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Relative income inequality and selected health outcomes in urban Chinese youth

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Abstract

Self reported cross-sectional data gathered in 2002 from 12,449 middle and high school students from seven major cities in China were examined to explore the association of self-perceived relative income inequality (SPRII) with general health status, depression, stress, and cigarette smoking. Two types of self-perceived relative income were evaluated: household income relative to peers (SPRII-S) and relative to their own past (SPRII-P). SPRII-S and SPRII-P were coded as three-level categorical variables: lower, equal, and higher. As hypothesized, the youth in the "Lower" SPRII-S or SPRII-P groups reported the worst general health and the highest levels of depression and stress; the youth in the "Higher" groups reported the best general health. Unexpectedly, the youth in the "Higher" groups did not report the lowest levels of depression and stress, and the relationship between SPRII and cigarette smoking was even less straightforward. The expected positive relationship between SPRII and the general health status is consistent with previous research, but the relationships between SPRII and depression, stress, and cigarette smoking behavior are not. Further studies are needed to elucidate the complex associations between SPRII and health outcomes in rapidly transforming economies such as China.

Keywords

Income inequality; Relative deprivation; Affluence; Health behavior; Youth; Mental health; China; Self-reported health

Introduction

Economic growth involves the reshaping of both the economy and society within a nation (Easterlin,1996). Since the implementation of economic reforms in 1978, China has transformed from a poor country with a relatively even distribution of wealth to a rapidly growing economic power with increasing income inequality (Benjamin, Brandt, Giles, & Wang, 2008; Chotikapanich, Rao, & Tang, 2007; Coldwell, 2004). During the past 30 years,

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China's average annual Gross Domestic Product growth rate was over 10%, and its average annual per capita income growth rate was over 8% ("Chinese economy slows to still sizzling 11.5% growth," USA Today, 2007). However, the reduction in poverty has been accompanied by expanding income inequalities. According to Chinese official statistics, the Gini coefficient (a measure of income inequality ranging from 0 to 1, where higher numbers represent more inequality) of China rose from 0.33 in 1980 to 0.40 in 1994 and to 0.46 in 2000 (Cheng, 2007). Compared to other countries (e.g. 0.27, 0.33, 0.41, and 0.58 for Finland, Canada, USA, and South Africa, respectively), China's current income gap has surpassed that of most developed countries and it is now among those countries with the most unequal distribution in the world (Benjamin et al., 2008; Chang, 2002). This increased income inequality may result in economic, psychological, behavioral, and physical health costs for those who have not benefitted from the new economic opportunities (Coldwell, 2004; Deaton, 2001; Pei & Rodriguez, 2006; Szreter,1999; Wilkinson,1996).

Low absolute household income (AHI) has been associated with poor health status and numerous other adverse health outcomes (Adler & Ostrove, 1999). Independent of AHI, relative income inequality (RII) – one's perception of one's own wealth relative to a desired level of wealth–also can affect health (Runcimam, 1966). The RII hypothesis posits that people's health is affected when they perceive themselves to be economically deprived relative to their peers or reference group, or relative to their own income in the past (Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996; Wilkinson, 1996; Wilkinson, 1992). Therefore, even those individuals with high absolute income can suffer adverse health outcomes if their income is lower than that of their peers or their previous standard of living (Eibner, Sturn, & Gresenz, 2004).

RII at the population level

RII is typically defined as a group-level index that can be objectively calculated as a function of the income distribution among residents in a geographic region (e.g. country, state, county, community). Various measures have been used to quantify RII at the population level (e.g. gini coefficient, Robin Hood index) (Berrebi & Silber, 1985).

Several studies have found that after adjusting for absolute household income, income inequality at the group level (community, state, or school) was associated with higher rates of overall mortality (Daly, Duncan, Kaplan, & Lynch, 1998), cardiovascular disease mortality (Osler et al., 2003), drug overdose mortality (Wilkinson & Pickett, 2007), self-reported poor health status (Eibner & Evans, 2005; Kennedy, Kawachi, Glass, & Prothrow-Stith, 1998; Pei & Rodriguez, 2006), and depressive symptoms (Goodman, Huang, Wade, & Kahn, 2003; Muramatsu, 2003). At the population level, the association between income inequality and adverse health outcomes may reflect disinvestment in human capital, erosion of social capital (Kawachi & Kennedy, 1999; Lynch & Kaplan, 1997), and/or stressful situations that result from the underlying individual-level inequality (Aberg Yngwe, Fritzell, Lundberg, Diderichsen, & Burstrom, 2003).

