Intergenerational Transmission of Parental Risky Health Behaviors in Chinese Children: Are There Socioeconomic Differences?

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Abstract

Background: Risky health behaviors in childhood, including smoking, drinking alcohol, and poor diet, are major sources of non-communicable diseases in adulthood. This study was intended to examine how parents affect children's risky health behaviors, and whether intergenerational transmission differed by Socioeconomic Status (SES).

Methods: Data were extracted from the 1991-2015 China Health and Nutrition Survey (CHNS). Smoking (n=5946), alcohol drinking (n=7821), and sugar-sweetened beverages (SSBs) drinking (n=3537) were singled out as proxies for risky health behaviors in children. A binary choice model for panel data with random effect specification was employed to examine whether the risky health behaviors can be transmitted from parents to their children. Subsequently, we conducted a seemingly unrelated test to explore the difference in parental transmission between SES groups.

Results: We found strong intergenerational persistence of smoking, alcohol drinking, and SSBs drinking behaviors, except mothers' smoking behavior. Mothers had a greater influence on children's alcohol drinking and SSBs drinking behaviors than fathers, both in urban and rural areas, and in different SES groups. The intergenerational transmission of SSBs drinking behaviors exhibited a downward SES gradient for both urban and rural families. In urban areas, mothers' drinking behavior has a downward gradient with their education level, occupation, and income, but in rural areas, the influence of mothers' drinking behavior is in the same direction with the upward gradient of education level and occupation type. In rural areas, the influence of fathers' drinking and smoking behaviors appears to show a mainly positive gradient with SES, while some become a downward gradient among urban fathers.

Conclusions: Parents' behaviors and socioeconomic status could make sense in the initiation of their offspring's risky health behaviors. To promote healthy behaviors, policymakers can introduce health education programs for parents, especially for rural areas and low SES parents.

Implications And Contribution

We estimated how parents affect children's risky health behaviors in the hope of adding up-to-date evidence to former cross-sectional studies. This paper researched from a major but rarely mentioned perspective of parental influence on children's risky health behavior, the SES differences, to shed light to preventing them from the parent level.

Introduction

Risky health behaviors such as smoking, drinking alcohol, and poor diets are major preventable causes of death [1-4]. These risky health behaviors are often initiated in childhood and tend to persist into adulthood [5-8]. Thus it is of great significance to prevent them earlier in life as precursors to disease [9]. However, the prevalence of smoking, alcohol drinking, and unhealthy diet like sugar-sweetened beverages (SSBs) drinking were substantial among children and adolescents. Approximately 43 million 13-15 years old children used tobacco [10], and about 155 million adolescents were current drinkers globally in 2018[11]. Investigations from the US and China both found that over 60% of children and adolescences consumed SSB almost daily [12, 13].

Family is a major environment for children's behavior formation. For one thing, as children's first teachers and socializing agents, parents' negative health behaviors would set a false model for their children [14]. In addition to the model effect, parental socioeconomic status (SES) variables, including educational attainment, income, and occupational status, together with the parenting styles, constitute the home environment in which children's behaviors are embedded [14-19].

However, whether SES differences exist in the intergenerational transmission of unhealthy behaviors has not been sufficiently clarified. According to Cockerham's Health lifestyle theory [20], high SES parents avoid not only the transmission of their own negative health behaviors but also their gentle parenting style helps to develop children's self-control [20]. In contrast, low SES families tend to adopt strict, punitive, authoritarian parenting styles, leading to children's poor self-control and more likely to emulate risky health behaviors from their parents [15-17, 19, 21-25]. In other words, the intergenerational transmission of risky

health behaviors is likely to be an "reverse gradient" with SES. However, some other researches showed that with the rise of SES, the intergenerational transmission effect of parental risky health behaviors to their children became more and more apparent [26, 27]. Yu et al. (2010) proposed that higher education in rural China was often associated with more social activities where more cigarettes and wines were more accessible. Wu (2014)'s studies confirmed Yu's conclusion about the association between education and liquor drinking [28]. A Belgian study found that higher-educated mothers tended to have higher workloads and thus spent less time with their children, making their children more vulnerable to risky health behaviors [26].

Therefore, this study was intended to examine how parents affect children's risky health behaviors by taking advantage of the longitudinal database from the China Health and Nutrition Survey (CHNS), in the hope of adding up-to-date evidence to former cross-sectional studies. What's more, considering that adults often have a hard time making behavioral changes to rationally addictive behaviors, it may be more effective to prevent and reduce risky health behaviors in children from the perspective of reducing intergenerational transmission. Therefore, we further explored whether intergenerational transmission differed by parental SES in order to shed light to preventing children's health from the parent level.

