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ARTICLE

The dynamic relationship between subjective social status and health: Evidence from a Chinese cohort study

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Abstract

Purpose: Using nationally representative longitudinal data from 2010 to 2018 in China, this study systematically investigates the relationship between Subjective Social Status (SSS) and health (physical health and mental health) in the Chinese adult population.

Methods: By applying between–within model, we disentangle the relationship between health outcomes and: (1) between-individual differences in SSS and (2) within-individual variations of SSS across time. In addition, to explore SSS mobility and trajectory, we further decomposed SSS into lagged SSS and the change between the current and lagged SSS (mobility).

Results: We find that there is significantly positive and unique relationship (independent of Objective Social Status (OSS)) between SSS and physical and mental health. However, for physical health, we observed an Inverse-U effect of average SSS, after some point (SSS = 3.93), higher average SSS is associated with a score decrease. Through heterogeneity analysis, we find that for physical health, within- and between-effects decreases with age and for mental health, the within effect is only significant among the urban population. Individuals with high expected mobility are also found to have significantly better health.

Conclusions: These findings show that the personal relative deprivation has negative, particularly salient and unique

effects on the health of the Chinese population, and it is important to consider the dynamic nature of SSS.

KEYWORDS
mental health, physical health, social mobility, subjective social status, within-between model

Statement of contribution

What is already known on this subject?

- Subjective Social Status (SSS) is cross-sectionally associated with health.
- Age-related social status is a multidimensional and complex concept.
- Social status is a dynamic construct and may change across time.

What this study adds?

- There is significantly prospective and unique relationship between SSS and health, and we observed an inverse-U relationship for physical health.
- The association between SSS and health varies with age, and the association is greater among younger people.
- Individuals with high expected mobility are also found to have significantly better health.

BACKGROUND

An extensive literature has documented health disparities by socioeconomic status (SES). An emerging literature indicates that lower SES is associated with poorer health. SES inequality has a serious impact on how people perceive themselves. Despite the persistent findings of SES inequality as one of the fundamental social causes of health disparities (Adler & Snibbe, 2003), socioeconomic-related health inequity is still an important question among researchers. Part of the reason may be that different SES measures and the analysis process cannot fully and systematically capture the multidimensional and dynamic nature of social status.

Distinguishing subjective social status (SSS) from objective social status (OSS)

Socioeconomic-related health inequity stems from and goes beyond disparities in opportunity and resources, which also includes psychosocial factors resulting from relative and perceived status differences (Adler et al., 2000). Furthermore, when a person perceives that he/she is in a relatively disadvantaged position compared to others, it would cause the experience of personal relative deprivation (Smith et al., 2012). OSS is composed of items that can reflect a person's objective position in a specific society, such as education, occupational prestige and income, and which can affect health through complex physiological and psychological mechanisms (Braveman et al., 2010; Hayward et al., 2000; Koh et al., 2010). Although OSS has been considered the most effective and reliable predictor of social gradient, only using OSS to assess health disparities will ignore contextual factors surrounding individuals that SSS could capture (Kang, 2017).

SSS refers to a person's self-perceived status in the social status hierarchy, which is a self-evaluation of social status in comparison with other's social status (Adler et al., 2000).

Most often, SSS is viewed as the result of social comparison (McLeod, 2013); therefore, it is closely related to the concept of relative deprivation. One theory holds that the SSS measure individual's perceived 'cognitive average' of OSS along with other factors (Vauclair et al., 2015), such as recognition by others, recognition and prestige that OSS can't measure (Demakakos et al., 2008). Some have suggested that using SSS as a proxy for SES would allow us to capture more comprehensive and dynamic characteristics of socioeconomic status. Since SSS incorporates not only the current state of SES but also past assessments as well as future projections, it goes beyond the objective indicators of SES (Charonis et al., 2017). Moreover, OSS usually ignored some subtle but important changes in social status, while SSS could consider these.

