
No	2781 (83.1)	–	–	
Age (years)#				
≤12	233 (7.0)	30 (12.9)	203 (87.1)	<0.001*
13-14	985 (29.5)	126 (12.8)	859 (87.2)	
15-16	1336 (39.9)	247 (18.5)	1089 (81.5)	
≥17	791 (23.7)	161 (20.35)	630 (79.7)	
Gender				
Male	1329 (39.7)	443 (33.3)	886 (66.7)	<0.001*
Female	2016 (60.3)	121 (6.0)	1895 (94.0)	
Weekly expenditure (USD)#				
<1	2015 (60.2)	317 (15.7)	1698 (84.3)	0.068
1-2	950 (28.4)	171 (18.0)	779 (82.0)	
3-5	380 (11.4)	76 (20.0)	304 (80.0)	
Parental employment status				
Employed	2056 (61.5)	339 (16.5)	1717 (83.5)	0.477
Unemployed	1289 (38.5)	225 (17.5)	1064 (82.5)	
Awareness of tobacco control messages on mass media				
Yes	2396 (71.6)	412 (17.2)	1984 (82.8)	0.442
No	949 (28.4)	152 (16.0)	797 (84.0)	
Exposure to graphic or text warnings on cigarette packs				
Yes	2243 (67.1)	445 (19.8)	1798 (80.2)	<0.001*
No	1102 (32.9)	119 (10.8)	983 (89.2)	
Education regarding the adverse effects of smoking				
Yes	1669 (49.9)	293 (17.6)	1376 (82.4)	0.289
No	1676 (50.1)	271 (16.2)	1405 (83.8)	
Family discussion about tobacco use				
Yes	1972 (59.0)	356 (18.1)	1616 (82.0)	0.027
No	1373 (41.1)	208 (15.2)	1165 (84.9)	
Reading school texts containing smoking-related topics				
Yes	1723 (51.5)	317 (18.4)	1406 (81.6)	0.016
No	1622 (48.5)	247 (15.2)	1375 (84.8)	

Note: The entries refer to frequencies. For total sample, column percentages are shown in parentheses. For respondents who smoked and did not smoke, row percentages are shown in parentheses.
#Pearson's Chi-square test was applied. For other variables, p-values for Fisher's exact tests.
*significant value < 0.05
Source: GYTS Timor-Leste 2019

widely accepted threshold of 10 (Wooldridge 2010). Keeping demographic factors constant, respondents who were exposed to graphic or text warnings on cigarette packs were linked with a 7.2 pp higher likelihood of smoking than those who were not. The likelihood of smoking increased by 1.7 pp if the respondents had read school texts containing smoking-related topics. Each additional unit of smoking risk perception raised the likelihood of smoking by 0.5 pp (Table 2).

Despite the finding that awareness of tobacco control messages on mass media, education about the harmful effects of smoking and family discussions about tobacco use were not significantly associated with smoking behaviour, they were included in the mediation analysis to explore their potential indirect effects on smoking. The study results revealed that the perception of smoking-related risks fully mediated the relationships between smoking behaviour and awareness of tobacco control messages on mass media, education about the harmful effects of smoking and family discussions about tobacco use. However, the connections between cigarette use and exposure to graphic or text warnings on cigarette packs, as well as reading school texts containing smoking-related topics, were not mediated by smoking risk perception (Table 3).

DISCUSSION

The rapid increase in the prevalence of smoking among adolescents is a concerning issue.

TABLE 2: Factors associated with smoking (n = 3345)

Variables	Model 1	Model 2	Model 3
Age			
≤12	-0.053 (0.028)	-0.044 (0.028)	-0.037 (0.028)
13-14	-0.048* (0.016)	-0.040* (0.017)	-0.040* (0.016)
15-16	-0.002 (0.015)	0.003 (0.015)	0.001 (0.014)
≥17	Ref.	Ref.	Ref.
Gender			
Male	0.240* (0.012)	0.243* (0.012)	0.236* (0.012)
Female	Ref.	Ref.	Ref.
Weekly expenditure (USD)			
<1	–	-0.061* (0.019)	-0.063* (0.018)
1-2		-0.024 (0.020)	-0.028 (0.020)
3-5		Ref.	Ref.
Parental employment status	–		
Employed		-0.014 (0.012)	-0.016 (0.012)
Unemployed		Ref.	Ref.
Awareness of tobacco control messages on mass media			
Yes	–	–	-0.012 (0.014)
No			Ref.
Exposure to graphic or text warnings on cigarette packs			
Yes	–	–	0.072* (0.014)
No			Ref.
Education regarding the adverse effects of smoking			
Yes	–	–	-0.001 (0.013)
No			Ref.

