The role of socioeconomic status in the association between advertising exposure and electronic cigarette use among young adults in China: A moderated mediation analysis

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ABSTRACT

INTRODUCTION Exposure to advertising is a determinant of electronic cigarette (e-cigarette) use among young adults. Few studies have explored the underlying mechanisms of advertising exposure on e-cigarette use among young Chinese adults.

METHODS An online survey was administered to a sample of 2956 young adults (aged 20–34 years) who were never smokers, from April to May 2022, in China. Mediation analyses were used to test the mediating effects of curiosity and harm perception, and moderated mediation models were conducted to examine whether the relationships in mediation modeling vary across different levels of socioeconomic status (household income, education level, and residence).

RESULTS Greater advertising exposure was associated with a higher likelihood of e-cigarette use (AOR=1.39; 95% CI: 1.26–1.54) and curiosity about e-cigarettes (AOR=1.33; 95% CI: 1.25–1.42), and the latter mediated the association between advertising exposure and e-cigarette use (proportion mediated=26.9%; 95% CI: 15.8%–40.7%) while harm perception did not. Additionally, the effect of advertising exposure on curiosity was moderated by household income (p=0.03) and residential area (p=0.001), and was stronger among participants with lower socioeconomic status.

CONCLUSIONS E-cigarette advertising may promote young adults' experimentation by increasing their curiosity towards the products. Socially disadvantaged groups may be more susceptible to e-cigarette advertising. The study suggests that the government should explore options for better regulation of e-cigarettes to prevent initiation by never smokers and protect vulnerable populations.

INTRODUCTION

Electronic cigarettes (e-cigarettes) are battery-powered devices that heat a reservoir of liquid that commonly contains nicotine as well as flavorings and other chemicals, which are vaporized and inhaled by the users. Originally introduced as a potential substitute for combustible cigarettes, these products have been widely perceived as being 'less harmful' than cigarettes and reported to aid cessation among adult smokers[1]. However, e-cigarettes are now attracting not only smokers but also those who have never used conventional tobacco cigarettes. The use of e-cigarettes has climbed significantly over the past decade among young generations globally. In China, e-cigarette use in this period has been lower but rising. The latest report released by the Chinese Center for Disease

Control and Prevention, indicated that one in ten college students had tried e-cigarettes at least once, and 2.5% were current users in 2021[2]. Laboratory and epidemiological studies suggest that e-cigarette use may have adverse impacts on respiratory and cardiovascular systems[3,4], but long-term health impacts remain unknown due to lack of data on this newly emerged product[5]. The ongoing debate about their harms has raised a pressing public health concern on e-cigarette use among youth, especially those who are not addicted to combustible cigarettes. In response to this, 35 countries have banned the sale of either all e-cigarettes or nicotine-containing e-cigarettes[6].

Advertising exposure has been identified as an influential risk factor for e-cigarette use among adolescents and young adults in both observational and experimental studies[7,8]. Manufacturers promote these products as fashion accessories to attract potential young users through multiple approaches, including celebrity endorsements, promoting sleek designs and a variety of flavors, and evoking positive feelings[9]. Overall, these strategies have been shown by strong empirical evidence to be effective in appealing to never smokers to try e-cigarettes[8]. Given this, further delineating mechanisms by which advertising exposure influences e-cigarette use is essential for developing policies to regulate marketing practices and reduce initiation by never smokers.

To our knowledge, little research has investigated the mechanisms regarding how and the extent to which advertising exposure impacts e-cigarette use in China. Existing studies, which are mostly from Western countries, have pointed out that curiosity and harm perception towards e-cigarettes might be critical mediators between advertising exposure and e-cigarette use[8,10-13], yet the evidence is still limited and inconsistent. Instead of health benefits, e-cigarette advertisements in China tend to promote product qualities and emotion-related benefits to cater to local young people[14]. Due to higher smoking rates and lower compliance with smoke-free legislation than in the US, young people in China are more likely to be exposed to secondhand smoke[15] and thus may hold different attitudes toward e-cigarettes. Therefore, whether the previous findings can be generalized to Chinese young adults needs to be examined. In addition, little is known about the role of socioeconomic status on the pathway of advertising exposure promoting e-cigarette use.

