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How community-level social and economic developments have changed the patterns of substance use in a transition economy?☆

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ABSTRACT

Most social changes take place at the community level before indirectly affecting individuals. Although the contextual effect is far-reaching, few studies have investigated the important questions of: how do community-level developments affect drinking and smoking, and how do they change the existing gender and income patterns of drinking and smoking, particularly in transition economies? In this study, I used a Chinese panel dataset between 1991 and 2011 to reveal the moderating effects of community developments. Through multilevel growth curve modeling that controls for age, period, and cohort effects, as well as individual- and community-level covariates, I found that community-level economic development and social development are negatively associated with drinking and smoking. Moreover, economic and social developments also moderate the important influences of income and gender: women start to drink more in communities with higher economic development; the traditionally positive association between income and smoking/drinking is also reversed, i.e. the rich start to smoke and drink less in communities with higher social development. This study concludes that the rapid changes in communal social and economic structures have created new health disparities based on the gender and socioeconomic hierarchy.

1. Introduction

Health behaviors such as tobacco smoking and alcohol drinking are often discussed at individual behavioral level, explained as a function or corollary of socioeconomic wellbeing, health beliefs, psychological adaptation to stress, or peer influence. Recently, the variation in health behaviors across communal or geographical units has received an increasing amount of attention from scholars across various disciplines. The apparent community-level variation in smoking and drinking is not only a matter of geographical distribution, but more importantly reflects "the wider social structures that operate to constrain or enable human behaviors"(Barnett et al., 2017). Within the extant literature, the evidence to demonstrate the profound impact of community-level social and economic development on individual's health behaviors is sufficiently convincing (English et al., 2014; Freisthler et al., 2005; Hill and Angel, 2005; Van de Poel et al., 2012; Tingzhong Yang et al., 2015), but there is a lack of understanding of how communal socioeconomic developments affect substance use in transition economies, much less do we know how these developments have changed the existing strong patterns of substance use—such as the very common observation that males smoke and drink more than females. Without taking into account of the contextual factors structurally constraining our behaviors, we cannot boldly claim these patterns are natural and universal.

Many transition economies have experimented with tremendous social and economic reforms. The modernization introduced through the reforms has fundamentally changed the community structures and social order in developing countries, and such changes have made a lasting impact on substance use. Undoubtedly, the nature of the community a person lives in can influence a person's substance use beyond the impact of personal characteristics. Less known, however, is how a community's socioeconomic development interacts with personal characteristics in these transition economies. To make the issue more intriguing, the personal characteristics associated with substance use in western societies often show a reversed pattern in transition economies. For example, legal substance use is repeatedly found as a symbol of social prestige and correlated with higher socioeconomic status in many non-Western cultures (Benedict, 2011; Eriksen, 1999; Transchel, 2006; Zheng, 2005). But will this seemingly odd pattern converge to that in the West as these transition economies develop? In this study, I will test this rarely explored topic by applying growth curve modeling on a panel dataset between 1991 and 2011 from China, and answer the following questions: Do the rapid economic and social developments decrease individual's smoking and drinking? How do community-level economic

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and social developments moderate the well-known gender and income pattern in smoking and drinking? Do a set of important meso-level community characteristics—social disorganization factors—confound the contextual effects of community development?

2. Literature review

2.1. The contextual effects and substance use

The overarching influences of geo-social units at the macro ecological level on human behaviors are well known, and the thesis "place matters" is not entirely new. Places such as communities and neighborhoods are not only where people geographically reside, but also embody a wide spectrum of interacting social and economic structures that shape the cognitive and behavioral mode of their residents. Therefore, the contextual effects of geo-social units have a distinctive conceptual importance beyond individual characteristics and even the effects of compositional aggregates—characteristics of a geo-social unit based on a numeric operation (e.g. mean or summation) of the characteristics of its residents (Hutchison, 2007). The social and economic structures of a community shape substance use behaviors through place-based practices and place-based regulations (Pearce et al., 2012). The social and economic development of a community are considered as the macro-level structural dynamic that guides and constrains meso-level characteristics, such as collective efficacy and social disorganization, and ultimately influences individual smoking and drinking behaviors at the micro-level (Barnett et al., 2017).

There are a number of theories linking social and economic development and substance use. The stress process thesis proposes that lagged economic development creates the chronic life stress whose temporary relief can be physically achieved from substance intake (Pearlin et al., 1981). Alternatively, Marxists criticized the consumption-inducing apparatus of economic development, in which workers have no *de facto* choice but buying their leisure through drinking and smoking (Marcuse, 1964; Marx, 1844/1977, p. Manuscript III). Community-level social development may exert a suppressive effect on population-level substance use, thanks to the social services, health facilities, and numerous other institutional resources it provides to the public. The modern welfare system and investment in the public good have produced not only visible material improvements, but have also raised an awareness that treats substance use as a public danger rather than individual behavior (Bambra, 2007; Bayer and Stuber, 2005). Social development may also reduce general deviances through facilitating civic activities among citizens (Browning et al., 2004; Sampson et al., 1997). Unfavorable economic and social development of an area prove to be the structural antecedents of social disorganization, and increase the level of concentrated poverty, residential turnover, and demographic heterogeneity (Bursik and Grasmick, 1993; Shaw and McKay, 1969).