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Variables	Model 1	Model 2	Model 3
Family discussion about tobacco use			
Yes	–	–	0.005 (0.013)
No			Ref.
Reading school texts containing smoking-related topics			
Yes	–	–	0.017* (0.012)
No			Ref.
Smoking risk perception	–	–	0.005* (0.003)
Log likelihood	-1296.489	-1289.031	-1270.260
Pseudo R²	0.146	0.151	0.163
AIC	2602.979	2594.062	2568.521
LR test of fit	–	12.920	37.540
p-value of χ² value	–	0.002	<0.001
Maximum VIF	1.620	2.560	2.570

Note: The entries refer to partial effect at the average. Robust standard errors in parentheses.
Ref: reference groups; AIC: Akaike's information criterion; VIF: variance inflation factor; LR: likelihood ratio test for goodness-of-fit. *significant value.
Source: GYTS Timor-Leste 2019

TABLE 3: The mediating effects of perception of smoking-related risks on the relationships between smoking and awareness, and educational variables (n = 3345)

Variables	Effect	Estimates	BSE	p-value
Awareness of tobacco control messages on mass media	Total	0.019	0.014	0.175
	Direct	0.013	0.014	0.352
	Indirect	0.006	0.002	0.017*
Exposure to graphic or text warnings on cigarette packs	Total	0.066	0.012	<0.001*
	Direct	0.065	0.012	<0.001*
	Indirect	0.001	0.001	0.457
Education regarding the adverse effects of smoking	Total	0.019	0.012	0.130
	Direct	0.012	0.013	0.366
	Indirect	0.007	0.003	0.019*
Family discussion about tobacco use	Total	0.021	0.012	0.083
	Direct	0.014	0.012	0.245
	Indirect	0.007	0.003	0.021*
Reading school texts containing smoking-related topics	Total	0.028	0.012	0.015*
	Direct	0.024	0.012	0.038*
	Indirect	0.004	0.002	0.060

Note: Models were adjusted for age, gender, weekly expenditure and parental employment status.
BSE: bootstrap standard errors; *significant value < 0.05
Source: GYTS Timor-Leste 2019

Although educational and awareness factors play a crucial role in influencing smoking behaviour, it is unclear whether these factors are positively or negatively associated with adolescents' inclination to smoke. Moreover, the pathways leading to the likelihood of smoking remain ambiguous. Therefore, the current study utilised a nationally representative sample and a rigorous statistical approach to explore the connections between smoking and various educational and awareness variables, along with the mediating role of the perception of smoking-related risks.

Contrary to popular belief and prior hypotheses, the perception of smoking-related risks was found to be correlated with an increased likelihood of smoking. This finding is somewhat unexpected as previous studies consistently demonstrated the opposite. For example, Al Omari et al. (2021) observed that students with negative attitudes toward smoking were less likely to smoke compared to those with positive attitudes, and Alves et al. (2022) identified a strong link between negative attitudes and smoking cessation among students. The results of the current study suggest a possibility of reverse causality in the relationship between the perception of smoking-related risks and smoking initiation. For instance, smoking may lead to increase exposure to information about the adverse effects of smoking. However, this assertion should be interpreted cautiously since cross-sectional data do not indicate a strong causal relationship. Nevertheless, we performed subgroup analysis to compare differentiated smoking risk perception across respondents who were exposed to education regarding the adverse effects of smoking and those who were not (Table 4). For those who received education, their mean value of smoking risk perception was 5.074, whereas for those who did not, their mean value was only 3.839. This may be because adolescents who smoke are often advised by educators to stop smoking; thus, they tend to receive more education and have better perception about smoking than their peers who do not smoke.

While awareness of tobacco control messages in mass media did not directly impact cigarette use, it did positively influence smoking behaviour through the perception of smoking-related risks. This result contradicts with the hypothesis of the current study and previous findings suggested that anti-tobacco media could protect adolescents from smoking. As emphasised by Allen et al. (2015) and Luo et al. (2021), who conducted a comprehensive review of studies on tobacco use among youths, tobacco-related media campaigns were effective in reducing smoking prevalence, and smokers engaged in smoking cessation programs on social media were more likely to quit smoking compared to those not involved. Similarly, Hoang et al. (2022) found that smokers were more inclined to quit if they received anti-tobacco information from mass media.

Exposure to graphic or text warnings on cigarette packs was found to be positively linked to the likelihood of smoking, but this association was independent of the perception of smoking-related risks. This finding needs to be interpreted considering a possible bidirectional relationship. Smokers purchase cigarette packs, so adolescent

TABLE 4: Smoking risk perception differences in exposure to education regarding the adverse effects of smoking (n = 3345)

Variables	Education regarding the adverse effects of smoking		p-value
	Yes	**No**	
Perception of smoking-related risks			
Mean	5.074	3.839	<0.001
Standard deviation	(2.278)	(2.371)	

One-way ANOVA was applied. * significant value < 0.05.
Source: GYTS Timor-Leste 2019

smokers tend to be more familiar with health warnings on packs. In essence, exposure to warnings on cigarette packs is associated with smoking, yet smoking itself may lead to increased exposure to these warnings. On the other hand, non-smokers do not buy cigarettes, so they have lesser knowledge of health warnings. These results contradict those of numerous studies. Mansour and Bakhsh (2017) discovered that smokers were more likely to quit if they took pictorial health warning messages on cigarette packs seriously. Tugrul (2015) also concluded that visual warning labels could enhance the intention to quit smoking, as evidenced by Wu et al. (2015).