Methods

2.1. Data

The primary database used in the present study was from the China Health and Nutrition Survey (CHNS). CHNS, an ongoing nationwide cohort project in China with ten available waves from 1989 to 2015. These areas are representative and diverse in a wide range of socioeconomic factors (including income, education, and employment) and other related demographic, health, and nutritional factors. Because only the individuals aged between 20 and 45 were surveyed in 1989, we excluded the baseline data, only used data from 1991 to 2015 to make analysis, singled out smoking, alcohol drinking, and sugar-sweetened beverages (SSBs) drinking as proxies for risky health behaviors in children under 18 years old. We excluded samples with outliers and missing data, leaving 5946 observations in the smoking group, 7821 observations in the alcohol drinking group, and 3537 observations in the SSBs drinking group.

2.2. Measures

The main dependent variables in this study were the surveyed children's smoking, alcohol drinking, and sugar-sweetened beverages (SSBs) drinking behaviors. Smoking was assessed based on the question "Have you ever smoked?", and was coded as 1 if the respondent answered "Yes". Alcohol drinking was assessed based on the question "Did you drink beer or any other alcoholic beverage?", and was coded as 1 if the respondent answered "Yes." SSBs drinking was assessed based on the question "Did you drink soft drinks or sugared fruit?" and was coded as 1 for respondents whose answers were "Yes."

The key independent variables were the parental risky health behaviors of these children, which were also assessed based on the three questions above. To analyze how risky health behaviors transmit from parents to their children, we also included parental socioeconomic status variables, including educational attainment (completed years of formal education in regular schools), household per capita income (RMB in 2015 value) and career type (Manual labor/Non-manual labor). Demographic variable like age (years), gender (male/female) was also included. In addition, we controlled area (categorized as Western: Guangxi, Guizhou, and Chongqing; Northeastern: Liaoning and Heilongjiang; Central: Henan, Hubei, and Hunan; Eastern: Jiangsu, Shandong, Beijing, and Shanghai) and wave (1991, 1993, 1997, 2000, 2004, 2006, 2009, 2011 and 2015) effects.

2.3. Statistical analysis

Data analyses were conducted by using the STATA/SE 14.0. Descriptive statistics for both parental and children's risky health behaviors, including smoking, alcohol use, and drinking SSBs were reported as proportions, with corresponding Chi-square tests to examine whether there were statistically significant whether the risky health behaviors could be transmitted from parents to their children. Parental socioeconomic status and demographic variables were also estimated as proportions for categorical and means for variables continuous variables, with Chi-square tests for dichotomous variables and t-tests for continuous variables were conducted and reported their *p*-values.

The result of We adopted a binary choice model for panel data with random effect specification after we conducted Hausman Test ($p_{smoking} = 1.000$, $p_{alcohol} = 0.9043$, $p_{ssbs} = 0.7745$) to investigate whether parental risky health behaviors could be transmitted and how these behaviors were transmitted. Odds ratios with their p -values were reported. The model was specified as:

$$\ln \frac{P_{i,t}}{1-P_{i,t}} = \beta_0 + \beta_1 \text{FatherBehavior}_{i,t} + \beta_2 \text{MotherBehavior}_{i,t} + \sum_{j=1}^4 \beta_{3j} \text{FatherSES}_{i,j,t} + \sum_{j=1}^4 \beta_{4j} \text{MotherSES}_{i,j,t} + \beta_5 \text{Area}_{i,t} + \beta_6 \text{Wave}_{i,t} + \beta_7 \text{Gender}_{i,t} + \beta_8 \text{Age}_{i,t} + u_{i,t} \quad (1)$$

The $P_{i,t}$ here represented the probability of children's smoking, alcohol drinking, and sugar-sweetened beverages (SSBs) drinking behaviors; $\text{FatherBehavior}_{i,t}$ / $\text{MotherBehavior}_{i,t}$ indicated whether the *child* 's father/mother had this kind of risky health behavior, including smoking, alcohol drinking, and SSBs drinking; $\text{FatherSES}_{i,j,t}$ / $\text{MotherSES}_{i,j,t}$ represented the *child* 's father/mother's socioeconomic status; $\text{Wave}_{i,t}$ indicated the time dummies to explore the dynamic evolution from 1993 to 2015; $\text{Area}_{i,t}$ indicated the region dummies to explore the region effects on children's risky health behaviors; $\text{Gender}_{i,t}$ and $\text{Age}_{i,t}$ represented *child* 's gender and age individually. $u_{i,t}$ represented the child individual effects. We used the model above to analyze the total sample, urban sample, and rural sample, respectively.

To understand the influence of different SES variables on intergenerational transmission of risky health behaviors, we grouped urban and rural parents according to their education level, income, and occupation type, respectively, used Model (1) without this variable for regression in different subgroups, and drew a bar chart with confidence interval. For parental education level, we divided them into subgroups with years of education less than or equal to 6 and those with years of education greater than 6. For income, those lower than or equal to the average are divided into the low-income subgroup, and those more than the average are the high-income subgroup. Finally, we divided the occupations into a blue-collar subgroup and a subgroup of other jobs, and then subgroup analysis was conducted. To test the difference in the coefficients $\text{FatherBehavior}_{i,t}$ and $\text{MotherBehavior}_{i,t}$ among different subgroups, a seemingly unrelated estimation test (SUEST) was used.

