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BRIEF REPORT

Future Smoking Intentions at Critical Ages among Students in Two Chinese High Schools

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Abstract

Background China is the world's largest tobacco consumer. Smoking initiation dramatically increases from teenage to adulthood. In this study, we investigated adolescents' future smoking intention at critical ages and its associated predictors.

Methods Using a longitudinal design (3 waves) across 6 months in 2016, data from 156 10th graders in two high schools in China were examined. We used latent class growth modelling to explore the heterogeneous trajectories of smoking intentions for two future age groups. Logistic regression was then used to estimate the predictors of trajectories.

Results Two trajectories and three trajectories were identified for future smoking intention in their twenties and forties, respectively. Gender, current smoking status, and mothers' and friends' smoking status all played distinct roles in future smoking intentions.

Conclusions Chinese adolescents' future intentions at critical ages are of concern. Future tobacco control should target the critical ages as well as incorporate social and cultural meanings of smoking in China. As important factors related to future smoking trajectories, gender and mothers' smoking status should also be considered in anti-smoking prevention efforts. Meanings associated with smoking status in the future should also be explored especially for female adolescents.

Keywords Smoking · Adolescence · China · Critical age · Future intention · Gender

Introduction

China is the world's largest tobacco consumer. In China, adolescent smoking rates among females are increasing, while this figure for males remains at a high level [1]. Although adolescent smoking rates are considerably lower than the rates observed in adulthood, high rates of smoking prevalence have been identified in previous national surveys, noticeably in one's early twenties and early forties [2]. As future smoking intentions have been shown as an important indicator of teenagers' smoking behaviour over time [3], identifying these intentions may be useful to understand teenagers' smoking agency. Previous studies, however, paid little attention to smoking intentions at these critical ages with higher smoking incidences.

Similar to other addictive behaviours, both actions and inner experiences of smoking operate within biological, social, and cultural contexts [4]. Largely based on disease models, most previous studies on adolescent smoking in China investigated smoking as a behaviourally defined action [1, 2]. Research based on this paradigm deems biological processes as the primary aetiology of smoking addiction; individuals have little or no control over these factors [4]. Studies based on these models largely neglect the agency and social aspect of smoking addiction [4]. Based on social cognitive models that were usually developed in the West, only a few studies investigated smoking intentions among Chinese adolescents, usually with a near future timeframe such as "the following year/month" [5]. The utilisation of theoretical frameworks is not culturally specific to Chinese smoking contexts [6], although studies on substance use identified different patterns in psychological cognitions across countries [7]. Unsurprisingly, although the utility of some theories has been established [8, 9], given the limited ecological validity,

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smoking interventions targeting these social cognitive constructs largely failed to curb adolescent smoking in China [10, 11].

The high prevalence of smoking in China seems to be associated with particular ages. Statistically the early twenties and early forties show much larger smoking rates compared to other age groups [2]. Qualitative research provides some contextual understandings of this phenomenon: smoking is perceived as a useful tool for adult socialisations and business negotiations; while positive smoker images (especially those related to authority and wealth) are often seen in adult life, high school student smokers are regarded as inappropriate [8, 12, 13]. Moreover, adolescent smoking in China has its own cultural and historical connotations. Anti-smoking campaigns targeting adolescents in China did not emerge until the early 1900s, a period influenced by a number of societal factors such as foreign invasions [14]. As such, adolescent smoking was stigmatised as an action that impacts not only on one's own health but also the entire nation's future [14]. By an exclusive focus on adolescents' smoking behaviour, these campaigns partially permitted adult smoking. Even today, this anti-smoking social norm is perceived by adolescents as predominantly targeting teenagers rather than smokers generally [12]. Although these age-related social meanings are important for adolescents' future-oriented smoking intentions and behaviours, empirical investigation of these meanings is lacking.