Empirically, Twigg, Mohan, and colleagues showed the clear correlations between smoking prevalence and several measures of social and political development in England, such as voting turnout and voluntarism (Mohan et al., 2005; Twigg et al., 2000). Ross and Taylor (1998) found that a community or region's economic mode and demographic composition have an independent influence on pro-smoking attitudes irrespective of individual smoking and socioeconomic. Similar finding from China indicates that the political economy of the regional reliance on cigarette manufacturing has significantly elevated the smoking likelihood among those regions' residents (Yang et al., 2015). In former Soviet countries, the consumption of tobacco has risen in regions that received more economic investment between 1990 and 2000 (Gilmore and McKee, 2004; Perlman et al., 2007).

Similarly strong socio-geographical patterns are also found for alcohol drinking. There is also a well-established association between drinking problems and neighborhood characteristics (Freisthler et al., 2003; Hill and Angel, 2005; Scribner et al., 2000). Latino immigrants living in acculturated and heterogeneous communities in the U.S. are more likely to drink and drink excessively (Abraído-Lanza et al., 2016). Some studies further demonstrated that such association is not just caused by the selection effect, instead, the community-level factors are causally real and robust (Gruenewald, 2007; Sampson, 2012; Sampson et al., 2002).

2.2. The context-dependent effects of individual characteristics

Although there are some studies on the contextual effects of community development on substance use, only a precious amount of discussions can be found on the interaction between community development and individual characteristics. No one lives in an abstract world where his gender or social class dictates his conducts irrespective of the surrounding social environment and interpersonal relationships, and how a context matters may differ substantially from individuals to individuals.

The literature has consistently shown that an individual's socioeconomic status is associated with smoking and drinking. However, such association may depend on community-level social and economic development. According to the rational choice theory, compared to the poor, people with more disposable income will be less likely to spend money for recreational substance use when the economy thrives since the room to allocate their resource has been diversified (Buchmueller and Zuvekas, 1998; Srivastava, 2013). Sociologists found that deviant behaviors are more closely associated with the level of relative deprivation in a community. Thus, taking drugs and drinking alcohol is not caused by the absolute lack of material goods but a sense of frustration and the subsequent adoption of subterranean values among the underclass who live in an unequal community (Ilan, 2015; Massey and Brodmann, 2014; Young, 1971). To illustrate this point, Sun (Sun et al., 2012) showed a positive relationship between at-risk health behaviors and one's relative income inequality. Chuang and others found that, in terms of smoking, women of lower social class do not benefit from good community-level education much as women of higher social class do, and social disorganization harms the lower class alone (Chuang et al., 2007). Daponte-Codina and colleagues' study in Spain showed a similar pattern where the least-educated men from deprived areas smoke the most, and the smoking rate dropped among the high-income people as the society develops (Daponte-Codina et al., 2009). These findings are closely in line with the arguments of the fundamental cause theory of health: initially, people of advantageous social status may use substance as a conspicuous consumption, but as the advanced health knowledge and technologies become available in their social milieu, they will adjust their health behaviors faster than the lower class (Link and Phelan, 1995, 2010). Thus, the association between socioeconomic status and legal substance use heavily depends on the embodied context of development.

The impact of gender on substance use is also context-dependent. Men do not have to smoke and drink more than women, so long as their culture has not constructed a separate set of performative codes for each gender. In fact, a wealth of literature have already suggested that economic and social development can change the gendered pattern of substance use through weakened gender roles. Using pooled data, Stevens and Caan showed that gender interacts with the pace of economic development to determine the likelihood of smoking. Women are less likely to smoke when the economy is rapidly developing, meanwhile men become more likely to smoke in this scenario (Stevens and Caan, 2008). In many developing countries, smoking for young women has lately become a popular practice suggestive of liberalism and Westernization, a tool used to negotiate for more independence and power during inter-gender interactions (Elkind, 1985; Gilbert, 2007). As a society develops economically and socially, another possible mechanism leading to the convergence of substance use patterns between men and women has to do with the stress (Lennon and Rosenfield, 1992) and exposure opportunities (Holmila

and Raitasalo, 2005; Roche and Deehan, 2002). As women take up jobs outside, they simultaneously take up more opportunities to be exposed to substances. Gabrielle Glaser's recent report on America's hidden drunken mothers is a vivid depiction of one consequence of the stressful work-life imbalance in the modern economic and social world (Glaser, 2014).

Overall, as a community develops economically and socially, we expect to see a reversed impact of gender and income on smoking and drinking according to what the current scholarship suggests. However, we have found very limited studies in this aspect. Particularly lacking is such studies that investigate the changing patterns of substance use caused by the social and economic development in transition economies, which may differ substantially from the experiences of the development in the Post-Industrial world (Barnett et al., 2017).

2.3. The (in)famous gender and income patterns of substance use in transition economies

The socioeconomic correlates of substance use in transition economies and non-western cultures have their unique features. Currently, while the prevalence of smoking and drinking is not enormously divergent between genders in the U.S. or West Europe, the gendered pattern of smoking and drinking in the East is too outstanding to ignore. Using China as an example, male concurrent smoking rate in China has hovered around 40–50% up to today, but less than 10% females have ever smoked (Yang et al., 2009a, 2009b; Yang et al., 2014a). Chinese males are twice more likely to drink than females. While habitual drinking is found among 33% of the Chinese males, only 3% of the females do so (Millwood et al., 2013). In contrast, between 2000 and 2010, 9.3% of American men and 9.7% of American women are current smokers, and 54.3% of American men and 41% of American women are former smokers (Thun et al., 2013). The rate of ever-smoking is also similar between women and men in the American college population (Everett et al., 1999). According to two major health surveys in the U.K., binge drinking rate between females and males only saw differences between 10% and 15% (McAlaney and McMahon, 2006). In Spain, the diffusion of smoking reached to the female population and quickly match them with males after the 60 s (Fernandez et al., 2003). To further reinforce the context-dependent nature of the gender pattern of substance use, scientists also found that as Asian immigrants become more acculturated in the West, their gendered gradient in drinking and smoking eventually disappears (Choi et al., 2008; Hahm et al., 2004).