Measurement of RII at the individual level

RII defined at the individual level offers a unique perspective from which to understand the independent individual-level mechanisms by which RII affects physical and mental health as well as health behavior. At the individual level, perceived income inequality may lead directly to ill health through psychosocial stress and health-compromising behaviors. Individuals who feel economically disadvantaged compared to their peers or compared to their past economic status may be depressed, have higher levels of stress, and generally feel demoralized or hopeless (Kondo, Kawachi, Subramanian, Takeda, & Yamagata, 2008; Wilkinson, 1997b). These emotions, in turn, may affect health directly through physiological mechanisms or indirectly by influencing health behavior.

The measurement of individual-level RII presents several challenges. When individual-level RII is calculated as income inequality relative to peers in a fixed reference group, this RII would be relevant to a defined reference group that may not always be pertinent to every individual, and this measure of RII might be highly correlated with absolute income. This could cause multi-collinearity problems when both absolute income and RII are included in a regression analysis (Aberg Yngwe et al., 2003; Gravelle & Sutton, 2009; Jones & Wildman, 2008; Kondo et al., 2008).

Another method of measuring individual-level RII is to assess self-perceived RII (SPRII). Although assessing individuals' perceptions also introduces potential bias (e.g. correlation with pessimistic/optimistic/hostile personality), the reference group for SPRII could be more accurately defined as peers in each respondent's proximal social context, or even the respondent's own income in the past. Thus, the measurement of SPRII may be one way to circumvent the possible difficulty in defining a pertinent reference group and the possible multi-collinearity problem between relative and absolute income inequality. For example, Stiles, Liu, and Kaplan (2000) assessed the relationship between SPRII and negative self-feelings and deviant adaptations. That study defined SPRII as the respondent's perceived household income compared with his/her friends, neighbors, or American families in general. This individual-level subjective measure of SPRII made it possible to conduct multiple regression analysis adjusting for each individual's absolute income and other covariates. The individual level analysis has also made it possible for them to study a possible mediation pattern: individual-level SPRII induced individual-level negative self-feelings, and the negative self-feeling, in turn, increased the risk of deviant behaviors such as violent crime, property crime, and drug use (Stiles et al., 2000).

The majority of studies of RII have been conducted in Western nations. Income inequality relative to others or to one's own past experience may be especially relevant in China, where historical cultural norms have undergone many transformations during and since the Cultural Revolution. As in many cultures that are undergoing rapid economic and social change, some of the traditional collectivistic norms embedded in the Chinese culture are at odds with the more individualistic norms that pervade much of the present-day global economy. Since the beginning of economic reform in 1979, Chinese adolescents have experienced dramatic changes in socioeconomic status in a short period of time. Although some studies have examined RII in China (Carlsson & Qin, 2010; Li & Zhu, 2006; Pei &

Rodriguez, 2006), to our knowledge, no studies have investigated SPRII at the individual level among Chinese youth.

This study examines individual-level absolute household income and SPRII as independent predictors of psychological (depression and perceived stress), behavioral (cigarette smoking), and physical health (self-reported general health status) among urban Chinese youth. Absolute income inequality was assessed through parents' self-reports of household income. SPRII was assessed as youth's perceived relative level of household income relative to others in the same social context (SPRII-S), or relative to their own past (SPRII-P). We hypothesized that both SPRII measures would be associated with the outcome variables: youth who perceive low relative household income compared with their peers or their own past would experience worse psychological, behavioral, and physical health.

Methods

Data source

The data used in this study are from a health survey conducted in seven of Mainland China's largest cities (*China Seven Cities Study, CSCS)* (Johnson et al., 2006). The choice of cities, from four regions in China–Northeast (Harbin, Shenyang), Central (Wuhan), Southwest (Chengdu, Kunming), and Coastal (Hangzhou, Qingdao)– permitted the assessment of associations among economic and social factors and their influence on psychological and behavioral outcomes and general health status throughout all of urban China.

Procedure and sample selection

The baseline CSCS survey was conducted between October 2002 and December 2002 in cooperation with the city municipal Centers for Disease Control and Prevention. The study included surveys of three age groups: middle and high school students, college students, and parents of middle and high school students. All study procedures and survey instruments were approved by both the University of Southern California and Chinese Institutional Review Boards.