In this longitudinal study, we investigated adolescents' future smoking intentions for their twenties and forties. We aimed to study the future smoking intentions during the critical ages associated with high smoking incidences and positive smoker images. We chose these critical ages based on previous statistics of smoking prevalence [2] as well as the distinct time-consciousness in Chinese cultural contexts [15, 16]. In contrast to the West, time in Chinese culture (traditionally and contemporarily) is not understood as a segmented and linear progression, but a cyclical time structure, highlighting the critical ages in people's lifespans; such time perceptions can lead to a vaguer sense of planning for future behaviours [15–17]. Theories developed in other cultures might have poor transferability for understanding smoking cognitions/behaviours in China given this distinctively different view of time. Take the Theory of Planned Behaviour [18] for example. This theory posits that one's behaviour is determined by intention and perceived behavioural control over this behaviour, and follows strict specificity about the time period when people conduct a certain behaviour; with a static view of time, timeframes (e.g. 'the next 7 days' or 'the next month') in this theory are often conceptualised as merely segments of time, failing to capture the time-associated values that are culturally and socially constructed [19]. We also hypothesised that heterogeneities exist among participants in terms of their future smoking intentions at critical ages. To further understand the subgroups, demographic and smoking-associated predictors of future smoking intentions were also examined.

Methods

Participants and Procedures

In 2016, we conducted a school-based smoking intervention among 10th graders in two high schools in Kunming, China. We recruited 207 participants (M_{age} = 15.81 years; 51.49% males; 10.45% current smokers) at Time 1 (1 week pre-intervention); 199 and 156 remained at Time 2 (1 week post-intervention), and 3 (6-month post-intervention). Participants were randomly allocated to intervention (n = 106) and wait-listed control (n = 101) groups based on the unit of class. The intervention group received a four-session school-based intervention. The intervention failed to reduce smoking intention and behaviour among students in the intervention group; participants' longitudinal trajectories on these two constructs also appeared to be unchanged across time [5]. The QUT Human Research Ethics Committee and principals of participating schools provided approval to undertake this study.

Measures

Broadly based on the operationalisation of intention in the TPB [20] with modifications for translation purposes, two questions assessed students' longer term smoking intentions (i.e. when I am 20–25 years old/40–45 years old, I will definitely smoke), with 7-point Likert scales ('strongly disagree' to 'strongly agree'). Additionally, we collected other background variables (age, sex [male = 1, female = 0], school type [private school = 1, public school = 0]), and smoking-related variables including smoking status (current smoker = 1, current smoker = 0), parents' smoking status (yes = 1, no = 0), and friends' smoking status (majority are smokers or not); all these variables were assessed with one-item measures and coded as binary. As these data were obtained from a randomised controlled trial [5], a binary variable for intervention condition was also included. All surveys were undertaken in Chinese.

Analytic Plan

Before the main analysis, mixed-effects Poisson regression was performed to evaluate the impact of the intervention on two future smoking intentions. Person-centred approaches, which have been rarely used for smoking studies in China, were adopted in this study given such approaches have elucidated heterogeneities in substance use among participants [21]. Specifically, latent class growth analysis (LCGA) was used to explore the changes on two items of future smoking

intentions. Optimal latent class number was decided based on the sample-size adjusted Bayesian information criteria (SSABIC), entropy, and the adjusted Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT) [22]. SSABIC was chosen because it may have advantages over the Akaike information criterion (AIC) [23]. Due to the local solution issue reported in most of the Bootstrapped Likelihood Ratio Tests, we only reported results from the LMR-LRT [24]. Lower SSABICs show better model fit, higher entropy values indicate improved enumeration accuracy, and a significant result in LMR-LRTs means adding a class number yields statistical improvements [22]. Based on the models generated from the previous step, multivariate logistic regression analyses were used to detect the relationship of intention trajectories and demographic/smoking-related variables. Rather than exporting the membership for further regression analyses, to avoid underestimating the associations between covariates and class membership, we conducted logistic regression using the three-step method in Mplus [25, 26]. Odds ratios (ORs) of logistic regression estimates were calculated [27] (p.492). However, the extremely large ORs due to the large estimates are not shown. The LCGA and its subsequent logistic regression analyses were conducted in Mplus 7.4; other analyses were completed in Stata 15.1.