To contrast with western societies again, higher social status is quite consistently associated with the consumption of legal substances in China. Before opium was outlawed by the communists, it had always been a symbol of the leisure class and epitome of conspicuous consumption (Zheng, 2005). Today, alcohol drinking and tobacco smoking is considered a ritualistic mandate in a wide range of formal social settings, which serves to promote the exchange of information, corroborate social capital and networks, and create an empathetic platform for one's career advancement (Collins, 2014; Hao et al., 2005; Millwood et al., 2013). Therefore, people in a higher class, as well as those who aspire to join them, are subject to the mounting pressure of social drinking and social smoking (Cochrane et al., 2003; Ma et al., 2008; Rich et al., 2014). Scientists have revealed the unique pattern of economic wellbeing and at-risk health behaviors in contemporary China: the richer tend to smoke, drink, and lead a sedentary lifestyle (Kim et al., 2004); income tends to be positively associated with legal substance use in China (Chen et al., 2004; Kim et al., 2004; Millwood et al., 2013; Pan, 2004; Wu et al., 2008; Yang et al., 2008, 2009a, 2009b, 2014b).

2.4. The current study

As I have shown in the literature review, important research schemes affirming the contextual effects have generally matured and produced fruitful results testifying to the significant and independent impact of community-level development on health behaviors. However, in the literature of substance use, advance in the knowledge about how macro-level developments change the individual-level patterns of smoking and drinking across time is called for by scholars. In addition, there is even a greater scarcity of such research investigating the changing pattern of smoking and drinking caused by community development in the transition economies and developing countries. Using the panel dataset from the China Nutrition and Health Survey, I have employed multilevel growth curve modeling to test the following hypotheses as inspired by the current literature and the gap therein:

H1: Positive individual effects: income and the male gender is positively associated with smoking and drinking.
H2: Negative contextual effects: social and economic development at community level is negatively associated with smoking and drinking.
H3.1: Negative interaction between gender and community development: the frequency of smoking and drinking is higher for the females in communities of greater social and economic development.
H3.2: Negative interaction between income and community development: the frequency of smoking and drinking is lower for people with higher income in communities of greater social and economic development.

3. Methodology

3.1. Sample and population

This study uses a panel dataset collected between 1989 and 2011, China Health and Nutrition Survey (CHNS). The survey uses multi-stage random cluster sampling to cover nine provinces of China. Counties of the nine provinces were stratified by income to yield four counties from each province. Besides regular household and individual surveys, CHNS has a separate community questionnaire at each wave, enabling multilevel analysis such as the current one. Since the first wave in 1989, eight subsequent panels were collected respectively in 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. It has been extensively used for a wide range of academic studies (Popkin et al., 2010).

3.2. . Measurement

The dependent variables of this study are the frequency of alcohol-drinking and tobacco-smoking. Frequency of substance use is a better measurement over usage status because it may capture the fine continuum of the behavior. The CHNS asked respondents if they have ever smoked cigarettes, and followed up with “the number of cigarettes smoked every day”. It also asked if respondents “drank beer/alcohol last year” and followed up with the frequency of alcohol consumption, which ranges from “no more than once a month” to “almost every day”. For other individual characteristics, we have adopted several socio-economic and demographic measures: age at each survey, respondent's birth cohort (born before the Great National Revolution in 1922, before the end of the Chinese Civil War in 1949, before the Cultural Revolution in 1966, before the end of the Cultural Revolution in 1976, and afterward), income measured in yearly Yuan, education measured by the highest degree completed, ethnicity (dichotomy of Han or ethnic minority), gender, as well as occupational class categorized into the unemployed, workers, self-employed, owners, farmers, and retirees.

Indicators of community development were provided by the CHNS dataset. Economic development is constructed from several indicators including the typical wage for a manual worker, number of people working in non-agricultural sectors, and the number of large stores and

supermarkets. Social development is constructed from four measures including: provision of preschool for children under 3 years old, availability of health insurance for women and children, proportion of households with treated water, and proportion of the residential area without excreta present. These restricted information was reported by official records or municipal administrators, rather than aggregated from household surveys of individuals, and they have been used in a number of studies in population health and epidemiology (Jones-Smith and Popkin, 2010; Monda et al., 2007; Van de Poel et al., 2012).

To control for potential confounders of the development indicators, I have also incorporated community-level information including population density/km^2, average residential turnover rate aggregated from household information, aggregated ethnic heterogeneity (calculated as the Simpson diversity index), and aggregated income inequality (calculated as the Gini coefficient). The choice of these control variables is theoretically based on social disorganization theory, which argues that individual deviance is a byproduct of the structural economic environment through three middle-range elements: concentrated poverty, racial heterogeneity, and residential turnover rate (Bursik and Grasmick, 1993; Shaw and McKay, 1969).