Therefore, this study aims to: 1) test whether curiosity and harm perception mediate the relationship between advertising exposure and e-cigarette use among young Chinese adults; and 2) examine whether socioeconomic status, including education level, income, and residential area, moderates the effect of advertising exposure on e-cigarette use through possible mediators (e.g. curiosity and harm perception).

METHODS
Data and participants
Data were collected from a national online survey conducted between April and May 2022, in China. Through quota sampling, we recruited 5215 young adults by gender, age (20–24, 25–29, and 30–34 years), and geographical area (East, Central, and West) to match their percentages in census data via Questionnaire Star, a leading enterprise technology platform that has been widely used for research purposes in China. Individuals who met the eligibility requirements were sent an invitation to participate in this online survey through the Questionnaire Star platform. When the number of individuals, according to the quota sampling structure, was reached, the platform stopped inviting new participants. Further details regarding the survey and sampling method are described in the Supplementary file. We first removed 95 (1.8%) participants who had never heard of e-cigarettes and 30 (0.6%) participants who had logical errors in their responses (e.g. their age of smoking initiation was greater than their current age). We further excluded 2134 (40.9%) smokers and ex-smokers with more than 100 cigarettes smoked throughout their lifetime and restricted our analytical sample to 2956 (56.7%) never smokers. The Institutional Review Board at Peking University approved the study, and informed consent was obtained from all participants.

Measures
E-cigarette use
The use of e-cigarettes was measured by the question: 'Have you ever tried an e-cigarette?'. If the answer was yes, participants were then asked: 'How often did you use e-cigarettes in the past 30 days?'. Those

who reported e-cigarette use in the past 30 days were defined as e-cigarette users, while those who did not were considered non-users.

Advertising exposure

Advertising exposure was measured using the question: 'On average, how often have you seen advertisements for e-cigarette products in the past six months?'. Respondents were presented with a range of response options, including 'never', 'less than once a month', 'once a month', 'more than once a month', 'once a week', and 'more than once a week'. We coded the responses from 0 to 5 to evaluate the intensity of advertising exposure.

Curiosity

Curiosity was assessed by the following question: 'Have you ever been curious about e-cigarettes?' with response options of 'yes' or 'no'.

Harm perception

All individuals were asked to rate their disagreement or agreement on a five-point Likert scale, from strongly disagree to strongly agree (ranging from 1 to 5), to the following three statements regarding e-cigarette benefits: 1) can help quit smoking, 2) are less harmful than cigarettes, and 3) are less addictive than cigarettes. Based on previous studies[8,11,16], we measured harm perception by the summed score, with a range 3–15 and a lower value suggesting that e-cigarettes were perceived as less harmful than cigarettes by respondents. Cronbach's alpha for the total scale was 0.84, indicating favorable internal consistency.

Socioeconomic status (SES)

We employed household income, education level, and residence, to represent respondent SES. Annual household income (RMB) was categorized into four groups by quartiles, including low <50000, lower middle 50000–99999, upper middle 100000–200000, and high >200000 [The mean per capita disposable income of a household in China in 2022 was RMB 36883 (about US$5164; with 1000 Chinese Renminbi about US$140), according to a report from China National Bureau of Statistics]. Education level was defined as 'high school and lower', 'junior

college', 'undergraduate', and 'postgraduate' (each includes both current students and degree holders). Respondents' residence was classified into two types: 'metropolis' (four megacities and other provincial capital cities in China) and 'small city and rural counties' (non-provincial capital cities, counties, or rural areas).

Other covariates

The following demographic characteristics were included as covariates in the analysis: age (years), gender (male, female), current student status (student, non-student), and professional occupation area (health-related, non-health-related). Health-related occupations mainly included clinicians, nurses, public health professionals, and nutritionists, who might have a higher level of knowledge regarding e-cigarettes.

Statistical analysis

Descriptive analyses were conducted for all variables (demographic characteristics, advertising exposure, curiosity, harm perception, and e-cigarette use behaviors) using independent t-tests for continuous variables and chi-squared tests for categorical variables to assess whether the distributions of the variables varied across e-cigarette use status (yes/no). Associations between advertising exposure (independent variable of interest) and outcome variables (curiosity, harm perception, and e-cigarette use) were examined using logistic and linear regression models. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported for logistic regression models. The mediating role of curiosity and harm perception about e-cigarettes was then tested using the general approach to mediation analysis developed by Imai et al.[17]. Point estimates for the average causal mediation effect, average direct effect, total effect, and their 95% CIs were estimated with 5000 bootstrap resamples. The mediation model could be established if the 95% CI of the indirect effect did not include zero.