Results

3.1 Descriptive analysis

The variables we used in the present study are displayed in Table 2 for the entire sample and the Risky health behavior and Non-risky health behavior samples.

The prevalence of smoking, alcohol drinking, and SSBs drinking in children were 4.37%, 6.43%, and 82.16%, respectively. Boys had significantly higher proportions of these three risky health behaviors than girls. Smoking and alcohol drinking children were significantly older than non-smoking and non-alcohol drinking children, while SSBs drinking children were significantly younger than non-SSBs drinking children.

Both fathers and mothers of smoking children had a significantly higher rate of smoking, while it's not significant in mothers. Both fathers and mothers of alcohol drinking children had a significantly higher rate of alcohol drinking than those of non-alcohol drinking children. Similarly, among children who drank SSBs, both their fathers and mothers had a significantly higher ratio of drinking SSBs than non-SSBs drinking children's fathers and mothers.

3.2 Logistic regression results

The results of logistic regression for intergenerational transmission of parental risky health behaviors in Chinese children are presented in Table 3. In the total sample, after controlling for confounding variables, children who had a smoking father were about 240.9% more likely to smoke ($p < 0.001$) than children whose father did not smoke. Similar intergenerational transmission of father's smoking behavior could be observed for rural children. The intergenerational transmission effect was even more pronounced among urban children: smoking father would increase the probability of children smoking by 2506% ($p = 0.034$).

Similarly, alcohol drinking fathers would increase the possibility of children alcohol drinking by 71.5% ($p < 0.001$) in the total sample, 119.4% ($p = 0.001$) in the urban sample, and 52.6% ($p = 0.012$) in the rural sample, respectively. Alcohol drinking mothers would increase the possibility of children alcohol drinking by 257.4% ($p < 0.001$) in the total sample, 214.7% ($p < 0.001$) in the urban sample, and 239.5% ($p < 0.001$) in the rural sample, respectively.

Likewise, in the total sample, children with an SSB drinking father were about 161.2% more likely to drink SSBs ($p < 0.001$) than children whose father did not drink SSBs. And SSBs drinking mother could increase the likelihood of children SSBs drinking by 259.2% ($p < 0.001$). Similar intergenerational transmission of this behavior could be observed for both urban and rural children. Different gender would play an important role in the intergenerational transmission of risky health behaviors. Compared with girls, boys were about 8316%, 353.3%, 25.1% more likely to smoke, drink alcohol and drink SSBs, respectively. Age also played an important role in the intergenerational transmission of smoking and alcohol drinking. Similar effects could be observed for both urban and rural children.

Various parental socioeconomic status (SES) variables also significantly affected children's these behaviors. Higher parental per capita income would make both urban and rural children more likely to drink alcohol and SSB. However, the effects of educational attainment and occupation status were not consistent or even opposite between urban and rural areas and between parents.

3.3 Subgroup analysis

To further clarify the intergenerational transmission of urban and rural parental risky health behaviors between SES groups, the results of subgroup analysis and SUEST test can be found in Table 4 to Table 9, Figure 1 and Figure 2. Considering the unreliability of the subgroup analysis due to the small sample size on mothers' smoking, the maternal smoking transmission between different SES groups was not reported here.

3.3.1 Subgroup analysis for urban families

The higher the father's education level, the more significant the intergenerational transmission of smoking ($OR_{LowEdu} = 16.89$, $OR_{HighEdu} = 29.52$) and alcohol drinking ($OR_{LowEdu} = 1.997$, $OR_{HighEdu} = 2.314$), but OR of SSBs drinking dropped from 5.302 to 2.393. From low education level to high education level, OR of mother's liquor drinking behavior went down from 3.545 to 3.509 and OR of maternal SSBs drinking reduced from 5.090 to 2.972, with insignificantly coefficients difference between low educational mother group and high educational mother group.

Comparing with non-manual labor fathers, blue-collar jobs fathers had more significant intergenerational transmission of smoking ($OR_{Blue-Collar} = 156.9$, $OR_{Others} = 29.67$), alcohol drinking ($OR_{Blue-Collar} = 4.065$, $OR_{Others} = 1.644$) and SSBs drinking ($OR_{Blue-Collar} = 5.164$, $OR_{Others} = 2.754$). Non-manual labor mothers significantly showed less intergenerational transmission effects of liquor drinking ($OR_{Blue-Collar} = 3.660$, $OR_{Others} = 3.050$) and SSBs drinking ($OR_{Blue-Collar} = 3.401$, $OR_{Others} = 3.361$).