3.3. Statistical analysis

I used multilevel growth curve modeling to analyze the specified hypotheses, with time nested within individual persons, individuals nested within their communities, and communities nested/stratified by the urban-rural duality. By assuming identical independent distribution for the sample, linear regression fails to minimize the unbiased variance when sampling units were themselves clustered within a larger aggregated unit. Meanwhile, multilevel growth curve modeling allows a unique growth trajectory for each individual, thus it derives more accurate estimates for variances by partial pooling. It then applies the same logic to individuals who were sampled from their geographical communities (Raudenbush and Bryk, 2002). The interactions between individual- and community-level variables are realized through cross-level random effects. I specified the coefficients of the individual-level variables to randomly vary across different communities, and specified the coefficients of community-level developments to be random effects at the fourth level—urban-rural duality. By doing so, the results will be less vulnerable to the idiosyncratic influence of outlier estimates and avoid the problems associated with using pooled data (Gelman, 2006). The formal expression of the final cross-level random effect model is: $y_{ijt} = \alpha + \beta_{01} income_{ijt} + \beta_{02} gender_{ijt} + \beta_{03} economic_{jt} + \beta_{04} social_{jt} + \boldsymbol{\beta X_{ijt}} + \pi_{10} genderXeconomic_{jt} + \pi_{20} genderXsocial_{jt} + \pi_{30} incomeXeconomic_{jt} + \pi_{40} incomeXsocial_{jt} + \boldsymbol{\delta X_{jt}} + \epsilon_{ijt} + \theta_{jt} + \sigma_t$, where beta are coefficients for individual-level income and gender effects after controlling for a vector of covariates X, pi are cross-level interaction coefficients, and eta, theta, sigma expressing the variance at individual-, communal-, and temporal-level.

This study also post-stratifies the sample by a combination of gender and the number of households in communities. Post-stratification weight w is the inversed probability p of being randomly chosen in a sampling unit, and p equals $\sum \frac{n_{jk}}{N_{jk}}$. Censored information on the dependent variables are handled with propensity score matching. I consider those who have completed less than four waves of surveys in total to be "missing" or "dropouts". A propensity score based on gender, age, income, urban residency, community-development, and household population attrition is then used to "weight up" respondents who share the same demographic background with the survey dropouts (Austin, 2011). The major analysis tool is a popular mixed-effect package "lme" in R (Bates et al., 2014).

4. Results

In Fig. 1, I have visualized the longitudinal changes in community-level social and economic development separately for urban and rural area. During the two decades between 1991 and 2011, there had been a substantial improvement in the average level of developments for both urban and rural communities, although the urban ones had constantly outpaced their rural counterparts. Detailed descriptive information for community developments and other covariates are shown in Table 1 with means and standard deviations presented. Overall across waves, people in this sample smoke 5 cigarettes, the standard deviation is as large as 9 cigarettes. The average frequency of drinking is 1.15, corresponding roughly between "no more than once a month" and "once a month".

4.1. Main effects

A series of growth curve models are presented in Tables 2.1, 2.2 for smoking and drinking frequency, started by an unconditional model with only an intercept and the survey wave identifier. The wave identifier is negatively associated with smoking (−.06, $p < .001$) and drinking (−.05, $p < .001$), indicating that people smoke and drink

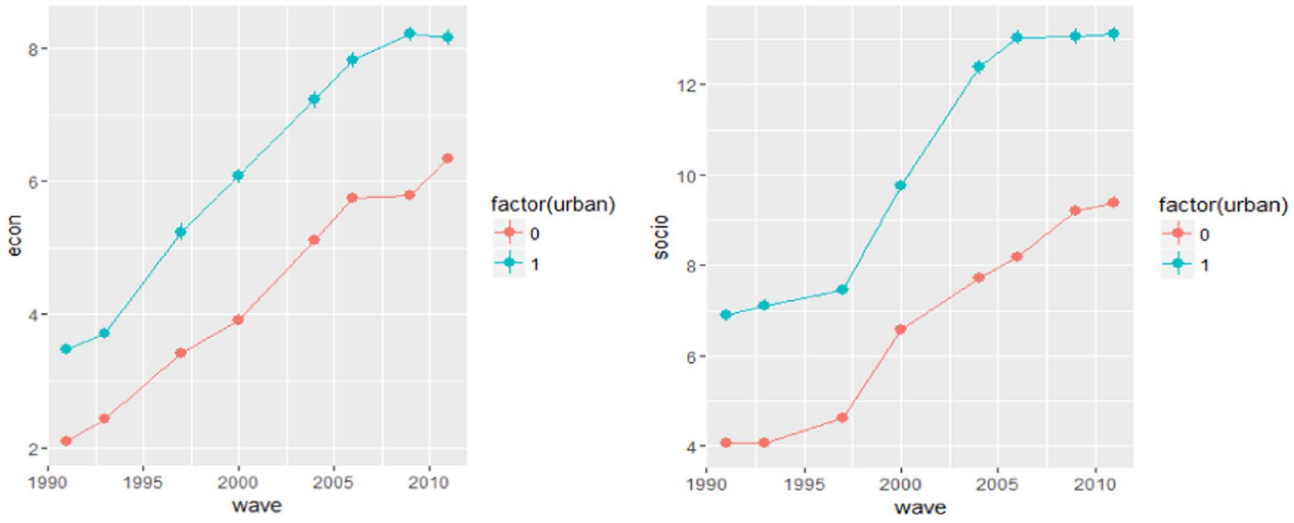

Fig. 1. Changes in the average index of economic (left) and social (right) development in China between 1991 and 2011, stratified by the urban-rural duality.