Moderated mediation analyses were used to examine whether SES moderated the direct and indirect effect of advertising exposure on e-cigarette use through possible mediators. The hypothetical model is presented in Figure 1. Specifically, moderated effects

Figure 1. Hypothetical conceptual models explaining how advertising exposure impacts e-cigarette use among Chinese never smokers
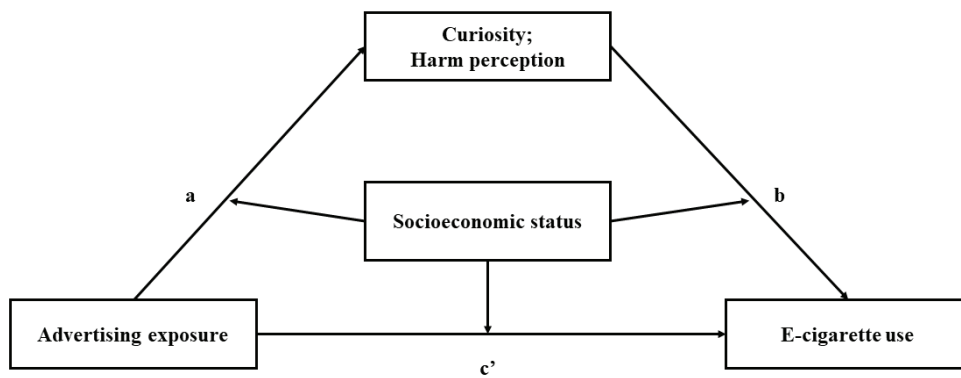

Table 1. Characteristics of study participants by e-cigarette use status in Chinese never smokers, 2022 (N=2956)

Characteristics	Total (N=2956) n (%)	Non-user (N=2759) n (%)	E-cigarette user (N=197) n (%)	p
Gender				0.294
Female	1947 (65.9)	1810 (65.6)	137 (69.5)	
Male	1009 (34.1)	949 (34.4)	60 (30.5)	
Age (years), mean (SD)	26.2 (4.09)	26.1 (4.11)	26.4 (3.88)	0.334
Student status				0.071
Non-student	2268 (76.7)	2106 (76.3)	162 (82.2)	
Student	688 (23.3)	653 (23.7)	35 (17.8)	
Professional area				0.003
Non-health-related	2518 (85.2)	2365 (85.7)	153 (77.7)	
Health-related	438 (14.8)	394 (14.3)	44 (22.3)	
Education level				0.484
High school or lower	186 (6.3)	178 (6.5)	8 (4.1)	
Junior college	505 (17.1)	467 (16.9)	38 (19.3)	
Undergraduate	1985 (67.2)	1851 (67.1)	134 (68.0)	
Postgraduate	280 (9.5)	263 (9.5)	17 (8.6)	
Household income				0.041
Low	840 (28.4)	794 (28.8)	46 (23.4)	
Lower middle	665 (22.5)	623 (22.6)	42 (21.3)	
Upper middle	890 (30.1)	833 (30.2)	57 (28.9)	
High	561 (19.0)	509 (18.4)	52 (26.4)	
Residence				0.602
Metropolis	1486 (50.3)	1391 (50.4)	95 (48.2)	
Small city and rural counties	1470 (49.7)	1368 (49.6)	102 (51.8)	
Advertising exposure, mean (SD)	1.70 (1.32)	1.66 (1.31)	2.37 (1.32)	<0.001
Curious				<0.001
No	1135 (38.4)	1119 (40.6)	16 (8.1)	
Yes	1821 (61.6)	1640 (59.4)	181 (91.9)	
Harm perception (score), mean (SD)	9.54 (2.84)	9.65 (2.84)	8.02 (2.36)	<0.001

were examined by testing the statistical significance of the interaction terms, and the conditional indirect effects of advertising exposure on e-cigarette use among different SES groups were estimated. Covariates (age, gender, current student status, and professional occupation area) were controlled in the moderated mediation models. The adjusted regression coefficients and their 95% CIs were also calculated. All statistical analyses were performed using R 4.3.1 with the bruceR and mediation packages. The mediation package, in particular, accommodates binary outcomes and mediators in moderated mediation models. All p-values were two-tailed, with p<0.05 considered to be of statistical significance.