With the increase of income, father's intergenerational transmission effect of smoking and SSBs drinking was getting weaker and insignificant ($OR_{LowInc} = 174.2$, $OR_{HighInc} = 3.007$; $OR_{LowInc} = 5.071$, $OR_{HighInc} = 2.219$). On the contrary, the transmission effect of fathers' wine drinking behavior became stronger ($OR_{LowInc} = 2.061$, $OR_{HighInc} = 2.699$) as income increased. Both mother's liquor drinking behavior ($OR_{LowInc} = 4.009$, $OR_{HighInc} = 1.874$) and SSBs drinking behavior ($OR_{LowInc} = 2.966$, $OR_{HighInc} = 2.807$) decreased from low-income group to high-income group.

3.3.2 Subgroup analysis for rural families

With the rise of paternal education level, intergenerational transmission of father's smoking ($OR_{LowEdu} = 2.962$, $OR_{HighEdu} = 4.038$) and alcohol drinking ($OR_{LowEdu} = 1.333$, $OR_{HighEdu} = 1.743$) increased, but OR of father's SSBs drinking behavior dropped from 3.294 to 2.339. Compared with low-education level mothers, OR of advance-educated mother's alcohol drinking behavior went up from 2.542 to 5.354, and that of maternal SSBs drinking reduced from 5.408 to 3.403, with significantly coefficients difference ($p_{alcohol \text{ of SUEST}} = 0.0888$) ($p_{ssbs \text{ of SUEST}} = 0.0203$).

Comparing with blue-collar jobs fathers, smoking of non-manual labored fathers would have a stronger effect on children's formation of this behavior ($OR_{\text{Blue-Collar}} = 2.995$, $OR_{\text{Others}} = 19.03$) while non-manual labored fathers were less connected with children's alcohol drinking ($OR_{\text{Blue-Collar}} = 1.847$, $OR_{\text{Others}} = 1.171$) and SSBs drinking ($OR_{\text{Blue-Collar}} = 2.842$, $OR_{\text{Others}} = 2.228$). Meanwhile, non-manual labor mothers significantly showed less effects of liquor drinking ($OR_{\text{Blue-Collar}} = 3.289$, $OR_{\text{Others}} = 5.290$) and SSBs drinking ($OR_{\text{Blue-Collar}} = 4.045$, $OR_{\text{Others}} = 3.916$).

With the increase of income, father's intergenerational transmission effect of smoking was getting stonger ($OR_{\text{LowInc}} = 2.683$, $OR_{\text{HighInc}} = 29.74$), and similarly, father's wine drinking behavior had similar effects ($OR_{\text{LowInc}} = 1.577$, $OR_{\text{HighInc}} = 1.762$). Inversely, the influence of father's SSBs drinking behavior on their children's this behavior went through a process of weakening as income increased ($OR_{\text{LowInc}} = 3.310$, $OR_{\text{HighInc}} = 1.225$) and the coefficient difference was significant ($p_{\text{ssbs of SUEST}} = 0.0003$). Both mother's liquor drinking behavior ($OR_{\text{LowInc}} = 4.054$, $OR_{\text{HighInc}} = 1.948$) and SSBs drinking behavior ($OR_{\text{LowInc}} = 4.591$, $OR_{\text{HighInc}} = 3.035$) decreased from low-income group to high-income group. ($p_{\text{ssbs of SUEST}} = 0.0007$) while the other was not.

Discussion

There were three central findings of the present study: 1) Risky health behaviors had significant intergenerational transmission effects. 2) The intergenerational transmission of mothers' alcohol consumption and SSBs drinking behavior was greater than that of fathers. 3) The influence of SES on intergenerational transmission in urban areas was different from that of rural children. For addictive behaviors like alcohol drinking and smoking, the intergenerational transmission mostly exhibited a downward SES gradient for urban families but a positive SES gradient for rural families. But the influence of parental SSB drinking behaviors shows a consistently downward SES gradient for both urban and rural families.

The present study showed that consistent with many previous findings [14-19, 21, 23-25], parental risky health behaviors could be significantly transmitted to their children. Children are usually easy to imitate their parents' behavior, even if it is negative and unhealthy [14, 29, 30]. So, parents' words and deeds are very important to prevent children's risky health behavior.

There were also differences between paternal influence and maternal influence. We found father's smoking behavior had a greater significant effect on leading children's smoking behavior than the mother's, contrary to many previous studies [14, 15, 18, 19]. This may be because, compared with previous studies, the sample size of maternal smoking in this study was too small to make good statistical inferences. However, when it came to alcohol drinking and SSBs drinking, impacts of both mother's risky health behaviors were significantly higher than impacts of father's behaviors, samples, the impact of both mother's on children, which was consistent with some former researches [15, 24]. This may be because, compared with fathers, generally, mothers spent more time with their children. Therefore, the children could be more affected by mothers' behaviors rather than fathers' behaviors [15, 24].