Smoking-related risk perception completely explained the relationship between education regarding the risks of smoking and smoking participation. In other words, adolescents who smoked were more likely to be those who held a better perception of risks because they had received education about the adverse effects of smoking on health. This may be due to smokers having more opportunities to learn about the harmful impacts of smoking. The current study's finding contradicts both the prior hypothesis and the results from earlier research. For example, Derbel et al. (2021) observed that attendance at smoking education conferences could promote smoking cessation and reduce cigarette use. Hong et al. (2015) found that adolescents were more likely to quit smoking if they had participated in education programs on the risks of tobacco use. Ruokolainen et al. (2021) identified education as a critical protective factor against smoking.

Having family members who discussed the negative impacts of smoking was linked to an increased likelihood of cigarette use, and this link was entirely mediated by smoking-related risk perception. It is conceivable that smokers are more inclined to have family discussions than non-smokers due to intervention activities. The findings of the present study not only contradict the hypothesis but also the evidence from previous studies. For instance, a review of past studies suggested that individuals who frequently discussed health-related issues with their family members had better knowledge about smoking

risks and consequently were less likely to smoke (Bekalu et al. 2019). Moreover, the awareness factor within families was crucial in protecting adolescents from smoking (Hong et al. 2015).

While exposure to smoking-related reading materials did not enhance the perception of smoking-related risks, it was directly linked to smoking behaviour. Smoking risk perception seemed to have no mediating role in the relationship between reading and smoking. One plausible explanation for this finding is that smokers are more likely to come across smoking content through reading compared to non-smokers. Future studies are advised to use an experimental approach to delve further into the factors contributing to the positive correlation between reading and smoking. It is noteworthy that the present study does not support conclusions drawn from previous research that adequate knowledge about smoking is associated with a reduced likelihood of smoking among youths (Rahman & Gietel-Basten 2024). Additionally, smokers who actively seek health-related information are more likely to quit smoking than those who do not (Upadhyay et al. 2019).

The findings of the current study provide crucial insights for policy formulation. Policymakers should recognise that improving adolescents' perception of smoking-related risks in Timor-Leste may not be the sole solution to the high prevalence of smoking. Understanding why adolescents are more likely to smoke despite having a high perception of smoking-related risks is vital for developing more effective intervention strategies to reduce adolescent smoking. The present study sheds light on the fact that educating adolescents about the negative consequences of tobacco use through teachings, family discussions and mass media can enhance adolescents' perception of smoking-related risks. Therefore, public health administrators and school authorities are urged to focus on adolescents' knowledge about smoking and explore other measures that can directly discourage smoking. Furthermore, policymakers should acknowledge that exposure to graphic

or text warnings on cigarette packs and reading school materials on smoking are significant factors influencing smoking behaviour. To achieve the goal of reducing cigarette use among high school students, policymakers need to further investigate why awareness of the adverse effects of tobacco use on health is linked to smoking behaviour.

Although the present study provides insightful findings on the mediating effects of smoking-related risk perception on the relationships between smoking and educational and awareness factors, it has some limitations. Firstly, findings derived from cross-sectional data cannot determine causality. Secondly, underage smoking is illegal in Timor-Leste, so respondents may underreport their cigarette use. Nevertheless, interviewers made efforts to minimise social desirability bias by ensuring respondents of confidentiality for research and policy planning purposes. Thirdly, only one mediator was assessed in the study. Research that considers multiple mediators can yield more compelling results. Fourthly, out-of-school adolescents may have different perceptions of smoking-related risks, but they were not included in the study. Despite these limitations, this study is the first comprehensive investigation into whether smoking-related risk perception can elucidate the associations between cigarette use and awareness of tobacco control messages in the mass media, exposure to graphic or text warnings on cigarette packs, education on smoking risks, family discussions on tobacco use and reading school materials on smoking. The utilisation of large, nationally representative data with comprehensive information to generate novel and accurate findings is another strength of this study. Furthermore, unlike previous studies, this research focused on a low-income country where studies on adolescent smoking are scarce.

CONCLUSION

To the best of the author's knowledge, this is the first comprehensive study to provide new evidence of the direct and indirect effects of educational and awareness factors on smoking behaviour among adolescents through the perception of smoking-related risks. The relationships between smoking and awareness of tobacco control messages on mass media, education regarding the adverse effects of smoking, as well as family discussions about the risk of tobacco use were fully mediated by smoking risk perception. These findings are vital for policymakers who aim to reduce the prevalence of cigarette use among adolescents in Timor-Leste. If longitudinal data are made available, a future study is advised to thoroughly explore the causal impacts of smoking-related risk perception on smoking behaviour and their connection with anti-tobacco policies.

Ethical statement: Ethical approval was sought from the WHO's Ethical Committee and Ministries of Education and Health in Timor-Leste. Written consent was obtained from respondents before the interviews.

Availability of data and material: The data that support the findings of this study are openly available at https://extranet.who.int/ncdsmicrodata/index.php/catalog/927/study-description.

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