A stratified sampling strategy was used to recruit a more representative sample of schools. In each city, three administrative districts were selected based on household income. Districts with the highest and the lowest residential incomes were identified by consulting with appropriate city agencies. Geographical balance was considered in selecting a third district whose residents were of medium income level in the city. Local Education Committees in the selected districts provided lists of middle and high schools grouped according to three levels of academic achievement within each district. One middle school and one academic high school were randomly selected from each of the 9 (3 academic levels * 3 city districts) clusters to participate in the study. One class from each of grades 7 and 8 (middle school) or 10 and 11 (high school) was randomly recruited for the study. In addition, one professional (vocational) high school was selected from each district. Professional schools were matched across districts by enrollment, type of occupational training, and male/female student ratios.

Participants

This analysis involved data from adolescent-parent dyads. Therefore, only data from the Youth and Parent surveys are included. Across the seven cities, a total of 15,516 7th, 8th, 10th, and 11th grade middle and high school students were invited to participate and 14,434 (93.2%) provided consent and completed the survey. A total of 20,526 parents/guardians of the students completed the adult survey. This analysis included adolescent-parent dyads with complete survey data from the adolescent and at least one parent. After excluding the families who did not return a parent survey (N = 1139, 7.9% of the 14,434 surveyed students) or had missing values on the variables of interest (N = 845, 5.9%), this analysis was performed with complete data from 12,449 youth (52% female).

Survey instruments

Parents' self-reported absolute household income (AHI) was assessed with the question, "What is your total monthly family income from all sources?", with 12 answer categories ranging from "<100 yuan", to "more than 10,000 yuan". If both parents completed the survey, AHI was calculated as the average income reported by both parents. This measure was converted to a six-level categorical variable ("less than 401", "401–600", "601–1000", "1001–1700", "1701–3200", and "more than 3200"). Defining absolute household income as a multi-level categorical variable made it possible to detect both linear and non-linear patterns in the relationships between absolute household income and the outcome variables.

SPRII was assessed in two dimensions: self-perceived relative income relative to others (SPRII-S) and self-perceived relative income relative to the student's own past (SPRII-P). The SPRII-S measure was adapted from an earlier study by Stiles and colleagues (Stiles et al., 2000). It includes three questions assessing the perceived income level relative to "most of your friends", "most of your neighbors", and "mo st other families in your city. " The response options were "much lower," "somewhat lower," "roughly the same," "somewhat higher," and "much higher." The SPRII-S score was the mean of the three questions (Cronbach's alpha = 0.78). SPRII-P was assessed with new questions developed for this study. The question was, "Compared with last year, would you say your family's income is:", with the same 5 level answers with the SPRII-S items. Due to the low prevalence of students reporting 'much lower', or 'much higher', the answers to SPRII-S and SPRII-P were coded as three ordinal level categorical variables: "−1 = much or somewhat lower," "0 = roughly the same," and "1 = much or somewhat higher." Again, treating SPRII variables as categorical made it possible to detect both linear and non-linear relationships between SPRII and the outcome variables. In addition, the SPRII variables were also treated as ordinal variables (coded as −1, 0, and 1) to make it possible to calculate the significance of linear trends.

The outcome variables were self-reported depression, perceived stress, cigarette smoking, and general health status. The perceived stress measure was derived from Cohen, Kamarck and Mermelstein's 10-item scale (Cohen & Williamson, 1988). The three items with the highest item-total correlations were selected for the survey (Cronbach's alpha = 0.83), with 5-level Likert scale answer options. Depression was assessed with three items (Cronbach's alpha = 0.84) with 4-level Likert scale answer options, adapted from the Center for

Epidemiological Studies Depression Scale, CES-D (Radloff, 1977). The complete scales for depression, stress, and hostility (described later) were tested in a pilot study, from which the three items with the highest factor loadings were chosen for each construct. The one-year test-retest correlations for depression, perceived stress, and hostility were 0.47, 0.39, and 0.42, respectively. Past-month cigarette smoking was assessed with the question "During the past 30 days, on how many days did you smoke cigarettes?", with 7 answer options ranging from 0 days to 30 days.

These variables were recoded to dichotomous variables (0 days = '0' and 1 or more days = '1') because the distributions were extremely skewed. Self-reported general health status was assessed with one item from the BRFSS (Hennessy, Moriarty, Zack, Scherr, & Brackbill, 1994): "Would you say that in general your health is (5) Excellent, (4) Very Good, (3) Good, (2) Fair, or (1) Poor?". Previous validation studies have demonstrated that even such a simple global assessment has high predictive validity for the onset of disability (Ferraro, Farmer, & Wybraniec, 1997) and mortality (Idler & Kasl, 1995).