The role of parental socioeconomic status (SES) in the intergenerational transmission of risky health behaviors for urban and rural children was not exactly the same. Generally speaking, there was a significant downward SES gradient in the intergenerational transmission of SSBs drinking behavior: the risky health behavior transmission effect of high-SES parents was weaker than that of low-SES parents. We also notified that the intergenerational transmission effect of urban mother's drinking behavior had downward gradients with all three SES variables, but rural mother's wine drinking behavior had a synthetic gradient with the rise of education level and occupational class. A similar situation occurred among fathers: rural father's risky health behaviors mainly appeared to show a synthetic gradient with SES, while urban father's smoking had downward gradients with the rise of occupational type and income.

This reflected SES had a dual influence on the intergenerational transmission of parental risky health behavior. On the one hand, higher SES means better family capital and better parenting style, which will prevent formations of children's unhealthy behaviors and reduce transmissions of these behaviors from their parents [24, 31-34]. High-SES parents were usually well aware of the dangers of risky health behavior and were therefore inclined to discourage their children from these behaviors, while low-SES parents often did not care whether their children did or not, or even engaged in these behaviors in front of their children, setting a bad example for their children and leading them to engage in these behaviors [31, 34, 35]. There are some facts

supporting the standpoint that higher SES can promote people's health and healthy behaviors. In the health model presented by Grossman, more affluent families tend to spend more money on health care like better-quality medical care and healthy food [32, 36]. Well-educated parents would be more inclined to adopt healthy behaviors, both for themselves and their children, so the incidence of risky health behaviors among children will be lower [32, 33]. In addition to the fact that education could increase knowledge that promoting healthy behaviors, there were also potential indirect effects, such as smoother ways to get a job, better affordability of health-improving goods, less stress, better work environments where the high-SES were also exposed to healthier colleagues [37]. However, lower-SES people may care less about their health and that of their family members, be less responsive to health promotion and receive less information about how to get healthy and have limited access to health promotion services [31, 34]. Similar effects have been observed in risky health behaviors such as sugar-sweetened beverage drinking, which mainly exists in children and adolescents.

On the other hand, higher SES means that parents will devote more time to their own career to cope with higher workloads, more often ignored messages they received or enlisted the support of nannies or, in Chinese traditional culture, from their own retired parents, who were often less educated [26], leading to the absence of family education. Children with high-SES parents tended to have more disposable pocket money. All these may increase the risk of unhealthy behaviors of children. In the second case, the parents' deeds effect is bigger than their Words effect, which may promote intergenerational transmission of risky health behaviors in children. This may be because high-SES parents tended to have a higher status in their children's minds, children would be more likely to imitate parental risky health behaviors [14]. In our sample, for traditional rational addictive behaviors such as smoking and alcohol drinking, higher parental occupation and education level could enhance intergenerational transmission, which is an example of deeds effect bigger more than Words effect. These showed the necessity and importance of behavioral change starting from parents.

Conclusions

We observed that parents played an important part in the development of children's risky health behaviors. Parental risky health behaviors set a bad example for their children, for tempting and affecting children to imitate their parents' such behaviors. It is worth noting that, urban areas, especially urban mothers, mostly reflected the positive effects of SES while Fathers, especially those in rural areas, reflected adverse effects. It suggests that we should pay more attention to fathers' behaviors and parental awareness of health education in rural areas and invest in the rearing of their children. Apart from persuading children to drop these behaviors, we should pay more attention on reducing intergenerational transmission.

Abbreviations

CHNS: China Health and Nutrition Survey

SSB: Sugar-sweetened Beverage

SES: Socioeconomic Status

SUEST: Seemingly Unrelated Estimation Test

OR: Odds Ratio

Declarations

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Availability of data and materials:

The datasets generated and analyzed during the current study are public available in the CHNS website [<http://www.cpc.unc.edu/projects/china>].

Authors' contributions:

ZY and JL conceptualized and designed the study. ZY analyzed the data. ZY and JL participated in explaining the data. ZY and JL participated in writing and revising the manuscript. All authors approved the final version of the paper. All authors have directly accessed and verified the underlying data reported in the manuscript.

Declaration of Interest statement:

The authors declare that they have no competing interests.

Consent for publication:

Not applicable

Ethics approval and consent to participate:

Data of this study was from the China Health and Nutrition Survey (CHNS). CHNS was approved by the Institutional Review Committees of the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety, Chinese Center for Disease Control and Prevention.