Table 1
Descriptive statistics for variables at all levels, pooled from all waves.

	Min, Max	Mean or proportion	Standard Deviation*
Time variable (n=8): Wave	1991, 2011	2002	6.70
Individual variables (n=12432)			
Smoking	0, 50	4.91	8.90
Drinking	0, 5	1.15	1.79
Age	18, 107	51.41	14.01
Cohort	1, 5	2.63	.73
Income (group-centered and logarithm)	−9.94, 5.11	.19	1.20
Education (group-centered)	−3.82, 4.35	−.13	1.11
Gender	0, 1	48%	.4%
Han		87%	.3%
Class			
Unemployed		19%	.4%
Worker		13%	.3%
Self-employ		10%	.3%
Owner		2.8%	.1%
Farmer		36%	.4%
Retiree		12%	.3%
Community variables (n=235)			
Economic development (grand-centered)	−10.93, 11.99	.14	5.15
Social development (grand-centered)	−9.74, 11.03	.13	4.24
Income inequality	.01, .23	.06	.02
Residential turnover	0, .65	.15	.10
Ethnic heterogeneity	0, .73	.09	.17
Population density	.5, 10	5.85	1.38
Urban-rural (n=2) Urban	0, 1	31%	.4%

* Standard deviation for proportions equals $\sqrt{p(1-p)/n}$, for means equals $\sqrt{\frac{\sum x_i - \mu}{n}}$.

significantly less as time passes from 1991 to 2011. Intraclass correlation coefficient (ICC)[1] at individual level indicates that 39% of the variation in smoking exists at the individual level, and 31% of the variation in drinking exists at the individual level.

Model 2 in the Tables 2.1 and 2.2 add individual-level characteristics to the unconditional model. The wave effect now disappears for smoking, but age and cohort effects have emerged: older people smoke less (−.037, $p < .001$), the later birth-cohort smoke less (−.595, $p < .001$). For drinking, after controlling for age and cohort effects, the period effect of survey wave becomes positive (.006, $p < .001$), which suggests that within the same cohort and the same age, people drink more as time passes. Being male is strongly associated with higher frequency of smoking (9.17, $p < .001$) and drinking (1.87, $p < .001$), and income is also positively associated with smoking (.057, $p < .01$) and drinking (.025, $p < .001$). As compared to the unemployed, all other occupation categories except retirees smoke and drink more. Taken together, these patterns convincingly prove that the consumption of legal substances is a marker of higher social status in China, and hypothesis H1 is supported. With the addition of individual-level variables, the proportional reduction in error (PRE)[2] at the individual level is 43% for smoking and 49% for drinking—our included individual characteristics explained a large portion of the behavioral variations. Other diagnostic statistics such as AIC, BIC, Chi-square difference in the deviance, all suggest a significant improvement over the unconditional model.

[1] $ICC_i = \tau_i/(\tau_i+\tau_{i2}+\ldots\tau_j+\epsilon)$.
[2] $PRE = (\tau_{m1}-\tau_{m2})/\tau_{m1}$

Community-level variables are included in model 3 of Tables 2.1 and 2.2. The results affirm hypothesis H2, that community-level social and economic developments reduce smoking and drinking. Community-level social development is negatively associated with smoking frequency (−.024, $p < .05$), and economic development is negatively associated with drinking frequency (−.004, $p < .05$), after controlling for other individual- and community level covariates. Compared to the unconditional model, the PRE at community- and urban-rural level is 23% for smoking and 36% for drinking. The inclusion of communal variables explained a considerable portion of the behavioral variations across communities and rural-urban areas.

4.2. Cross-level random effects

When a variable's coefficient is allowed to freely vary between the units of a higher ecological level, we can test the cross-level interaction between an individual-level variable and a community variable. Table 3 added such interaction terms, allowing gender and income to be random effects at community-level, social and economic development to be random effects at urban-rural level. In this table, we see evidences to support hypotheses H3.1 and H3.2.

The existing gender pattern of drinking is reversed by economic development (−.008, $p < .05$). For males, community-level economic development is negatively associated with drinking. But for females, economic development increases drinking frequency. To a lesser extent, the gender pattern of smoking also tends to be reversed by social development (−.044, $p < .10$). Two pictures in Fig. 2 have visualized this interactive pattern. For females (red lines), there are positive relative changes in smoking and drinking as the level of community development increases.

The income pattern of smoking and drinking is reversed by community-level social development, as indicated by two highly significant negative interaction terms (−.024, $p < .01$; −.006, $p < .001$). As Fig. 2 shows, in communities with very high level of social development (blue lines), the incremental change in income brings down the frequency of drinking and smoking. As a community develops socially, the richer people living there drink less and smoke fewer; but the richer people living in less developed communities still consume more alcohol and cigarettes relative to the poor.

5. Discussion

The development in economic and social spheres since the reforms in the 1980s has brought about enormous changes to communal living in China, and some of the changes have considerable impacts on substance use. In this study, with multilevel growth curve models that isolated the effects of time, age, and cohort, I found that: 1) there is a unique gender and income pattern of substance use in China, males and higher income people drink and smoke more; 2) economic development at community level is negatively associated with drinking, and social development is negatively associated with smoking; 3) the existing gender pattern of drinking has been changed by economic development, and the income pattern of both drinking and smoking has been altered by social development. In addition, these associations are not confounded by meso-level social disorganization factors—the compositional effects of income inequality, residential turnover rate, and ethnic heterogeneity.