RESULTS

Sample characteristics

Of 2956 never smokers included in this study, 1947 (65.9%) were female, and the average age was 26.2 (SD=4.09). Most participants (76.6%) were currently college students or had obtained a Bachelor's degree. On average, the frequency of e-cigarette advertising exposure was close to once a month, and the majority of participants (61.6%) were curious about e-cigarettes. The mean score of harm perception was 9.54 (SD=2.84). As shown in Table 1, a total of 191 participants (6.46%) were current e-cigarette users. These participants tended to be health-related professionals, curious about e-cigarette products, lived in a wealthy family, had greater advertising exposure, and perceived e-cigarettes as less harmful (p<0.05).

Regression models exploring the association between advertising exposure and e-cigarette use

Table 2 displays results from a linear regression model examining the association between advertising exposure and harm perception, alongside logistic regression models assessing the relationship of advertising exposure with curiosity and e-cigarette use. Adjusted for sociodemographic characteristics, those who had higher exposure to advertisements were more likely to be current e-cigarette users (AOR=1.39; 95% CI: 1.26–1.54) and be curious about e-cigarette products (AOR=1.33; 95% CI: 1.25–1.42). However, the relationship between advertising exposure and

Table 2. Associations of advertising exposure with e-cigarette use, curiosity, and harm perception, among never smokers in China, 2022 (N=2956)

Variables	Curiosity	Harm perception	E-cigarette use	
	AOR (95% CI)	B (95% CI)	AOR (95% CI)	AOR (95% CI)[a]
Advertising exposure	1.33 (1.25–1.42)***	-0.01 (-0.09–0.07)	1.39 (1.26–1.54)***	1.33 (1.20–1.48)***
Age (years)	0.96 (0.94–0.98)**	-0.03 (-0.06–0.00)	0.99 (0.95–1.04)	0.99 (0.95–1.04)
Gender (Ref: female)	0.63 (0.54–0.74)***	0.47 (0.25–0.69)***	0.88 (0.64–1.21)	1.13 (0.80–1.57)
Student status (Ref: non-student)	0.83 (0.66–1.03)	0.35 (0.06–0.64)*	0.71 (0.45–1.10)	0.79 (0.50–1.23)
Professional area (Ref: non-health-related)	1.04 (0.84–1.30)	-0.10 (-0.39–0.18)	1.63 (1.12–2.32)**	1.60 (1.09–2.30)*
Household income (Ref: low)				
Lower middle	1.18 (0.95–1.46)	-0.26 (-0.55–0.03)	1.08 (0.69–1.69)	0.97 (0.62–1.54)
Upper middle	1.25 (1.02–1.54)*	-0.35 (-0.63 – -0.07)*	1.05 (0.69–1.61)	0.95 (0.61–1.46)
High	1.25 (0.98–1.59)	-0.19 (-0.51–0.13)	1.54 (0.99–2.42)	1.41 (0.88–2.24)
Education level (Ref: high school and lower)				
Junior college	1.59 (1.12–2.26)*	0.18 (-0.30–0.66)	1.68 (0.80–3.99)	1.68 (0.77–4.10)
Undergraduate	1.98 (1.44–2.74)***	0.19 (-0.24–0.63)	1.43 (0.72–3.27)	1.40 (0.68–3.28)
Postgraduate	1.76 (1.17–2.64)**	0.39 (-0.15–0.94)	1.21 (0.50–3.11)	1.23 (0.50–3.26)
Residence (Ref: metropolis)	0.91 (0.78–1.07)	-0.11 (-0.32–0.09)	1.21 (0.90–1.64)	1.19 (0.88–1.62)
Curiosity (Ref: no)				5.48 (3.33–9.64)***
Harm perception				0.84 (0.79–0.89)***

AOR: adjusted odds ratio; models adjusted for advertising exposure, age, gender, student status, professional area, household income, education level, and residence.
a Additionally adjusted for curiosity and harm perception toward e-cigarettes. B: linear regression coefficient. *p<0.05, **p<0.01, ***p<0.001.