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Tables

Table 1 Descriptive Statistics

Variables	Smoking				Alcohol Drinking				SSBs Drinking			
	Total	No	Yes	p^a	Total	No	Yes	p^a	Total	No	Yes	p^a
	(n=5946)	(n=5686)	(n=260)		(n=7821)	(n=7318)	(n=503)		(n=3537)	(n=631)	(n=2906)	
Father's Behavior, n (%)				0.000				0.000				0.000
No	1749 (29.41)	1712 (30.11)	37 (14.23)		2311 (29.55)	2212 (30.23)	99 (19.68)		2418 (68.36)	571 (90.49)	1847 (63.56)	
Yes	4197 (70.59)	3974 (69.89)	223 (85.77)		5510 (70.45)	5106 (69.77)	404 (80.32)		1119 (31.64)	60 (9.51)	1059 (36.44)	
Mother's Behavior, n (%)				0.089				0.000				0.000
No	5792 (97.41)	5543 (97.49)	249 (95.77)		6852 (87.61)	6490 (88.69)	362 (71.97)		1984 (56.09)	538 (85.26)	1446 (49.76)	
Yes	154 (2.59)	143 (2.51)	11 (4.23)		969 (12.39)	828 (11.31)	141 (28.03)		1553 (43.91)	93 (14.74)	1460 (50.24)	
Father's Education, mean (SD)	7.79 (3.67)	7.85 (3.67)	6.47 (3.50)	0.0000	7.72 (3.54)	7.74 (3.52)	7.53 (3.79)	0.1976	9.19 (3.14)	8.63 (3.18)	9.31 (3.11)	0.0000
Mother's Education, mean (SD)	5.89 (4.34)	5.96 (4.35)	4.41 (3.83)	0.0000	5.84 (4.24)	5.86 (4.25)	5.59 (4.12)	0.1702	8.23 (3.55)	7.25 (3.68)	8.45 (3.49)	0.0000
Income (Inflated to 2015, LN), mean (SD)	8.26 (1.17)	8.27 (1.17)	8.26 (1.21)	0.0185	8.08 (1.11)	8.06 (1.11)	8.31 (1.03)	0.0000	8.73 (1.29)	8.32 (1.36)	8.82 (1.25)	0.0000
Father's Job, n (%)				0.666				0.788				0.000
Blue-collar	3507 (58.98)	3357 (59.04)	150 (57.69)		4678 (59.81)	4380 (59.85)	298 (59.24)		1936 (54.74)	434 (68.78)	1502 (51.69)	
Others	2439 (41.02)	2329 (40.96)	110 (42.31)		3143 (40.19)	2938 (40.15)	205 (40.76)		1601 (45.26)	197 (31.22)	1404 (48.31)	
Mother's Job, n (%)				0.516				0.453				0.000
Blue-collar	3775 (63.49)	3605 (63.40)	170 (65.38)		5050 (64.57)	4733 (64.68)	317 (63.02)		2027 (57.31)	442 (70.05)	1585 (54.54)	
Others	2171 (36.51)	2081 (36.60)	90 (34.62)		2771 (35.43)	2585 (35.32)	186 (36.98)		1510 (42.69)	189 (29.95)	1321 (45.46)	
Age, mean (SD)	14.98 (1.96)	14.89 (1.94)	16.93 (1.31)	0.0000	12.71 (4.50)	12.50 (4.53)	15.72 (2.61)	0.0000	11.87 (3.58)	12.19 (3.76)	11.80 (3.54)	0.0133
Gender, n (%)				0.000				0.000				0.099
Male	3115 (52.39)	2862 (50.33)	253 (97.31)		4120 (52.68)	3723 (50.87)	397 (78.93)		1949 (55.10)	329 (52.14)	1620 (55.75)	
Female	2831 (47.61)	2824 (49.67)	7 (2.69)		3701 (47.32)	3595 (49.13)	106 (21.07)		1588 (44.90)	302 (47.86)	1286 (44.25)	
Area, n (%)				0.000				0.000				0.001
Western (Ref.)	1921 (32.31)	1845 (32.45)	76 (29.23)		2704 (34.57)	2523 (34.48)	181 (35.98)		956 (27.03)	197 (31.22)	759 (26.12)	
Northeastern	868 (14.60)	831 (14.61)	37 (14.23)		1014 (12.97)	964 (13.17)	50 (9.94)		709 (20.05)	143 (22.66)	566 (19.48)	
Central	1829 (30.76)	1695 (29.81)	134 (51.54)		2368 (30.28)	2177 (29.75)	191 (37.97)		1100 (31.10)	185 (29.32)	915 (31.49)	
Eastern	1328 (22.33)	1315 (23.13)	13 (5.00)		1735 (22.18)	1654 (22.60)	81 (16.10)		772 (21.83)	106 (16.80)	666 (22.92)	
Wave, n (%)				0.025				0.000				0.000
1991 (Ref.)	1177 (19.79)	1104 (19.42)	73 (28.08)		3009 (38.47)	2862 (39.11)	147 (29.22)					
1993	1015 (17.07)	973 (17.11)	42 (16.15)		1243 (15.89)	1163 (15.89)	80 (15.90)					
1997	1008 (16.95)	973 (17.11)	35 (13.46)		982 (12.56)	915 (12.50)	67 (13.32)					
2000	576 (9.69)	545 (9.58)	31 (11.92)		563 (7.20)	517 (7.06)	46 (9.15)					
2004	669 (11.25)	647 (11.38)	22 (8.46)		669 (8.55)	629 (8.60)	40 (7.95)		1112 (31.44)	286 (45.32)	826 (28.42)	
2006	441 (7.42)	421 (7.40)	20 (7.69)		439 (5.61)	402 (5.49)	37 (7.36)		845 (23.89)	200 (31.70)	645 (22.20)	
2009	358 (6.02)	343 (6.03)	15 (5.77)		358 (4.58)	322 (4.40)	36 (7.16)		706 (19.96)	80 (12.68)	626 (21.54)	
2011	424 (7.13)	410 (7.21)	14 (5.38)		426 (5.45)	386 (5.27)	40 (7.95)		874 (24.71)	65 (10.30)	809 (27.84)	
2015	278 (4.68)	270 (4.75)	8 (3.08)		132 (1.69)	122 (1.67)	10 (1.99)					