SSS and health

An increasing amount of evidence suggests that low SSS may negatively be associated with health; for example, low SSS was associated with higher risks of coronary heart disease, hypertension, diabetes, dyslipidaemia and pain (Adler et al., 2008; Tang et al., 2016; Wakefield et al., 2016) and cognitive function and psychological health are negatively affected by relative deprivation (Lyu & Sun, 2020). Recently, SSS was even found to be an independent predictor of mortality at older ages in one study (Demakakos et al., 2018). Moreover, with respect to OSS, SSS had significantly stronger and more consistent associations with psychological functioning and health-related factors (Adler et al., 2000).

In explaining the underlying mechanism, social-psychological explanations can provide a theoretically plausible explanation. According to social comparison theory, people may compare themselves with higher- or lower-status individuals for different reasons (Collins, 1996; Taylor & Lobel, 1989), which emphasizes the significance of comparisons with others in self-assessment (Zell & Alicke, 2010). When social comparison occurs, people further down in the hierarchy would feel relatively deprived of others, marginalized and angry, and all these accumulated stressful environments and feelings in turn will affect individuals' health directly or indirectly (Schnittker & McLeod, 2005). In the downward-comparison theory, it was emphasized that downward comparisons had a positive effect, whereas upward comparisons would inevitably have a negative result (Suls et al., 2002).

However, its results and effects can vary according to the social environment in which it takes place and are multi-directional and the idea that upward comparison invariably is aversive was reconsidered. On the one hand, compared with high standards, individuals who are 'doing poorly' will have negative feelings and poor health; on the other hand, it can also lead to a motivating impact (Schneider, 2019). Thus, the absence of a baseline made it impossible to determine whether upward comparisons diminished well-being or downward comparisons enhanced it (Suls et al., 2002).

Currently, the majority of studies that provide explanations for the association between SSS and health are cross-sectional in nature (Hoebel & Lampert, 2020), and the possibility for associations to be bidirectional or driven by other variables. Furthermore, SSS has rarely been assessed in population-based longitudinal studies (Euteneuer et al., 2021; Nobles et al., 2013; Zou et al., 2020). Nobles et al. (2013) used fixed-effect model to identify the relationship between SSS and health (Nobles et al., 2013). Using cross-lagged panel analysis, Euteneuer et al. (2021) investigated reciprocal longitudinal associations of SSS with health-related quality of life (Euteneuer et al., 2021). The two studies found a bidirectional relationship between SSS and physical health. However, they could not eliminate reverse causality problems well as only two survey waves data were available in their analysis. In addition, potential time-invariant confounders in the SSS–health relationship do not be considered in the latter. Zou et al. (2020) applied lagged dependent variable models confirm a linear relationship between current SSS and self-rated health two years late (Zou et al., 2020). Although they used survey data from four waves, they did not consider the impact of SSS in the current period and measurement of health is not comprehensive. When we control for OSS in the context of SSS, we are able to examine whether there is a unique correlation between SSS and health, above and

beyond OSS. There is an important theoretical distinction here, as it relates to the ongoing debate of whether SSS is simply an accumulation of OSS, or whether it reveals distinct factors that are related to health (Singh-Manoux et al., 2005).

In light of the above and based on prior theoretical reasoning and research findings, the first hypothesis is as follows:

H1: SSS is associated with health, and the relationship is independent of OSS

Age-based dynamic changes of relationship

Age-related social status is a multidimensional and complex concept (Robertson & Weiss, 2018), and people have varying aspirations for social status throughout their lifespan (Weiss & Kunzmann, 2020). Prior research has suggested that midlife represents a critical period of social status attainment and that achieving social status appears to be at the core of life during this period (Lachman, 2004; Twenge & Campbell, 2002). In addition, middle age is a key period with respect to health. During this period, health problems associated with the cumulative effects of undesirable behaviours often begin to surface. Therefore, the association between SSS and health may be stronger in middle age. Over age, there is a decline or loss in SSS, and a lower desire to gain and maintain social status (Robertson & Weiss, 2018). In this respect, the current social status of an individual should be less important to older adults, as the motive for gaining higher social status is less pronounced for them. Additionally, the ageing process can lead to decline of health status, reduced functional levels and mental health problems (Yang et al., 2021). With advancing age, people is becoming more and more motivated to maintain their health status (Weiss & Freund, 2012). Thus, although SSS loss might be more salient in the older people and perceived SSS loss may result in psychological and physiological responses that have a negative impact on health (Weiss & Weiss, 2016), it might be less important for their health.