Results

Both intention measures showed high test-re-test stability. The three-wave data for both 20–25-year-old intention (Spearman's ρs range from .61 to .79, $p < .001$) and 40–45-year intention (Spearman's ρs range from .60 to .68, $p < .001$) possessed high inter-item correlations across time. Using mixed-effects Poisson regression analyses, the condition by time effect was not identified at both Time 2 (for the 20–25-year intention, $b = .15$, $p = .286$; for the 40–45-year intention, $b = .09$, $p = .511$) and Time 3 (for the 20–25-year intention, $b = .02$, $p = .869$; for the 40–45-year intention, $b = -.06$, $p = .669$) as opposed to the baseline, suggesting that the intervention did not impact on future smoking intentions. Mann-Whitney U tests were also undertaken, suggesting that participants from different schools had no differences in 20–25-year intentions ($U = 1486.50$, $p = .110$) or 40–45-year intentions ($U = 1600.50$, $p = .345$) at baseline.

Fit indices of 2-class, 3-class, and 4-class models of both future smoking intentions are provided in Table 1. Following the comparisons of the above fit indices, the 2-class model and the 3-class model were chosen and described for future smoking intention when one is 20–25 years old and 40–45 years old, respectively (see Fig. 1).

In the logistic regression model of future intentions at 20–25 years old, being a male ($b = 1.89$, $p = .001$; OR = 6.65), current smoker status ($b = 3.66$, $p = .002$; OR = 38.82), and having a mother who smokes ($b = 3.41$, $p = .012$; OR = 30.33) predicted one's membership of being a 'high intender', as opposed to 'low intenders' (the reference class).

In the logistic regression model of future intentions at 40–45 years old, 'lower intenders' were used as the reference class. Being a male ($b = 16.17$, $p < .001$), having a mother who smokes ($b = 15.84$, $p < .001$), and friends as mostly smokers ($b = 22.07$, $p < .001$) all predicted one's membership of being 'medium intenders'; large regression estimates indicate the majority of 'medium intenders' possessed the above three properties. Furthermore, being a private school student ($b = 1.36$, $p = .007$; OR = 3.89), female ($b = -1.61$, $p = .002$; OR = 0.20), and non-current-smoker status ($b = -2.51$, $p = .031$; OR = 0.08) predicted one's membership of being a 'high intender'.

Discussion

As the first study investigating future smoking intentions at critical ages, this study conveys important message for Chinese smoking research and preventative practices. Although the current smoking rate was only 14.3% [5], about 40% of participants consistently reported a medium or high intention to smoke in the future. Of concern, the 'lower intenders' (60.67%) for the 40–45-year-old set showed a significant increase in smoking intention from Time 1 to Time 3. Results from this study highlight the meanings of different future time periods that may have an important impact on smoking behaviours in China. Due to this reason, health promotion programmes based entirely on existing social cognitive models with a standard concept of time frames may be suboptimal [5, 7, 10].

Potentially driven by positive smoker social images associated with business success in adulthood [8], males showed comparatively higher levels of intentions in both sets (6.65 times more likely to be in the "high intenders" at 20–25-year-old set; being a male was strongly correlated with the 'medium intenders' membership in the 40–45-year-old set). However, surprisingly the predictors of 'high intenders' of smoking intention at 40–45 years old, specifically being female (0.20 times more likely) and having current non-smoking status (0.08 times more likely), are the opposite determinants of smoking behaviour in adolescence [28]. This class did not appear in the 20–25-year-old set, suggesting the age of 40–45 years might be associated with unique archetypes (typical people who conduct a certain behaviour). For example, previous studies among female smokers in Hong Kong identified that weight control is a reason that women smoke [29]. This finding may also suggest that "rebellious"-related female smoker negative images [13] are still expected to be a concern to women in their early twenties but not for women in their early forties. Due to the scarcity of