N.B. ^a: χ^2 tests for dichotomous variables and t-tests for continuous variables.

Table 2 Results of random effect Logistic regression

VARIABLES	Smoking		Alcohol Drinking			SSBs Drinking			
	All	Urban	Rural	All	Urban	Rural	All	Urban	Rural
Father's Behavior: Yes	3.409***	26.06**	2.835***	1.715***	2.194***	1.526**	2.573***	2.748***	2.508***
	(0.882)	(40.05)	(0.737)	(0.234)	(0.526)	(0.257)	(0.421)	(0.876)	(0.492)
Mother's Behavior: Yes	1.784	76.22**	1.142	3.574***	3.147***	3.395***	3.592***	3.394***	3.917***
	(0.894)	(164.1)	(0.633)	(0.530)	(0.649)	(0.705)	(0.504)	(0.952)	(0.656)
Father's Education	0.961	1.229	0.954	1.007	1.026	0.999	1.005	0.912*	1.030
	(0.0314)	(0.251)	(0.0317)	(0.0197)	(0.0338)	(0.0257)	(0.0201)	(0.0451)	(0.0244)
Mother's Education	0.938**	0.706*	0.985	0.992	0.959	1.001	1.037**	1.105**	1.016
	(0.0295)	(0.135)	(0.0328)	(0.0180)	(0.0304)	(0.0249)	(0.0182)	(0.0495)	(0.0212)
Income	0.962	2.281	0.919	1.160**	1.235	1.071	1.165***	1.126	1.162***
	(0.0846)	(1.278)	(0.0801)	(0.0768)	(0.158)	(0.0823)	(0.0468)	(0.0973)	(0.0552)
Father's Job: Others	1.329	9.559	1.399	0.913	0.998	1.130	1.384**	0.811	1.556**
	(0.338)	(13.53)	(0.374)	(0.136)	(0.226)	(0.234)	(0.207)	(0.251)	(0.294)
Mother's Job: Others	0.788	5.384	0.454**	0.976	0.897	0.547**	1.244	1.210	1.008
	(0.210)	(8.854)	(0.162)	(0.149)	(0.226)	(0.140)	(0.189)	(0.415)	(0.204)
Age	2.531***	10.13***	2.299***	1.429***	1.454***	1.408***	1.001	1.077**	0.975
	(0.233)	(4.846)	(0.209)	(0.0376)	(0.0608)	(0.0480)	(0.0144)	(0.0354)	(0.0160)
Gender: Male	84.16***	135,565***	53.80***	4.533***	3.982***	5.002***	1.251**	1.193	1.268**
	(42.32)	(405,173)	(27.75)	(0.635)	(0.817)	(0.944)	(0.129)	(0.280)	(0.148)
Area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wave	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.93e-10***	0***	3.50e-09***	2.52e-05***	1.97e-05***	4.69e-05***	0.287***	0.579	0.343**
	(4.05e-10)	(0)	(6.96e-09)	(1.85e-05)	(2.81e-05)	(4.37e-05)	(0.115)	(0.643)	(0.167)
Observations	5,946	1,682	4,264	7,821	2,124	5,697	3,537	1,063	2,474

seEform in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3 Subgroup analysis of intergenerational transmission with different SES