Covariates included district, city, type and rank of school, age, youth's self reported academic performance, parents' education (from the Adult survey), and the student's level of hostility. Parents' education had 7 response options ranging from 1 = "did not graduate from elementary school" to 7 = "university graduate or higher." If both parents returned the survey, parents' education was coded as the highest level attained by either parent. Hostility was assessed with three questions from the Irritability subscale of the Buss-Durkee Hostility Inventory (Buss & Durkee, 1957) (Cronbach's alpha = 0.67).

Analysis

Multiple linear regression models were calculated to estimate the independent relationships between relative income inequality measures and the outcomes (depression, perceived stress, cigarette smoking, and general health status). To facilitate cross comparison and interpretation, the general health status and the three psychological variables were standardized to their z scores before the regressions. The analyses were conducted with SAS Proc Mixed or GLIMMIX (SAS Institute Inc., 2009) to control for intraclass correlations within schools, using a two-level random effects modeling procedure. This is analogous to estimating the school-specific relationships in each school first, then averaging all the school-specific relationships to obtain the overall relationships.

Interaction analyses were conducted to explore potential moderators of the patterns of associations between SPRII variables and the outcomes. Gender was evaluated as a moderator because previous studies have identified gender differences in determinants of physical health (Shumaker & Hill, 1991), psychological health (Nolen-Hoeksema & Girgus, 1994), and health behavior (Clayton, 1991). The analyses were subsequently conducted separately among boys and girls because many of the gender interactions were significant. AHI was evaluated as a moderator to determine whether the relationship between income inequality and health varies according to actual income level (Ravallion & Lokshin, 2005; Wilkinson & Pickett, 2007). Sampling-related parameters (student's age group, school rank, school type, city district, and city) were evaluated as moderators as a sensitivity test of

whether the estimated relationships would likely vary with different sample composition (Reiter, Zanutto, & Hunter, 2005).

Results

Analysis sample comparability

Among the students invited to the Youth survey, 93.2% completed the survey. No data were available about the students who declined to participate. However, it was possible to compare the analytic sample and the students excluded from the analysis because of missing parent surveys or missing data on the variables of interest (N = 1984, 13.8% of the 14,434 surveyed students). There were no significant differences between the analysis sample and the excluded sample on hostility (p = 0.95), depression (p = 0.15), and perceived stress (p = 0.73). However, compared with the excluded sample, the analysis sample reported better health (2.90 vs. 2.83, p = 0.001), was less likely to smoke cigarettes (16.8% vs. 20.9%, p < 0.0001), was younger (14.9 vs. 15.1, p < 0.0001), had higher academic scores (3.45 vs. 3.11, p < 0.0001), was less likely to be male (47.8% vs. 53.8%, p < 0.0001), had higher levels of parents' education (4.5 vs. 4.3, p = 0.02), reported higher household income (p = 0.001), and reported higher SPRII-S (p = 0.01) and SPRII-P (p < 0.01).

Univariate and bivariate summaries

Response distributions are shown in Table 1. When compared with their own income in the past (SPRII-P), more adolescents reported higher (35%) than lower (19%) current income. However, when compared with others in their own social contexts (SPRII-S), more adolescents perceived lower (41%) than higher (26%) income. The correlation between the two dimensions of SPRII measures (SPRII-S and SPRII-P) was 0.35. As expected, SPRII-S and SPRII-P were correlated with AHI (r = 0.39 with SPRII-S; r = 0.20 with SPRII-P). AHI also was positively correlated with parents' education (r = 0.40). To validate the SPRII-S measure, we constructed an 'objective' income inequality measure by comparing each student's AHI with that of their schoolmates (by standardizing the household income variables within each school). This 'objective' RII measure was moderately correlated with SPRII-S (r = 0.38). Not surprisingly, it was highly correlated with self-reported AHI (r = 0.90). The high correlation between the 'objective' R II measure with a fixed reference group (school) and AHI is consistent with previous research (Aberg Yngwe et al., 2003; Gravelle & Sutton, 2009; Jones & Wildman, 2008; Kondo et al., 2008).

Multiple regression between SPRII and the health-related outcomes

Tables 2 and 3 show the least-square means of the outcome variables according to the adolescents' AHI and SPRII. Among boys and girls, both SPRII-S and SPRII-P had strong relationships with the selected health outcomes. Whereas SPRII-S and SPRII-P were monotonically related to the general health status, their relationships with depression, stress, and cigarette smoking did not appear linear. Specifically, compared with boys who reported roughly the same income relative to others, the average self-reported health status was −0.16 (std) among the boys who reported lower income, and 0.15 (std) for the boys who reported higher income (p < 0.0001 for linear trend of "the higher the income relative to others, the better the self-reported health status"). However, for depression and stress, although the

boys and girls who reported lower income relative to the others or the past reported the most distress (all p's < 0.0001), those who reported relative affluence compared with peers or with the past did not have less distress status than the groups who reported equality in income with others or the past. Surprisingly, boys who reported higher SPRII-P actually experienced higher (β = 0.07 std, p < 0.05) depression than those who reported roughly the same household income relative to the past.