Table 3. Testing the mediating effect of curiosity on the relationship between advertising exposure and e-cigarette use among never smokers in China, 2022 (N=2956)

Effect	B	SE	z	p	Boot 95% CI
Total effect	0.0142	0.0015	9.2174	<0.001	0.0111–0.0171
Direct effect (c')	0.0104	0.0014	7.6693	<0.001	0.0076–0.0129
Indirect effect (a×b)	0.0038	0.0010	3.6786	<0.001	0.0020–0.0060

The model was controlled for age, gender, student status, professional area, household income, education level, and residence. B: unstandardized coefficient. SE: standard error. Boot 95% CI: confidence interval estimated by 5000 bootstrap resampling.

harm perception was not significant (B= -0.01; 95% CI: -0.09–0.07), which did not support the hypothesis that harm perception mediates the association between advertising exposure and e-cigarette use. Those who were younger, female, living in a wealthy family, and had a high level of education were more likely to be curious about e-cigarettes. People with higher socioeconomic status, indicated by higher education level (postgraduate vs high school and lower: AOR=1.21; 95% CI: 0.50–3.11) and higher household income (high vs low: AOR=1.54; 95% CI: 0.99–2.42), were more likely to be e-cigarette users, although this was not statistically significant.

Testing for the mediation model

Table 3 presents the total effect, indirect effect, and direct effect of the association between advertising exposure and e-cigarette use. The results of a simple mediation model revealed a significant indirect effect of advertising exposure on e-cigarette use through curiosity (B=0.0038; 95% CI: 0.0020–0.0060, p<0.001). This indirect effect accounted for 26.9% (95% CI: 15.8–40.7) of the total effect estimated with 5000 bootstrap resamples, suggesting that curiosity only played a partial mediating role in the association between advertising exposure and e-cigarette use. We also examined the mediating role of harm perception and found no statistically significant effect (not shown in the results).

Moderated mediation effects of advertising exposure on e-cigarette use

The results of the moderating effects of SES on hypothetical paths are shown in Table 4. We hypothesized that household income may function as a moderator between advertising exposure and e-cigarette use in the direct effect (path c') and indirect effect (path a, and path b). However, the findings suggest that household income only played a moderating role in the effect of advertising exposure on curiosity (path a, χ^2=8.90, df=3, p=0.03). Similar results were also found when residence was used as a moderator; the direct effect of advertising exposure on curiosity was moderated by the type of residence city (path a, χ^2=11.24, df=1, p<0.01). Nonetheless, education level did not moderate the effect of advertising exposure on e-cigarette use through any paths in Figure 1. Thus, the moderating effect of SES on paths b and c' were deleted from the hypothesized model, and the modified model is displayed in Figure 2.

As shown in Table 4, the positive effect of advertising exposure on curiosity varied across the levels of household income. The stimulative effect of advertising exposure on curiosity was stronger for lower levels of household income (low: B=0.31; 95% CI: 0.18–0.43, and lower middle: B=0.46; 95% CI: 0.32–0.60). In comparison, for higher levels of household income, the effect weakened (upper middle: B=0.23; 95% CI: 0.12–0.34, and high: B=0.19; 95% CI: 0.06–0.33). These findings supported the significant moderating effect of household income on the relationship between advertising exposure and curiosity. In addition, the results of conditional indirect effects of advertising exposure on e-cigarette use at different SES levels indicated that curiosity significantly mediated the association between advertising exposure and e-cigarette use when household income was <200000 RMB (low: B=0.0034; 95% CI: 0.0008– 0.0057, lower middle: B=0.0057; 95% CI: 0.0028–0.0091, and upper middle: B=0.0023; 95% CI: 0.0000–0.0038); however, it did not mediate when household income exceeded 200000 RMB (95%

Table 4. Conditional effects in the mediation model in different SES groups, among never smokers in China, 2022 (N=2956)*