The current literature has discussed the important contextual effects of the place where people live and socialize in (Barnett et al., 2017; Dreier et al., 2013). Regarding the effect of social and economic developments, people may drink and smoke less due to the rising health awareness, the investment in education rather than hedonistic activities, as well as other psychological and cultural transformations relating individual health behaviors to broader developmental issues (Kimbro, 2009; Robert J. Sampson et al., 2002). Furthermore, beyond shifting the normative sanctions of smoking and drinking, community

Table 2.1
Multilevel growth curve models for smoking frequency between 1991 and 2011.

	Unconditional model 1 Estimates	s.e.	Model 2 Est.	s.e.	Model 3 Est.	s.e.
Time variable (n=8):						
Wave	−.060***	.004	.016	.010	.019†	.010
Individual variables (n=12432)						
Age			−.037***	.005	−.066***	.009
Cohort			−.595***	.166	−.59***	.171
Income			.057**	.024	.092**	.031
Education			−.196***	.042	−.199***	.043
Gender			9.17***	.114	9.20***	.114
Han			.035	.224	.166	.242
Class (unemployed)						
Worker			.581***	.115	.602***	.118
Self-employ			.553***	.119	.529***	.123
Owner			1.14***	.182	1.14***	.187
Farmer			.473***	.092	.437***	.094
Retiree			−.539***	.124	−.542***	.128
Community variables (n=235)						
Economic development					−.002	.009
Social development					−.024*	.011
Inequality					2.09	1.72
Residential turnover					−.454	.328
Ethnic heterogeneity					.449	.532
Population density					−.131**	.048
AIC, BIC	373198, 373251		360859, 361002		348554, 348749	
Deviance, df	373177, 55262		360781, 54227		348448, 52312	
Residual	74.38		74.22		75.09	
Individual variance τ00	49.15		27.94		27.85	
Community variance τ00	1.31		1.36		1.27	
Urban-rural variance	.301		.112		.033	

Significance level: *p < .05, **p < .01, ***p < .001, †p < .10, all are two-tailed tests based on t-values. Key individual-level variables are group-mean centered, key community-level variables are grand-mean centered.

Table 2.2
Multilevel growth curve models for drinking frequency between 1991 and 2011.

	Unconditional model 1 Estimates	s.e.	Model 2 Est.	s.e.	Model 3 Est.	s.e.
Time-level variable (n=8):						
Wave	−.005***	.001	.006***	.002	.006**	.002
Individual variables (n=12432)						
Age			−.007***	.002	−.007***	.002
Cohort			−.093**	.03	−.095**	.031
Income			.025***	.005	.036***	.007
Education			−.009	.008	−.009	.009
Gender			1.87***	.021	1.86***	.021
Han			−.102*	.045	−.082	.048
Class (unemployed)						
Worker			.131***	.024	.117***	.025
Self-employ			.140***	.025	.132***	.026
Owner			.312***	.038	.299***	.039
Farmer			.118***	.019	.110***	.020
Retiree			−.101***	.026	−.111***	.027
Community variables (n=235)						
Economic development					−.004*	.002
Social development					.001	.003
Inequality					−1.25***	.369
Residential turnover					.109	.071
Ethnic heterogeneity					.154	.125
Population density					−.005	.011
AIC, BIC	212289, 212343		198907, 199051		192269, 192465	
Deviance, df	212260, 58002		198792, 56090		192109, 54162	
Residual	3.62		3.57		3.59	
Individual variance τ00	1.71		.866		.868	
Community variance τ00	.103		.099		.084	
Urban-rural variance τ00	.018		.014		.006	

Significance level: *p < .05, **p < .01, ***p < .001, †p < .10, all are two-tailed tests based on t-values. Key individual-level variables are group-mean centered, key community-level variables are grand-mean centered.

Table 3
Cross-level random effect models for smoking and drinking behaviors with interactions between individual- and community-level variables.

	Smoking Est.	s.e.	Drinking Est.	s.e.
Time-level variable (n=8):				
Wave	.015	.009	.005**	.002
Individual variables (n=12432)				
Income	.092**	.031	.038***	.006
Gender	9.23***	.213	1.87***	.03
Age	−.061***	.009	−.006***	.002
Cohort	−.544***	.162	−.089**	.031
Education	−.187***	.042	−.006	.008
Han	.291	.219	−.092*	.045
Class (unemployed)				
Worker	.634***	.118	.118***	.025
Self-employ	.538***	.113	.135***	.026
Owner	1.23***	.187	.307***	.038
Farmer	.420***	.093	.112***	.019
Retiree	−.482***	.126	−.112***	.027
Community variables (n=235)				
Economic development	−.003	2.19	−.001	.005
Social development	.011	1.85	.005	.004
Inequality	1.41	1.69	−1.22***	.036
Residential turnover	−.443	.322	.126	.069
Ethnic heterogeneity	.316	.434	.006	.102
Population density	−.086*	.042	−.011	.009
Gender X economic development	.002	.017	−.008*	.003
Gender X social development	−.044†	.022	−.005	.004
Income X economic development	.009	.007	.001	.001
Income X social development	−.024**	.008	−.006***	.002
AIC, BIC	348060, 348353		192022, 192315	
Deviance, df	347914, 52301		191799, 54151	
Residual	75.08		3.59	
Individual variance τ00	25.71		.831	
Community variance τ00	.004		.021	
Urban-rural variance τ00	6.29		.025	

Significance level: *p < .05, **p < .01, ***p < .001, †p=.10, all are two-tailed tests based on t-values. Key individual-level variables are group-mean centered, key community-level variables are grand-mean centered.

development may also provide other means of engagement in public life rather than a collective participation in drinking and smoking (Bambra, 2007; Bayer and Stuber, 2005). The strong social connection and cohesion based on kinship, work unit, and place of origin may have gradually faded out in modern China. Instead, people spend more time on civic and voluntary public life where substance use is marginalized or even penalized (Thompson et al., 2007).