H2: The association between SSS and health varies with age, and the association is greater among younger people

China context

China provides an ideal environment for studying health inequalities, not only because of its sharply rising distribution of SES but also health effects of SES have increased dramatically(Zou et al., 2020). In addition, due to China's rapid socialization and urbanization processes, SSS could be a more accurate measure of SES (Chen & Williams, 2018) and a better predictor of health than conventional measures of SES (Rarick et al., 2018; Zou et al., 2020).

Although urbanization has been recognized as a major driver of economic growth and poverty eradication, the dividends of urbanization development have not been equitably distributed among various groups. As more and more people move into cities, inequalities such as urban poverty, social exclusion, and economic exclusion are deepening in parallel within cities across a wide range of developing countries. Therefore, within-urban SES inequality becomes increasingly prominent in overall inequality (Wang & Yu, 2016), and it should be noted that urban residents are more likely to be adversely affected by personal relative deprivation (Lyu & Sun, 2020). Thus, socioeconomic-related health inequity are becoming more and more pronounced for urban populations (Wan et al., 2018; Yang & Kanavos, 2012; Zhuang & Li, 2016).

H3: Comparing with rural regions, the relationship between SSS and health is stronger in urban regions

Social status mobility and health

Social mobility can be used to assess the fairness of a society (Simandan, 2018). Social status is a dynamic construct and may change across time (Havighurst, 1971; Robertson & Weiss, 2017), which people will experience social status gain or loss (Weiss & Kunzmann, 2020). The current literature on social mobility has mostly focused on intergenerational or migrant mobility (Chen et al., 2021; Dolan & Lordan, 2021; Güell et al., 2018; Lu, 2021), such as absolute/relative income mobility. One recent review by Edith Chen et al. pointed out that upward mobility was related to a trade-off, whereby individuals achieve financial success, good mental health and other positive life outcomes but are more likely to have poor physical health (Chen et al., 2021). Different from actual social mobility, the term 'SSS mobility' refers to changes in person's SSS. Generally, it appears in migration or intergenerational related studies, indicating spatial or intergenerational mobility. To our knowledge, prior studies have not explored the relationship between SSS mobility and health from the perspective of intra-individual changes in SSS over time. Additionally, there is a distinction between intra-individual SSS differences and individual fluctuations in SSS over time and there are also differences in the way the two are related to health.

In order to improve our understanding of the relationship between SSS mobility and health, we tested the hypothesis:

H4: Upward within-person changes in SSS will be positively associated with changes in health

The analyses conducted in this study aimed to examine the link between SSS and health using longitudinal data from a population-based sample of Chinese individuals. First, we further tested whether SSS is associated with health independent of OSS. In this paper, in order to capture OSS more accurately, we fully considered the multidimensional nature of OSS. Second, by adopting a 'within-between' model introduced by Schunck (2013), we disentangle the relationship between health outcomes and (i) between individual differences in SSS and (ii) within-individual variations of SSS across time. Third, we explored the heterogeneity of our primary results in gender, age and urban-rural areas. Finally, by decomposing the current SSS, we examined the dynamic aspect (mobility and trajectory) of SSS and its relationship with health.

METHOD

Data source

Our study utilized data from the China Family Panel Studies (CFPS), a nationally representative longitudinal study of Chinese communities, families and individuals, to examine the association between SSS and health.