Levels of SES	Effects of advertising exposure on curiosity (path a)		Effects of curiosity on e-cigarette use (path b)		Effects of advertising exposure on e-cigarette use (path c')		Indirect effect of advertising exposure on e-cigarette use	
	B	95% CI	B	95% CI	B	95% CI	B	Boot 95% CI
Household income								
Low	0.31	0.18–0.43	2.38	1.20–3.57	0.27	0.04–0.49	0.0034	0.0008–0.0057
Lower middle	0.46	0.32–0.60	2.34	0.90–3.78	0.41	0.20–0.62	0.0057	0.0028–0.0091
Upper middle	0.23	0.12–0.34	1.55	0.69–2.41	0.28	0.09–0.47	0.0023	0.0000–0.0038
High	0.19	0.06–0.33	1.66	0.71–2.60	0.15	-0.05–0.35	0.0022	-0.0013–0.0043
Comparison of groups	χ^2=8.90, df=3, p=0.03		χ^2=1.97, df=3, p=0.58		χ^2=3.05, df=3, p=0.38			–
Education level								
High school and lower	0.44	0.19–0.69	2.09	-0.07–4.25	0.24	-0.24–0.73	0.0055	0.0026–0.0139
Junior college	0.34	0.19–0.48	1.81	0.75–2.88	0.26	0.04–0.48	0.0046	0.0014–0.0077
Undergraduate	0.29	0.22–0.37	1.89	1.24–2.55	0.29	0.17–0.42	0.0037	0.0018–0.0059
Postgraduate	0.14	-0.05–0.33	2.34	0.30–4.38	0.21	-0.16–0.58	0.0013	-0.0016–0.0041
Comparison of groups	χ^2=4.20, df=3, p=0.24		χ^2=0.25, df=3, p=0.97		χ^2=0.24, df=3, p=0.97			–
Residence								
Metropolis	0.20	0.12–0.28	1.59	0.93–2.26	0.21	0.06–0.35	0.0021	0.0000–0.0036
Small city and rural counties	0.41	0.32–0.51	2.29	1.45–3.13	0.35	0.21–0.49	0.0052	0.0022–0.0069
Comparison of groups	χ^2=11.24, df=1, p<0.01		χ^2=1.67, df=1, p=0.20		χ^2=1.89, df=1, p=0.17			–

*Coefficients of direct effects shown in this table were estimated from logistic regressions and their exponentiation gives the odds ratio. Those of indirect effects were estimated via the mediation package and represent the change in probability of e-cigarette use due to advertising exposure mediated by curiosity. The models were controlled for age, gender, student status, and professional area. B: unstandardized coefficient. Boot 95% CI: confidence interval estimated by 5000 bootstrap resampling.

Figure 2. The modified conceptual model explaining how advertising exposure impacts e-cigarette use among Chinese never smokers
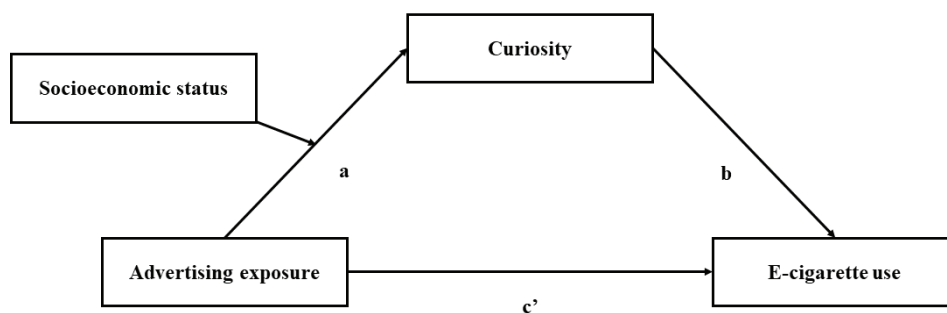
CI: -0.0013–0.0043).

Additionally, the stimulating effect of advertising exposure on curiosity about e-cigarettes decreased as education level increased (Table 4) and became insignificant in the highest education level group (B=0.14; 95% CI: -0.05–0.33). The indirect effect of curiosity on the relationship between advertising exposure and e-cigarette use was no longer significant either among people who were

pursuing or had received a Master's degree or higher (postgraduate: B=0.0013; 95% CI: -0.0016–0.0041). As for residence as a moderator, the effect of advertising exposure on curiosity was weaker among individuals residing in a metropolis (B=0.20; 95% CI: 0.12–0.28) than those in a small city or rural county (B=0.41; 95% CI: 0.32– 0.51). Likewise, the indirect effect of curiosity on the relationship between advertising exposure and e-cigarette use

was relatively higher among people living in s small city or rural county (B= 0.0052; 95% CI: 0.0022–0.0069) than those in a metropolis (B=0.0021; 95% CI: 0.0000–0.0036).

DISCUSSION

We constructed moderated mediation models to examine the relationships between e-cigarette use, advertising exposure, and socioeconomic status. Our results suggest that advertising exposure and e-cigarette use are positively correlated and partially mediated by curiosity toward e-cigarettes. Furthermore, the analysis reveals that the path from advertising exposure to curiosity among adult never smokers was negatively moderated by SES level. However, we did not observe a significant relationship between advertising exposure and e-cigarette use through the mediation of harm perception.