The relationship between SPRII and cigarette smoking differed across genders. SPRII-S was related to cigarette smoking in girls only (p < 0.05 for gender difference). Girls who reported higher income than others had the highest odds of cigarette smoking (OR = 1.52 vs. those who reported income equality, p < 0.05). The relationship between SPRII-P and cigarette smoking was also significantly different across gender (p < 0.05). Among girls, a linear trend was detected of "the higher the income relative to the past, the less likely the girls would smoke cigarettes (p < 0.05)". Among boys, compared with those who reported equality in income relative to the past, those who reported lower income were more likely (OR = 1.37; 95%CI: 1.12–1.66) to smoke cigarettes. Similar results were found among boys who reported higher income relative to the past (OR = 1.26; 95%CI: 1.06–1.50).

Moderation analysis

The moderation analysis was conducted to determine whether the relationships between SPRII and the outcomes varied according to absolute household income, age group, school rank, school type, district, or city. Regression analysis with interaction terms was conducted separately for the four outcomes: general health status, past 30-day cigarette smoking, depression, and stress. The p-values for omnibus tests of an overall interaction were 0.49, 0.47, 0.23, 0.14 between AHI and SPRII-S; and were 0.47, 0.69, 0.41, 0.08 between AHI and SPRII-P, for the four outcomes, respectively. None of the interaction terms between SPRII variables and household income was statistically significantly different from zero. Similar moderation analyses with age, school rank, school type, city district, or city also revealed the lack of statistically significant moderation.

Discussion

This study analyzed the relationships between SPRII and selected health outcomes among urban Chinese youth. A novel contribution to the RII literature is that this study assessed two distinct types of RII: self-perceived income relative to peers (SPRII-S) and relative to the past (SPRII-P). With SPRII assessed in both interpersonal and temporal dimensions, the findings support the hypothesis that both SPRII-S and SPRII-P independently influence general health status as well as selected psychological and behavioral outcomes.

Another novel contribution to the RII literature is the non-linear association between relative income inequality and psychological and behavioral health. Most previous studies have used continuous measures of RII or SPRII, under the assumption that the association between RII and health would be linear (Stiles et al., 2000; Wilkinson, 1997a). The present analysis found linear associations for self-reported physical health status but not for mental health status (depression and stress), and health-related behavior (cigarette smoking).

For depression and stress, we found that youth with poorer relative income may experience the most distress, which is consistent with earlier findings (Eibner et al., 2004). However, having higher relative income did not appear to confer additional advantages for psychological outcomes; youth who reported higher relative income were similar to youth who reported equal income on these outcomes.

The relationship between two types of SPRII and cigarette smoking differed between girls and boys. Higher income relative to others is a risk factor for smoking among girls but not boys. On the other hand, both higher and lower income relative to the past are risk factors for smoking among boys but not girls. One possible mechanism is that rapid changes in family income in either direction are indicators of changing life circumstances that can cause stress and require adjustment (e.g. change in residence or school, change in family members' schedules, parents becoming unemployed or returning to work, etc). These added stresses in the family may lead to distress and substance use among the adolescents in the family (Bernburg, Thorlindsson, & Sigfusdottir, 2009). These results also suggest that the underlying mechanisms linking RII and smoking may be different for boys and girls in China. For example, it is possible that social comparisons with peers are more salient among girls than among boys during adolescence (Bekker & van Assen, 2008; Chodorow, 1989). Girls may be more likely to compare their socioeconomic status with that of their friends, whereas boys may be more likely to make comparisons with their own past.

The observed associations between SPRII and mental and behavioral health outcomes may indicate a possible complex pathway between RII and health. While the data are consistent with the hypothesis that RII may lead to poorer health outcomes through poorer mental health or detrimental health behavior, the positive relationship between relative affluence and better general health may be mediated by mechanisms other than good mental health or healthier behaviors. Examples of such factors may be better health care, more balanced nutrition and higher standards of hygiene, and access to better indoor and outdoor environments (Lee, 1999).