5.1. Changing income pattern

A surprising gap in the literature, given the widely acknowledged fact that individuals are socially embedded in networks and environment, is that few have investigated how community features such as its development level have changed those seemingly natural patterns of smoking and drinking. Such patterns are actually not natural, nor are they universal across contexts, particularly in transition economies whose community structures are being changed at an unprecedented pace. I have showed in this study that a unique pattern in China—higher income is associated with more drinking and smoking—has loosen up due to social development.

As discussed shortly above, social development brings in a transition in the normative perception of substance use. Smoking and drinking may no longer appeal to higher class as a symbol of leisure and an embodiment of material affluence. The same transition happened to the opium consumption when the British dumped cheap opium to the Chinese market and the Mandarin officials and intelligentsia found out the loss of prestige associated with opium smoking (Zheng, 2005). Others have discussed how tobacco smoking has shifted from being an embodiment of the intellectual identity to a stigmata of poverty and primitiveness (Bayer and Stuber, 2005; Constance and Peretti-Watel, 2010; Peretti-Watel et al., 2007). In addition, the fundamental cause of health theory argues that the advances in development (socially, economically and technologically) disproportionally benefit the higher social class, and the equilibrium between health and social status is maintained by rich people's ability to change health behaviors ahead of the poor (Link and Phelan, 1995, 2010). The context-dependent association between socioeconomic status and health is replicated in 29 countries, where the benefits of higher social status is amplified in affluent environments (Präg et al., 2016). In China, a study by Luo and Xie (2014) found that the income pattern of mortality is mediated by health behaviors and access to health care. Miao and Wu (2016) showed that chronic diseases among the higher-income category are moderated by urbanization. In light of substance use, the findings here suggest that even though the higher class in China use to consume more alcohol and tobacco, they have quickly adapted their behaviors as social development brings in updated health beliefs and knowledge.

5.2. Changing gender pattern

This study has also shown that economic development interacts with gender in a manner that women start to drink more in economically advanced communities. Although the same interactions for smoking had a p-value larger than .05, which we attribute to the much stronger cultural sanction against female smokers, the direction of the effect is the same: social development elevates the risk of smoking for women but reduced it for men.

Smoking and drinking in transition economies can help construct an independent and liberalized female identity, while on the other hand, the need to demonstrate masculinity through risk-taking behavior and substance use becomes less pressing (Elkind, 1985; Gilbert, 2007). Licit substance use then becomes the most convenient and easily accessible token that is not deprived of pleasure while representing this modernistic identity. Earlier studies on other health and behavioral issues have long discovered an ironic phenomenon: economic liberalization and converged gender division of labor could harm the mental and physical wellbeing of women (Artazcoz et al., 2004; Lennon and Rosenfield, 1992). This is especially true when women are able to join the economic competition but discriminatory treatment and inadequate recognition are still ingrained, which further deteriorates their sense of self-efficacy and mental wellbeing (Banerjee, 2014; Umberson et al., 1996). For some women, resorting to drinking has become a convenient self-medication to deal with the mounting stress of family life and their career (Glaser, 2014).

Overall, this study has provided a fuller image of the impacts of community-level developments on substance use during the two decades of China's market reform. Community-level development as a whole has contributed to less smoking and drinking, but its effects are very divergent depending on one's gender and income. Health disparities in terms of substance use pose a realistic concern for people living with different combinations of community and individual characteristics. Some social groups face greater risks of substance use due to communal development factors. The rapid development in transition economies such as China proves to have exerted undeniably strong and far-reaching influences on people's substance use behaviors, which reflects the importance of understanding the interplay between community-level development and individual characteristics.