Advertising exposure associated with e-cigarette use

Consistent with previous studies, we found that the likelihood of e-cigarette use increased with a higher frequency of advertising exposure among young never smokers. The conventional tobacco industry has historically invested a substantial amount of resources in media advertising and promotions to attract youth, and this trend has expanded to e-cigarette markets[18]. Most Chinese adolescents describe e-cigarette advertisements as bright, striking, and eye-catching, and the products are often depicted as trendy, fragrant, and socially acceptable by young generations[19]. The vulnerability of youth to e-cigarette advertisements, in conjunction with high advertising exposure, heightens the need for stringent surveillance and regulation of e-cigarette advertising. In 2022, the Chinese government formally introduced the policy to establish regulations on e-cigarette advertising, but its effectiveness is unknown and thus needs to be assessed in the future. Further, we identified several factors that may contribute to curiosity towards e-cigarettes, including being younger, female, of higher education level, and having a higher household income, suggesting that these populations are more susceptible to e-cigarette use. Of particular interest is the fact that females were more likely to be curious about e-cigarettes than males, which warrants further

attention given prior evidence that males accounted for most e-cigarette users[20]. One possible explanation is that females tend to go shopping more frequently and use multiple social media platforms. Dai et al.[21] found that Chinese females were more likely to be exposed to e-cigarette sales in malls, e-cigarette information at brick-and-mortar stores, and on social media than males, which indicates that environmental cues of vaping may increase females' curiosity and thus potential to try e-cigarettes.

Curiosity mediates advertising exposure and e-cigarette use

We found that the positive association between e-cigarette use and advertising exposure in China was partially mediated through curiosity, which is consistent with prior research indicating that 40% of the effect of advertising exposure on e-cigarette trials was attributable to curiosity[10]. Previous studies have shown that young people are largely driven to use e-cigarettes by curiosity[22], which has been frequently employed to measure susceptibility in literature. Our findings align well with the demonstrated association between curiosity and e-cigarette use[10] and corroborate existing theories that have long viewed curiosity as an intermediate goal for effective advertising practice[23]. Advertising activities that highlight a product's benefits increase one's curiosity[24], as often described as being driven by internal motivation for external stimulation, learning, and receiving information[25]. Researchers indicate that curiosity about tobacco products may correlate with the acquisition and retention of smoking-related information that expresses a positive attitude toward these products[26]. Therefore, educational campaigns to raise youth awareness of e-cigarette harms and strict regulations of advertising campaigns should be encouraged to reduce the ability of the campaigns to solicit curiosity as a marketing strategy.

Previous studies did not reach consistency on whether harm perception mediates the relationship between advertising exposure and e-cigarette use[8,11-13]. The current study provides no evidence to support the mediating role of harm perception in the Chinese young adult never smoker population, consistent with two longitudinal studies that did not support those beliefs about health outcomes

of vaping significantly mediating the relationship between advertising exposure and young adult use[12,13]. In contrast, some research found that higher exposure to e-cigarette advertisements led to lower harm perception of e-cigarettes among youth, which further increased their probability of future use[8,11]. Mixed results regarding this are possibly due to the heterogeneity of the study populations. Those studies that detected significant mediating effects either comprised a considerable proportion of people with a smoking history or did not consider cigarette smoking status[8,12]. The two main reasons for trying e-cigarettes among never smokers are curiosity and peer influence, while those for smokers are smoking cessation and harm reduction[22]. Because of this, never smokers have been shown to exhibit less sensitivity in responding to e-cigarette advertising that promotes the health benefits of e-cigarettes versus cigarettes[27]. In addition, some of the studies explicitly asked respondents: 'Will e-cigarette use harm your health?', without comparing it with conventional cigarettes. Despite being statistically significant, the mediating effect of explicit harm perception only accounted for <5% of the total effect on susceptibility[28]. From a public health perspective, allowing e-cigarette manufacturers to advertise the relative harmlessness of their products that only appeal to smokers and strictly regulating advertising content that may trigger the curiosity of non-smokers may help to minimize tobacco-related harm and prevent youth initiation from using e-cigarettes.