As a nationally representative dataset, the CFPS focuses on the well-being of the Chinese population and provides rich information about economic activities, education achievements, family dynamics and relationships and health. The CFPS covers 25 of China's 31 provinces/regions or their administrative equivalents (i.e., municipalities and autonomous regions) in China (Xie & Hu, 2014). For the 2010 CFPS, a multistage probability distribution was used to stratify the sample. As a result, five provinces/regions (Gansu, Guangdong, Henan, Liaoning and Shanghai) were selected for initial over-sampling (1600 households in each, or an aggregate of 8000) to obtain regional comparisons

and another 8000 households were selected by weighting from the remaining provinces/regions to make the overall CFPS sample nationally representative. The CFPS was chosen as a data source for this study due to its broader research agenda, broader population coverage, and the fact that it is representative of the country.

Sample

In the CFPS, there are three waves (2014, 2016 and 2018) of data using the CES-D8 to measure depressive symptoms. In terms of physical health, all waves could be applied. Therefore, we divided the data into sample 1 and sample 2, and the analysis of mental health and physical health drew on the sample 1 and sample 2,s respectively.

Consequently, we restricted our analysis, in order to consistently estimate the dynamic relationship between SSS and health, to a sample of those who (1) were over 25 and (2) were surveyed at least two times in the analytical samples. For the cases with missing data on the variables used in our analysis, we performed a listwise deletion. We allowed the analytical sample size to vary according to the number of valid responses to each outcome variable in order to maximize statistical power.

The study sample characteristics are presented in Table 1. The remaining sample one contains 77,790 individuals, and sample two contains 36,097. The mean of Mental Health Index was 13.95 ± 4.01. The distributions and means of the variables in sample one and sample two are very similar.

Variables and measures

Physical health

The CFPS asked individuals multiple questions about their physical health, which was relevant to our study. The following four questions can be directly related to an individual's physical health status from which we construct three binary outcome variables (1/0) and one ordinal categorical variable (1/2/3) reflecting the individual's physical health status.

The first variable, denoted perceived health decline, takes a value of 1 if the respondent answered 'Worse' to the question 'How would you rate your current health status compared to a year ago?', 2 'No change' and 3 'Better'. The second measure, normal BMI, indicates whether an individual is underweight (BMI < 19.5) or overweight (BMI > 25). The third, physical discomfort, takes a value of 1 if the respondent answered 'No' to the question 'During the past two weeks, have you felt any physical discomfort?' and 0 otherwise. The last variable, chronic disease, takes a value of 1 if the respondent answered 'No' to the survey question 'During the past six months, have you had any doctor-diagnosed chronic disease?' and 0 otherwise.

We used principal component analysis (PCA) to construct a comprehensive physical health index. In Table 1, we list the health measures for physical health. A higher physical health index reflects better physical health.

Mental health

We focus on the association between SSS and depressive disorders, the most common mental illnesses, which we refer to here using the more general terms 'mental health'. The CES-D8 scale can be utilized to assess the severity and frequency of certain feelings and behaviours. Respondents were asked how often they can't get going, felt sad, enjoyed life, felt lonely, were happy, slept restlessly, felt that everything was an effort and felt depressed; these items are scored from 1 (none of the time) to 4 (all or almost all of the