China is still at the beginning of the process of shaping its socioeconomic hierarchy, and therefore there is a lack of a true upper class. Consequently, many of those who felt somewhat or even much better off than others are in fact still working class people who are still striving for success. With such rapid individual-level and society-level shifts in economic circumstances, household income alone may not define social status in China. Although this analysis adjusted for level of education, other variables might also be needed to construct better measures of absolute and relative social economic status in China. It is generally acknowledged that better measures of social differentiation and hierarchy are needed in the study of income inequality and population health (Wilkinson & Bezruchka, 2002). Another limitation of this analysis is the assessment of the selected health outcomes. Single-item measures were used to assess self-reported health status and cigarette smoking, and the shortened versions of the other scales lack the sensitivity to differentiate extreme levels of perceived stress and depression among the population studied. For example, perhaps these measures cannot differentiate high levels of distress from everyday hassles and positive stressful events.

We investigated whether the relationships between RII and health outcomes were moderated by SES. Previous studies have indicated that RII is a stronger determinant of health outcomes among those at higher levels of SES, whereas absolute income is a stronger determinant of health outcomes among those at lower levels of SES (Aberg Yngwe et al., 2003; Wildman, 2001). We defined SES as a micro subject-level variable and tested whether self-reported household income moderated the relationship between SPRII and health-related outcomes. The data did not show a statistically significant moderation. Thus, it is reasonable to conclude that pattern of findings between SPRII and the selected health outcomes do not change with the actual household poverty or affluence the adolescents may be experiencing.

This study revealed interesting and potentially important relationships between the health-related outcomes and SPRII-S as well as SPRII-D. It also suggests further unanswered questions. A first topic for further studies is whether the findings are confounded by intra-personal characteristics. Could SPRII actually be picking up aspects of an individual's personality that may be related to the assessed health outcomes? For example, a pessimistic or more hostile person who is inclined toward depression could be inclined to believe-rightly or wrongly-that he or she is "deprived" relative to peers. Perceived affluence, on the other hand, could be related either to unrealistic optimism or even narcissism; this could potentially explain the unexpected relationship between perceived relative affluence and poor mental health outcomes. Alternatively, adolescents may find it stressful to be different from the "norm," regardless if the difference makes them better or worse off in an absolute sense. Although one measure of personality (e.g. hostility) was adjusted for in the analysis, a definitive answer to these important questions can only be obtained with the collection of detailed intra-personal information. A second topic for further studies might be to compare the behavior and other health outcomes between those who reported the same level of perceived stress, depression, but at different ends of the RII spectrum. RII may be tied to negative health outcomes because individuals respond to the stress, depression, and low self-esteem caused by RII by engaging in health compromising behavior (Wilkinson, 1997a). It would be very interesting to know how much of the relationship between RII and general health outcome is mediated through their relationships with psychological factors.

In this large sample of Chinese adolescents, most students perceived that their family income was higher than in the past, but lower than their peers' family incomes. This may reflect the growth of absolute income and the simultaneous expansion of income inequality in China. The bivariate analysis demonstrated that the two dimensions of SPRII were intercorrelated ($r = 0.35$), and they are also moderately correlated with an 'objective' income inequality measure constructed as relative level of household income in reference to schoolmates ($r = 0.39$ and 0.20, respectively). In addition, household income was moderately correlated with parents' level of education ($r = 0.40$). This supports the convergent and discriminant validity of the measures of absolute and relative income inequality used in this study. The statistical model involving parents' education level, AHI, SPRII-S, and SPRII-P and other covariates are thus the appropriate multiple regression model to estimate the independent association between each of the constructs and health-related outcomes.

Limitations

The present findings are subject to several limitations. Because the data were cross-sectional, the reported associations do not bear directionality and any causality in interpretation is only assumed rather than proven. The findings may not generalize beyond the analytic sample, who represented 80% (=12449/15516) of the targeted population. Families that did not provide complete data from the adolescent and at least one parent may differ in stability or functioning from the families with complete data. Furthermore, the measures could be subject to self-report bias. This study may have omitted important confounding variables (e.g. pessimistic/optimistic personality). We recognize that the manner in which we measured relative income inequality was not exhaustive. The original study that generated this dataset was not intended to focus on relative income inequality; thus we were limited by the measures available on the survey. Similarly, due to time constraints, the survey used shortened measures of perceived stress, depression, and general health status. The absolute household income measure was not adjusted for the number of people in the household, and the actual SES hierarchy may not be fully captured by household income alone. More comprehensive measures of such variables may be beneficial to obtain a more complete picture of the effects of perceived relative income inequality on physical, mental, and behavioral health.