The moderating role of socioeconomic status

The increasing popularity of e-cigarettes may breed new health inequalities across socioeconomic status, although evidence on use patterns has remained inconclusive in high-income countries[29]. Preliminary results in China have shown that although use was more prevalent in adults with higher socioeconomic status, it has recently started to increase significantly in low SES populations[20]. However, little research has investigated the reasons for socioeconomic differences in e-cigarette use by smoking status. Simon et al.[30], using data collected from 3473 Connecticut high school students, indicated that higher SES was associated with more advertising exposure and, therefore, greater frequency of e-cigarette use[30]. Our

study further revealed that socioeconomic status negatively moderates the relationship between advertising exposure and e-cigarette use among never smokers. Specifically, the mediating effect of curiosity on the association between advertising exposure and e-cigarette use was much stronger in groups with lower household income, lower education level, or residents in non-metropolis areas.

Our findings suggest that those with low SES may be particularly vulnerable to the price discounts and free samples commonly used as promotional tactics by Chinese e-cigarette companies[9]. Socially disadvantaged groups also have fewer psychosocial resources to deal with stressful events[31], which could make emotional benefits embedded in marketing claims more appealing to them. Similarly, a US study found that healthy food promotions that emphasize appeal rather than health were more effective in low-SES populations in enhancing their expectations, experience, behavioral satiety, and choice[32]. Consequently, placement of e-cigarette advertisements and marketing content in areas with a higher concentration of the socially disadvantage warrants oversight and continuous monitoring. Although advertisements of e-cigarettes, unlike other tobacco products, have so far not been disproportionately situated in disadvantaged neighborhoods in the US[33], further research is needed to discern trends in the Chinese e-cigarette marketing landscape. More broadly, disparities in e-cigarette use warrant continual monitoring as changing norms and stigma around vaping may decrease appeal among higher SES groups[34].

In addition, the weaker mediating effect of curiosity in the lowest household income group compared to the lower middle household income group in our study, may indicate that financial constraints can suppress individual curiosity and limit their desire to experiment with e-cigarette products. It is noteworthy that education level was the only SES indicator that did not display a significant moderating effect on the association between advertising exposure and curiosity, which was probably caused by its skewness in our sample. Most respondents recruited for our study were current college students or had earned a college degree. Overall, the high susceptibility to e-cigarette advertising exposure in low SES populations calls for strengthening market regulations

to reduce consequent potential disparities in long-term harms from e-cigarette use.

Limitations

Some limitations should be considered in the interpretation of the results of our study. First, the nature of this cross-sectional study did not allow for the verification of the temporal sequence of the included variables. We could not rule out possible reverse causality that purchase behavior leads to greater exposure to advertisements. Therefore, longitudinal research should be conducted to examine this issue. Second, self-reported data were potentially subject to social desirability and recall bias. For example, when asked about their advertising exposure level within the past six months, respondents who were curious about or currently used e-cigarettes might be more likely to remember those experiences. Third, although we adjusted for control variables in the study, there may still be unmeasured confounding factors, such as parental smoking. Fourth, this survey relied on a web-based platform to collect data from respondents who were willing to complete the questionnaire, which may introduce selection bias[35,36]. While this potentially limits the generalizability of our results, the application of demographic quotas ensured adequate coverage across population subgroups. Considering the lack of nationally representative relevant data, this approach enabled detailed analyses of the emerging trend regarding youth vaping in China in a timely and efficient manner.

CONCLUSIONS

Although a growing body of literature has documented the potential correlation between advertising exposure and e-cigarette use, few studies have investigated the mechanisms behind it, especially in developing countries such as China. Our study addressed this research gap with data collected from Chinese young adult never smokers. Curiosity, rather than harm perception, could mediate the association between advertising exposure and e-cigarette use. Furthermore, the relationship between advertising exposure and curiosity was negatively moderated by socioeconomic status. Our study calls for additional research on marketing practices being utilized by e-cigarette retailers and manufacturers, and policymakers should continuously monitor and address e-cigarette marketing practices that attempt to initiate young adult never smokers into e-cigarette use, especially those with low socioeconomic status.

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

AUTHORS' CONTRIBUTIONS
YW and DY conceptualized and designed the study. DY implemented the data analysis. YW and DY contributed to the methodology. DY wrote the first draft of the manuscript with substantial input from YW, and all other authors (XL, LL, FAW, MY, AM) provided feedback and editing. All authors read and approved the final version of the manuscript.

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