Table 1 Fit statistics for latent class growth analysis

Fit statistics	Future smoking intention in 20–25 years			Future smoking intention in 40–45 years		
	2-class	3-class	4-class	2-class	3-class	4-class
SSABIC	**1565.11**	1526.94	1512.95	1599.71	**1539.34**	1517.51
Entropy	**.87**	.86	.82	.87	**.95**	.91
Adj. LMR − LRT (*p*)	**185.93 (<.001)**	40.98 (.133)	18.31 (.536)	172.20 (.003)	**61.79 (.010)**	25.66 (.072)

SSABIC sample size adjusted Bayesian information criteria, *Adj. LMR-LRT* adjusted Lo-Mendell-Rubin Likelihood Ratio Test

p = *p* value

Optimal models were shown in bold

For intention at 20–25 years, although SSABIC decreased with the class number increasing, entropy was the highest for the 2-class model and the adjusted LMR − LRT was not significant when the class number increased from 2 to 3. Comparatively, 3- and 4-class models showed lower entropy indices than the 2-class model; although they had slightly lower SSABICs, the non-significant adjusted LMR-LRT results suggested adding a class number from the 2-class model had no statistical meaning. Therefore, the 2-class model was chosen for the future smoking intention at 20–25 years

For intention at 40–45 years, the 3-class model was chosen because this model has the largest entropy and its significant LMR-LRT suggests that it is statistically meaningful when adding another class from the 2-class model but not from the 3-class to 4-class. For the 2-class model, although its LRT result showed significance, the much larger entropy of the 3-class indicated the enumeration accuracy can be enhanced by adding one more class. For the 4-class model, apart from the slightly decreased SSABIC statistic, the smaller entropy and non-significant LRT result both suggested its worse fit than the 3-class model. Thus, the 3-class model was the optimal choice for the future smoking intention at 40–45 years

smoking research among middle-aged people in China, the different future smoking plans between genders require further investigation. School type also was a significant predictor (private school students were 3.89 times more likely to be in the 'high intender' subgroup at 40–45 years old), suggesting school ethos may be influential for smoking and should be examined further.

Consistent with previous studies, significant others are predictors of higher intender membership. Friends' smoking status played an important role for participants' smoking intention when 40–45 years old, consistent with much of the research examining the influence of peers for smoking [8, 9, 28]. Whereas fathers' smoking status was a non-significant predictor, mothers' smoking status strongly predicted several higher intention trajectories. Previous research noted that maternal smoking status is strongly associated with current smoking experience among 11–17-year Chinese adolescents [30] and the findings of the current study suggest maternal smoking influences may persist through one's later developmental stages. As discussed in previous studies, mothers' smoking may be an important environmental and genetic factor for one's smoking, as well as a mirror of their socioeconomic status [31, 32]; research unpacking these associations in China is needed.

Given the distinct social environments in China, smoking in adolescence and adulthood has distinct connotations. While images of students who smoke are mostly negative, adult smoking is deemed as normal and, in some case, "manly", mature, or fashionable [8, 13]. These smoking-associated social meanings and functions could be targeted in smoking interventions. For example, smoking prevention could focus on altering future smoking intentions via targeting positive adult smoking images and meanings (e.g. if sharing cigarettes denotes a symbol of generosity, then the program can encourage replacing it with other actions that have similar meanings such as sharing food or verbalising positive expressions) [6].