TABLE 1 Descriptive statistics

	Sample one			Sample two		
Variables	**#Obs**	**Mean**	**SD**	**#Obs**	**Mean**	**SD**
Physical Health Index	77,790	−0.02	1.01	–	–	–
Perceived Health Decline				–	–	–
Worse	28,004	0.36	0.48			
No change	42,785	0.55	0.50			
Better	7001	0.09	0.29			
BMI (Normal = 1)	51,341	0.66	0.47	–	–	–
Physical discomfort (No = 1)	52,119	0.67	0.47	–	–	–
Chronic disease (No = 1)	63,010	0.81	0.39	–	–	–
Mental Health Index	–	–	–			
CES-D8				36,097	13.95	4.01
Sub social status	77,790	2.94	1.06	36,097	3.05	1.08
Controls						
Objective SES	77,790	−0.02	0.99	36,097	−0.02	1.00
Ln (1+Income Per Capita)	77,790	9.03	1.21	36,097	9.19	1.24
Net Family Assets	77,790	499,527.43	766,946.09	36,097	626,300.62	936,045.12
Educational attainment						
Middle school or below	62,232	0.80	0.40	28,156	0.78	0.41
High school	13,224	0.17	0.38	6497	0.18	0.38
College or above	2334	0.03	0.17	1444	0.04	0.19
Employment status						
Out of the labour market	18,670	0.24	0.43	8663	0.24	0.43
Unemployed	778	0.01	0.08	361	0.01	0.08
Farm related	28,782	0.37	0.48	13,356	0.37	0.48
Off farm	28,004	0.36	0.48	12,634	0.35	0.48
Other	2334	0.03	0.16	722	0.02	0.16
CPC member (Yes = 1)	16,336	0.21	0.43	8302	0.23	0.46
Housing ownership (Yes = 1)	67,677	0.87	0.34	31,043	0.86	0.34
Other house (Yes = 1)	14,780	0.19	0.39	7580	0.21	0.41
Other variables						
Gender (Male = 1)	38,895	0.50	0.50	18,049	0.50	0.50
Age	77,790	51.45	13.36	36,097	52.01	13.40
Urban (Urban = 1)	38,117	0.49	0.50	18,049	0.50	0.50
Marital status						
Never married	2334	0.03	0.16	1083	0.03	0.16
Married	70,011	0.90	0.31	32,126	0.89	0.31
Divorced or widowed	6223	0.08	0.27	2888	0.08	0.27
Exercising (Yes = 1)	30,338	0.39	0.49	15,883	0.44	0.50
Smoking (Yes = 1)	24,115	0.31	0.46	10,829	0.30	0.46
Drinking (Yes = 1)	13,224	0.17	0.38	6136	0.17	0.38
Health Insurance (Yes = 1)	71,567	0.92	0.27	33,570	0.93	0.25

time). We summed these 8 items to conduct the mental health index, with higher scores indicating that the individual is mentally unhealthier. In Table 1, we list the health measures for mental health.

Subjective social status

Subjective social status (SSS) is commonly measured in Western studies by using a visual analogue scale with a picture of a ladder that asks individuals to place themselves on one of ten possible levels reflecting the social stratification of a particular social group (Cundiff & Matthews, 2017). In the CFPS, SSS was measured by asking respondents to rate their social status in the local area on a 5-point Likert scale from 1 ('very low') to 5 ('very high'). Test-retest reliability and construct validity have been shown for this measure (Zou et al., 2020). To better use its variance structure, in our study, SSS was considered a continuous variable.

Objective social status

Objective social status (OSS) comprises income, wealth, education, occupation, neighbourhood and social networks, factors that relate to health through several mechanisms and cause socioeconomic gradients in health. Given its multidimensional nature, this study conducted one comprehensive OSS index, which includes 'sticky' variables such as house ownership and education, as well as some 'fluid' variables such as income and current labour market conditions.

Income is measured by household income per capita. It was winsorized at the 2.5th and 97.5th percentiles to make sure that there are no outliers that would affect the results of the regression analysis (Shete et al., 2004). In order to account for heteroscedasticity and lessen the effect of extreme values on estimates, we conducted a logarithmic conversion (Ln(1+variable)). To make all scores positive, a constant of 1 is added to each score (Wooldridge, 2015).

A number of studies have demonstrated that wealth and assets may partly confound the relationship between SSS and health outcomes. Therefore, we introduced net family assets as one indicator of OSS.

Political capital is also one of the determinants of social stratification in the Chinese context (Chen & Williams, 2018). According to the results of a recent study, political capital, measured by membership in the Chinese Communist Party (CCP), predicts health more accurately than household income (Xu & Xie, 2017). Referring to the approach of Hongwei Xu et al., the measure of political capital at the family level is made up of a dichotomous variable that indicates whether any family members are members of the CPC (Zou et al., 2020). Based on these variables, PCA was used to conduct one comprehensive OSS index.