This study helps illustrate that psychological, behavioral, and physical well-being among youth might be independently determined by relative income inequality in income. Further research is needed to determine whether these findings generalize to other health outcomes, and to other developing countries.

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Table 1

Summary of variables in the analysis among girls and boys.

Variables	Girls	Boys	*p*[d]
N	6496	5953	
Self-reported general health status (1–4 for poor to excellent)[a,b]	2.82, 0.81	2.97, 0.83	<0.0001
30-day cigarette smoking status (% smoking)[e]	5.9	17.4	<0.0001
Perceived stress[a,b]	2.61, 0.86	2.44, 0.89	<0.0001
Depression[a,b]	1.58, 0.70	1.45, 0.67	<0.0001
Self-perceived relative income inequality (SPRII)[e]			
Relative to others (SPRII-S) (%)			
Much or somewhat lower	40.3	41.3	0.14
Equal	33.6	32.4	
Much or somewhat higher	26.1	26.3	
Relative to the past (SPRII-P) (%)			
Much or somewhat lower	19.3	18.7	0.03
Equal	47.4	45.1	
Much or somewhat higher	33.3	36.3	
Parents-reported household monthly income (RMB,%)[a,b,c,e]			
Less than 401	13.7	13.2	0.42
401–600	11.1	11.6	
601–1000	22.0	20.9	
1001–1700	29.0	30.2	
1701–3200	13.7	14.0	
More than 3200	10.5	10.1	
Age (years)[e]			
11–12	9.5	8.1	0.03
13	18.4	19.7	
14–15	23.8	23.7	
16	25.9	25.2	
17–18	22.5	23.3	
Parents' highest level of Education[a,b,c]	4.51, 1.42	4.49, 1.42	0.37
Hostility[a,b]	2.43, 0.51	2.27, 0.55	<0.0001
Municipal District[e]			
Poor	33	32	0.20
Medium	35	35	
Good	32	33	
School Rank[e]			
Poor	26	27	0.12
Medium	28	29	
Good	30	30	

Variables	Girls	Boys	p^d
Professional/Vocational	16	14	
City[e]			
ChengDu	16	15	0.02
HangZhou	11	12	
Harbin	13	13	
Kunming	14	15	
QingDao	16	15	
ShenYang	17	17	
Wuhan	14	12	

[a] mean, std.

[b] means and standard deviations were based on the raw score for each variable. The standardized scores for these variables were utilized in the regression.

[c] information was obtained from the parents' survey.

[d] *p* value for across gender equivalence test was accomplished by *t*-test for continuous variables, and χ^2 test for categorical variables.

[e] proportion (%).

Table 2

Multiple linear relationship between relative and absolute income and outcomes among Chinese youth[a].

Outcomes	Predictors[a]	Girls			Boys			*P* (cross-gender difference)
		β ± se	***p*** [b]	$p^{\text{for}}_{\text{trend}}$	***β*** ± se	***p*** [b]	$p^{\text{for}}_{\text{trend}}$	
Depression (std)	*Self-perceived Relative Income Inequality (SPRII)*							
	Relative to others (SPRII-S)							
	Much or somewhat lower	0.11 ± 0.03	****	*	0.09 ± 0.03	**		
	Equal (reference group)	0			0			
	Much or somewhat higher	0.04 ± 0.03			0.04 ± 0.03			
	Relative to the past (SPRII-P)							
	Much or somewhat lower	0.20 ± 0.03	****	*	0.18 ± 0.03	****		+
	Equal (reference group)	0			0			
	Much or somewhat higher	−0.02 ± 0.03			0.07 ± 0.03	*		
	Household income (AHI)							
	less than 401	−0.06 ± 0.04		***	0.03 ± 0.04			*
	401–600	−0.14 ± 0.04	**		0.04 ± 0.04			
	601–1000	−0.07 ± 0.03	*		0.06 ± 0.03			
	1001–1700 (reference group)	0			0			
	1701–3200	0.00 ± 0.04			0.03 ± 0.04			
	more than 3200	0.09 ± 0.05	+		0.07 ± 0.05			
Stress (std)	*Self-perceived Relative Income Inequality (SPRII)*							
	Relative to others (SPRII-S)							
	Much or somewhat lower	0.16 ± 0.03	****	****	0.13 ± 0.03	****	****	
	Equal (reference group)	0			0			
	Much or somewhat higher	0.01 ± 0.03			−0.01 ± 0.03			
	Relative to the past (SPRII-P)							
	Much or somewhat lower	0.19 ± 0.03	****	****	0.16 ± 0.03	****	****	*
	Equal (reference group)	0			0			
	Much or somewhat higher	−0.03 ± 0.02			0.05 ± 0.03	+		
	Household income							
	less than 401	−0.16 ± 0.04	****	****	−0.08 ± 0.04	*	***	**