In contrast to the view regarding time as a "neat numerical series" in most social cognitive models, results from this study suggest that time-consciousness should be more valued in health promotion and education in China [16]. Practical implications of the findings include that local perceptions of time and life could be incorporated in future tobacco control in China. For example, given the cyclical time perspective, critical time points in a year (e.g. 春节, the Chinese New Year which literally and metaphorically relates to the season Spring symbolising the start of a year cycle) or in one's life (e.g. 本命年, the animal year one was born in) that contain special cultural meanings can be associated with health promotion. Future cross-cultural studies may consider operationalising how different views on time can influence people's health awareness and decisions about engaging in a health risk behaviour such as smoking in China.

Also, given the high levels of longer term future smoking intentions among adolescents, the focus of tobacco control in China should also focus on cessation among adults. As results from our study showed, adult smoking for some groups of Chinese adolescents assumes a predetermined character, which is culturally and historically constructed. Instead of only school students, smoking prevention efforts should also target young adults as they have fewer anti-smoking controls than school environments. Programmes based on living communities/districts (社区) or the Communist Youth League (共青团) in each company/organisation may be an ideal way to widely reach this cohort.

As a preliminary exploration of future smoking intention, the major study limitation is the use of single items. This

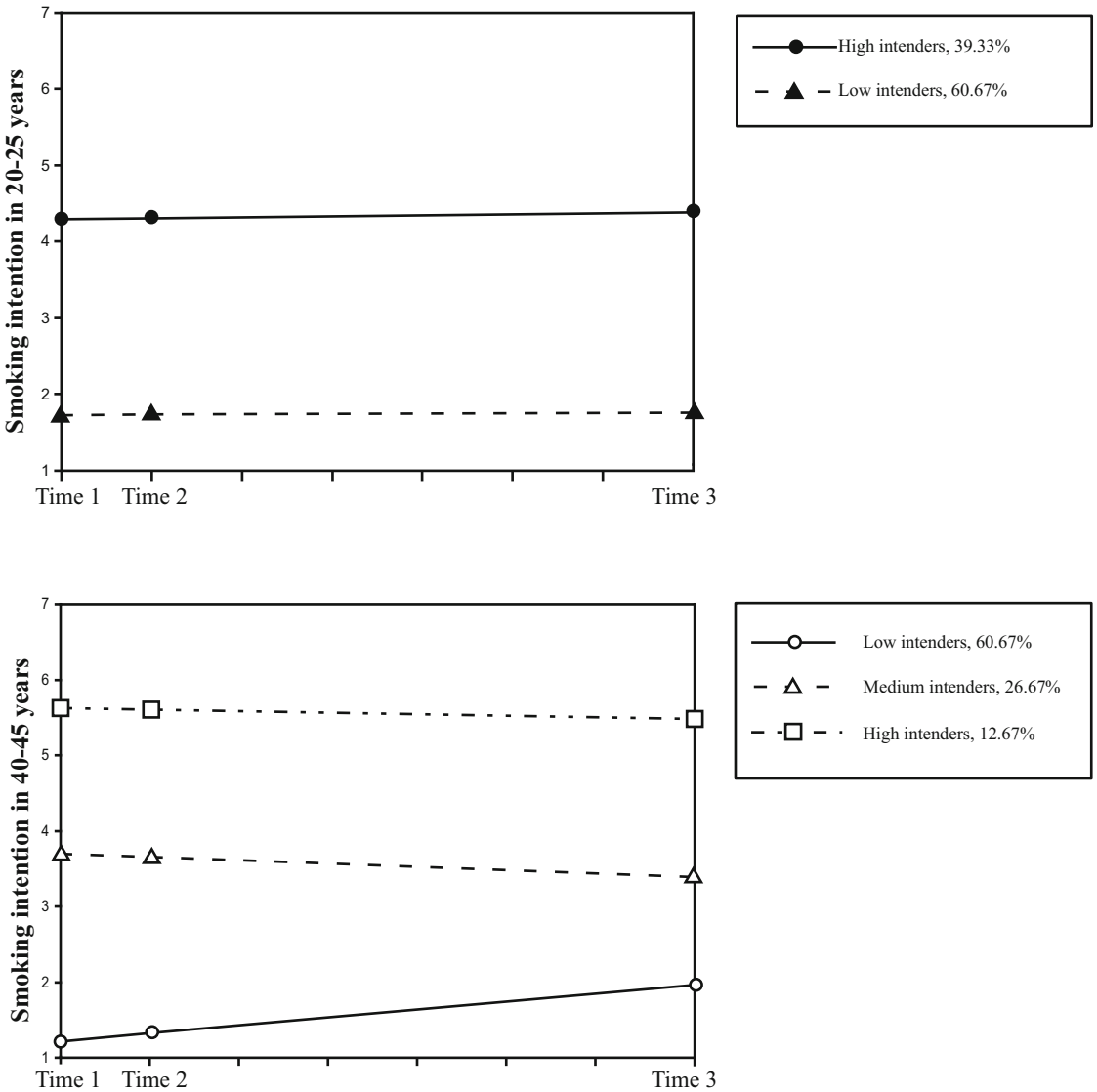

Fig. 1 Estimated trajectories of future smoking intentions from Time 1 to Time 3. The intervals between Time 1 and 2 and Time 2 and 3 are 6 weeks and 6 months, respectively. For smoking intention at 20–25 years, two distinct and constant trajectories existed. The first latent class ("low intenders") comprised 60.67% of the sample ($n = 91$), showing a stably low intention level. The second class ("high intenders"), including 59 participants (39.33%), represented a high and slightly increasing tendency. However, neither class showed a significant slope index. For smoking intention at 40–45 years, two decreasing trajectories and one increasing trajectory were identified. The latent class with 19 participants (12.67%) was labelled as "high intenders" because it showed a high starting level and a non-significant decrease. Similarly, another class ($n = 40$; 26.67%), the "medium intenders", also showed a slight decreasing tendency. By contrast, the majority ("low intenders"; $n = 91$; 60.67%) had a significant increase from Time 1 to Time 3 (slope mean = .11, $p < .001$), although it started at a low level