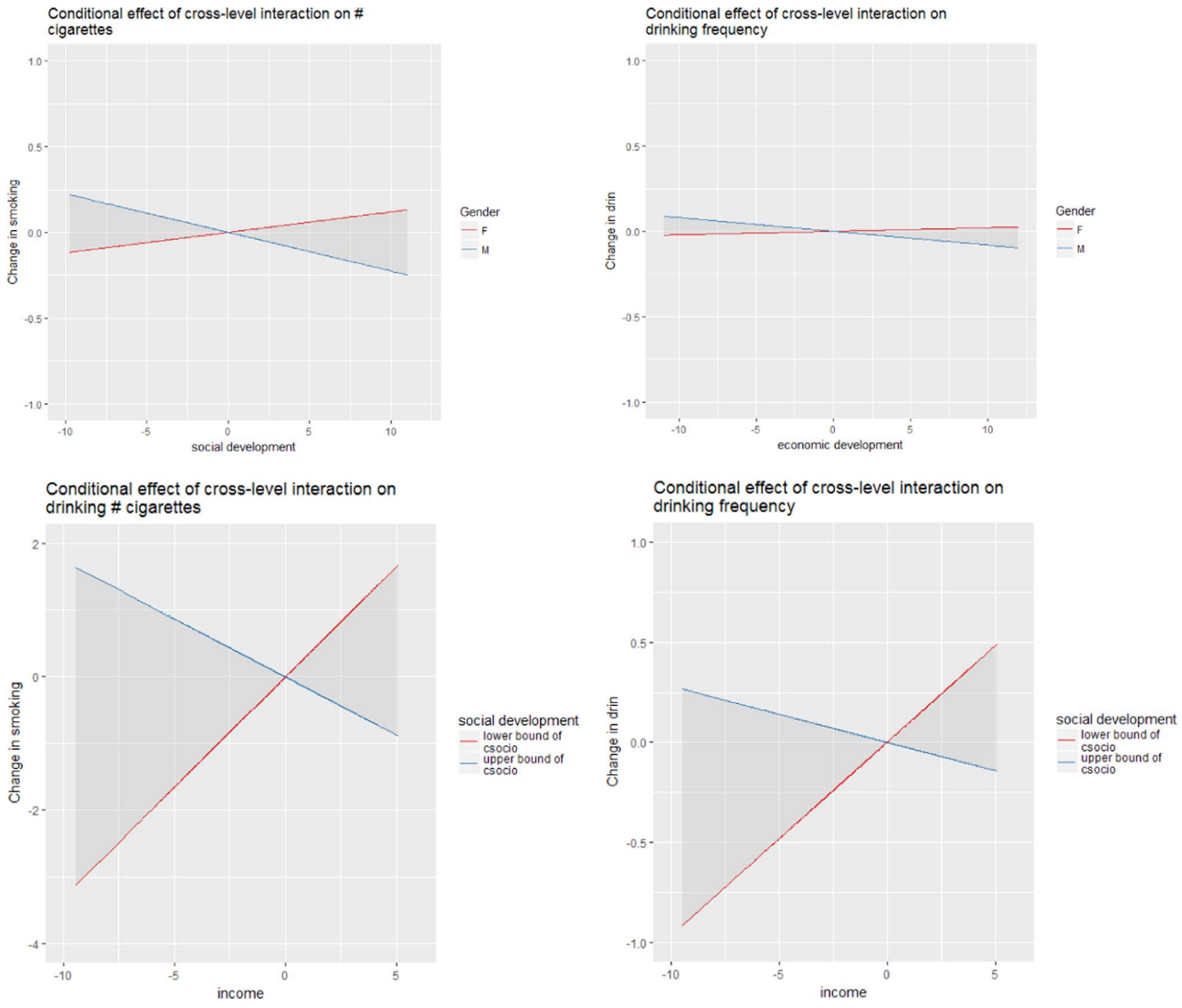

Fig. 2. Cross-level random interactions between individual factors and community developments. Values are mean-centered except for gender.

6. Limitations

Notwithstanding its merits, there are a few areas that future research could improve on top of this study. First, this study suggested that the income pattern may have been changed because the rich have gained disproportionally from advanced health education and technicalities, and the gender pattern may have been revised due to female liberalization and the stressful demand on women in a modern economy. However, these tempting mediators are not assessed in the data source I currently employ, future studies with relevant information should further explore the meso-level pathways linking communal change and health behaviors. Second, selective migration could be a source of endogeneity. Although I have utilized propensity scores to weight up the respondents who demographically resemble the survey dropouts, propensity score matching is only an *ante-exo* approach to quasi-experiment. Other scholars may utilize a different identification strategy to this issue.

Appendix A. Robustness check of the disturbance of model specifications on key coefficients

	Smoking, no community covariates	Smoking, no sampling weight	Smoking, OLS, no random effects	Drinking, no community covariates	Drinking, no sampling weight	Drinking, OLS, no random effects
Time-level variable (n=8): Wave	.012	.017	.014†	.006**	.005*	.006***
Individual variables						

(n=12432)						
Income	.055*	.067*	.121**	.025***	.037***	.049***
Gender	9.20***	9.26***	9.63***	1.88***	1.87***	1.89***
Age	−.061***	−.060***	−.073***	−.006***	−.005**	−.008***
Cohort	−.540***	−.535***	−.548***	−.086**	−.086**	−.108***
Education	−.183***	−.204***	−.343***	−.007	−.003	−.018*
Han	.193	.343	−.029	−.095*	−.113**	−.127***
Class (unemployed)						
Worker	.604***	.605***	.388**	.131***	.123***	.137***
Self-employ	.552***	.613***	.186	.142***	.133***	.108***
Owner	1.21***	1.18***	1.106***	.317***	.303***	.342***
Farmer	.424***	.341***	.412***	.116***	.102***	.045*
Retiree	−.467***	−.474	−1.23***	−.101***	−.117***	−.199***
Community variables (n=235)						
Economic development	−.006	−.005	.019	−.002	−.001	.003
Social development	.003	.009	.059***	.004	.004	.012***
Inequality		−.068	7.127***		−1.32**	−2.48***
Residential turnover		.026	.249		.033	−.107
Ethnic heterogeneity		.449	.381		.032	−.239***
Population density		−.085*	−.077**		−.006	.009
Gender X economic development	−.003	−.007	−.106***	−.008*	−.009**	−.001
Gender X social development	−.028	−.046*	−.135***	−.005	−.006	−.008*
Income X economic development	.010	.007	.011	.001	.001	−.001
Income X social development	−.012†	−.022**	−.029**	−.005**	−.006***	−.008***

Significance level: *p < .05, **p < .01, ***p < .001, †p=.10, all are two-tailed tests based on t-values. Key individual-level variables are group-mean centered, key community-level variables are grand-mean centered.

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