VARIABLES	Urban			Rural		
	OR (SD)	Suest Test	Observations	OR (SD)	Suest Test	Observations
Smoking						
Low Father Education	16.89 (48.27)	$\chi^2 = 0.04$, $p=0.8468$	187	2.962*** (1.065)	$\chi^2 = 0.76$, $p=0.3818$	1858
High Father Education	29.52** (48.64)		1206	4.038*** (2.033)		2406
Low Mother Education	0.232 (0.795)		336	1.202 (0.641)		2724
High Mother Education	9,533** (37,501)		912	-		825
Father's Job: Blue-collar	156.9 (512.1)	$\chi^2 = 1.42$, $p=0.2340$	631	2.995*** (0.874)	$\chi^2 = 1.95$, $p=0.1625$	2782
Father's Job: Others	29.67* (58.76)		957	19.03** (25.52)		1482
Mother's Job: Blue-collar	9,089 (57,695)		418	0.961 (0.532)		3229
Mother's Job: Others	7.763 (15.59)		585	-		1023
Low Income: Father's Effect	174.2** (376.2)	$\chi^2 = 0.27$, $p=0.6013$	478	2.683*** (0.738)	$\chi^2 = 0.01$, $p=0.9279$	3271
High Income: Father's Effect	3.007 (2.479)		411	29.74 (64.33)		744
Low Income: Mother's Effect	0.00132 (0.00538)		478	1.501 (0.807)		3271
High Income: Mother's Effect	8.549** (8.145)		411	-		744
Alcohol Drinking						
Low Father Education	1.997* (0.836)	$\chi^2 = 0.00$, $p=0.9499$	587	1.333 (0.346)	$\chi^2 = 0.84$, $p=0.3584$	2,420
High Father Education	2.314*** (0.699)		1,537	1.743** (0.389)		3,277
Low Mother Education	3.545*** (0.966)	$\chi^2 = 0.99$, $p=0.3189$	829	2.542*** (0.658)	$\chi^2 = 2.90$, $p=0.0888$	3,565
High Mother Education	3.059*** (0.902)		1,295	5.354*** (1.939)		2,132
Father's Job: Blue-collar	4.065*** (1.896)	$\chi^2 = 4.81$, $p=0.0283$	849	1.847*** (0.410)	$\chi^2 = 1.54$, $p=0.2142$	3,792
Father's Job: Others	1.644* (0.456)		1,238	1.171 (0.328)		1,905
Mother's Job: Blue-collar	3.660*** (1.201)	$\chi^2 = 0.45$, $p=0.5016$	651	3.289*** (0.820)	$\chi^2 = 0.69$, $p=0.4048$	4,399
Mother's Job: Others	3.050*** (0.780)		1,473	5.290*** (1.947)		1,298
Low Income: Father's Effect	2.061** (0.648)	$\chi^2 = 1.25$, $p=0.2639$	1348	1.577** (0.306)	$\chi^2 = 1.00$, $p=0.3710$	4707
High Income: Father's	2.699**		523	1.762		792

Effect	(1·314)			(0·650)		
Low Income: Mother's Effect	4·009*** (1·135)	$\chi^2 = 0·51,$ $p=0·4742$	1348	4·054*** (0·967)	$\chi^2 = 0·41,$ $p=0·5235$	4707
High Income: Mother's Effect	1·874 (0·875)		523	1·948 (0·956)		792
SSBs Drinking						
Low Father Education	5·032 (8·027)	$\chi^2 = 0·35,$ $p=0·5524$	125	3·294*** (1·397)	$\chi^2 = 1·91,$ $p=0·1669$	604
High Father Education	2·393*** (0·789)		924	2·339*** (0·536)		1,870
Low Mother Education	5·090*** (3·170)	$\chi^2 = 1·45,$ $p=0·2290$	205	5·408*** (1·650)	$\chi^2 = 5·39,$ $p=0·0203$	933
High Mother Education	2·972*** (0·943)		835	3·403*** (0·706)		1,541
Father's Job: Blue-collar	5·164* (4·799)	$\chi^2 = 0·46,$ $p=0·4966$	429	2·842*** (0·701)	$\chi^2 = 3·93,$ $p=0·0473$	1,507
Father's Job: Others	2·754*** (1·067)		634	2·228** (0·738)		967
Mother's Job: Blue-collar	3·401* (2·372)	$\chi^2 = 0·35,$ $p=0·5533$	350	4·045*** (0·798)	$\chi^2 = 3·19,$ $p=0·0739$	1,677
Mother's Job: Others	3·361*** (1·050)		713	3·916*** (1·236)		797
Low Income: Father's Effect	5·071*** (2·621)	$\chi^2 = 4·43,$ $p=0·0354$	341	3·310*** (0·868)	$\chi^2 = 13·33,$ $p=0·0003$	1312
High Income: Father's Effect	2·219 (1·286)		410	1·225 (0·407)		885
Low Income: Mother's Effect	2·966** (1·253)	$\chi^2 = 0·54,$ $p=0·4610$	341	4·591*** (1·043)	$\chi^2 = 11·51,$ $p=0·0007$	1312
High Income: Mother's Effect	2·807* (1·498)		410	3·035*** (0·875)		885

seEform in parentheses, *** $p<0·01$, ** $p<0·05$, * $p<0·1$

Figures

Figure 1

Subgroup analysis for urban families

Figure 2

Subgroup analysis for rural families