Outcomes	Predictors[a]	Girls			Boys			*P* (cross-gender difference)
		β **± se**	***p*** [b]	$p^{\text{for}}_{\text{trend}}$	***β*** **± se**	***p*** [b]	$p^{\text{for}}_{\text{trend}}$	
	401–600	−0.14 ± 0.04	***		0.00 ± 0.04			
	601–1000	−0.10 ± 0.03	***		−0.04 ± 0.03			
	1001–1700 (reference group)	0			0			
	1701–3200	0.05 ± 0.04			0.15 ± 0.04	****		
	more than 3200	0.07 ± 0.04	+		0.06 ± 0.05			

[a] other variables adjusted in the model include youth's age, youth's hostility, parents' highest education level, youth's academic performance, rank of school, school type, rank of district, and city.

[b] +: $p < 0.10$; *: $p < 0.05$; **;: $p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$.

Table 3

Multiple linear relationship between relative and absolute income and outcomes among Chinese youth[a].

Outcomes	Predictors[a]	Girls			Boys			*P* (cross-gender difference)
		OR (95%CI)		$p^{\text{for}}_{\text{trend}}$	OR (95%CI)		$p^{\text{for}}_{\text{trend}}$	
Cigarette smoking in the last 30 days (Yes vs. No)	*Self-perceived Relative Income Inequality (SPRII)*							
	Relative to others (SPRII-S)							
	Much or somewhat lower	0.96 (0.73–1.25)		**	1.02 (0.85–1.23)			*
	Equal (reference group)	1			1			
	Much or somewhat higher	1.52 (1.14–2.02)			1.13 (0.92–1.40)			
	Relative to the past (SPRII-P)							
	Much or somewhat lower	1.08 (0.81–1.42)		*	1.37 (1.12–1.66)			*
	Equal (reference group)	1			1			
	Much or somewhat higher	0.88 (0.69–1.14)			1.26 (1.06–1.50)			
	Household income							
	less than 401	1.14 (0.79–1.63)			0.84 (0.66–1.08)			
	401–600	1.34 (0.93–1.94)			0.93 (0.72–1.19)			
	601–1000	1.04 (0.76–1.43)			0.91 (0.74–1.13)			
	1001–1700 (reference group)	1			1			
	1701–3200	0.85 (0.57–1.29)			0.78 (0.58–1.03)			
	more than 3200	1.19 (0.78–1.80)			1.01 (0.73–1.39)			
		$\beta \pm$ se	p^b	$p^{\text{for}}_{\text{trend}}$	$\beta \pm$ se	p^b	$p^{\text{for}}_{\text{trend}}$	
Self-reported general health status (std)	*Self-perceived Relative Income Inequality (SPRII)*							
	Relative to others (SPRII-S)							
	Much or somewhat lower	−0.24 ± 0.03	****	****	−0.16 ± 0.03	****	****	+
	Equal (reference group)	0			0			
	Much or somewhat higher	0.05 ± 0.03	+		0.15 ± 0.03	****		
	Relative to the past (SPRII-P)							
	Much or somewhat lower	−0.08 ± 0.03	*	****	−0.13 ± 0.04	***	****	+
	Equal (reference group)	0			0			

Outcomes	Predictors[a]	Girls		Boys		P (cross-gender difference)
		OR (95%CI)	$p_{\text{trend}}^{\text{for}}$	OR (95%CI)	$p_{\text{trend}}^{\text{for}}$	
	Much or somewhat higher	0.06 ± 0.03	*	0.13 ± 0.03	****	
	Household income					
	less than 401	−0.01 ± 0.04		0.01 ± 0.04		
	401–600	−0.05 ± 0.04		−0.02 ± 0.04		
	601–1000	0.05 ± 0.03		0.02 ± 0.04		
	1001–1700 (reference group)	0		0		
	1701–3200	−0.02 ± 0.04		−0.01 ± 0.04		
	more than 3200	−0.06 ± 0.05		0.03 ± 0.05		

[a] other variables adjusted in the model include youth's age, youth's hostility, parents' highest education level, youth's academic performance, rank of school, school type, rank of district, and city.

[b] +: $p < 0.10$; *: $p < 0.05$; **: $p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$.