measurement weakness is due to the main purpose of the original study as the evaluation of the intervention [5]; future studies with better psychometric properties of future smoking intentions should be undertaken. While worded as closely to the concept of intention as possible, given language differences, the construct of intention may more accurately reflect behavioural engagement or anticipated behavioural action. As the study only focused on intention, influences from other potentially relevant social cognitions (e.g. social/descriptive norms, attitudes, plans) were not considered. Our small sample size may also have precluded the identification of other potential adolescent subgroups. Studies with larger sample sizes are needed to assess the heterogeneous intention trajectories of different ages simultaneously. Moreover, although an assessment of smoking behaviour was not the focus of our study, future research could also investigate actual cigarette consumption from one's early teenage to adulthood in order to compare one's intentions and behaviour. Longitudinal designs may also consider collecting data over at least four times in order to check whether future intentions can be better interpreted with non-linear slopes. As the smoking-associated variables (e.g. smoking status of parents and good

friends) may vary across time, future studies can also consider use of these variables as time-varying covariates in order to capture the dynamic changes. Moreover, stochastic approaches (such as hidden Markov modelling [33]) may be considered for data analysis in future studies with similar research designs since individuals are allowed to transit between latent classes with such statistics. Nevertheless, our initial identification of the heterogeneous patterns of future smoking intentions among adolescents provides initial empirical evidence for the association between high smoking prevalence and critical ages in Chinese culture. Future research should elucidate the underlying beliefs, motivations, and social images contributing to adolescents' future smoking intentions at critical ages. Our study also suggests that the archetypes and social meanings of middle-aged female smokers should be probed. Further studies utilising mixed-methods approaches should elaborate adolescents' perceptions about smoker images related to different critical age periods.

Compliance with Ethical Standards

Conflict of Interest The authors have no conflict of interest to declare.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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