The coding of OSS variables is shown in Table 1, where categorical variables are transformed into dichotomous variables for analysis. For example, educational attainment is composed of three levels, and we will transform it into three dichotomous variables (Middle school or below (0/1), High school (0/1) and College or above (0/1)) when conducting PCA.

Other control variables

Based on previous research, the analysis includes several control variables that may have a bearing on the relationship between SSS and health. In Table 1, we list the other control variables. We control for respondents' age (in years), gender, region of residence (urban vs. rural), marital status and health behaviour-related variables (exercising, smoking and drinking). and we include the variable of whether or not one has health insurance.

Statistical analyses

Considering that this study incorporated data from multiple waves of the CFPS, it was necessary to employ analytic approaches appropriate for panel data analysis to account for non-independence among responses by the same individual across waves. All data were stored and analysed using STATA version 16.

Principal component analysis

More specifically, our index construction follows that of (Abdi & Williams, 2010). In the first step, we used principal component analysis to identify the latent construct of OSS and physical health. Using this method, a large number of correlated variables can be reduced to a smaller number of principal components. The first component is the linear combination of variables, which retains most of the variation present in all of the original data (Jolliffe & Cadima, 2016). The component score is derived from the product of the weight of each variable (components' loading) and the variable's value, which is then aggregated.

We standardized the component score in the second step, with a higher score to denote higher SES and healthier conditions (Gong et al., 2020). Our statistical power increases as well when we aggregate to a summary index (Kling et al., 2007).

Analysis strategy

A four-stage analysis was conducted in order to examine the relationship between SSS and health.

In the first stage, population-average models (pooled OLS) were fitted to assess the relationship between SSS and various outcomes (physical health and mental health) in order to describe and compare the differences in overall health across different SSS. As a result of population-average models, the coefficient estimates indicate the difference in mean outcomes for individuals with varying SSS levels. As the population-average model is based on a linear regression model, it is appropriate for continuous outcomes. Considering that there were no explicit patterns for the within-individual correlations across waves, we specified the SSS correlation structure of the models as unstructured (Jang, 2011).

$$y_{it} = \beta_{\mathrm{OLS}}\mathrm{SSS}_{\mathrm{it}} + \beta' x_{it} + \delta' y_{it-1} + \varepsilon_{it}$$

where y_{it} is the dependent variable, the health outcome, for individual i at time t. x_{it} denotes a set of individual-level covariates, which include the respondent's OSS and other controls. Lagged health variables are represented by y_{it-1}, which is an attempt to reduce the impact that reverse causality has on the estimates. ε_{it} is the error term, is assumed to have mean zero and be normally distributed. The standard errors are clustered at the individual level in the estimations. Our coefficient of interest is β_{OLS}, the estimated relationship between the SSS and health.

Fixed-effect model was fit to determine whether SSS correlated with each outcome in the second stage, controlling for time-invariant confounders and wave (or year) effects. As a result, it allows us to estimate β more accurately.

$$y_{it} = \beta_{FE}\mathrm{SSS}_{it} + \beta' x_{it} + \delta' y_{it-1} + c_i + \alpha_t + \varepsilon_{it}$$

where c_i denotes individual fixed effect, which are included to capture individual-specific factors, potential confounders in the SSS–health relationship, such as any persistent personality trait, family background, childhood socioeconomic circumstances and genetic endowment, that may affect the association between SSS and health. a_t is the wave (or year) effect, which controls for factors changing each

wave (or year) that are common to all individuals for a given wave (or year). Our coefficient of interest is β_{FE}.

To test hypotheses 2 and 3 and to perform heterogeneity analysis, we introduced interaction terms based on age, residence and SSS and further analysis was performed based on gender grouping.

In the third stage, to disentangle the relation between health and SSS, we use the panel structure of the data to decompose SSS into two parts (within-person and between-person components). Both between-person and within-person variations are considered when estimating the coefficients of the random effect model. Unbiased results can be obtained only if there are no unobserved variables that are correlated with independent variables, an assumption that is frequently violated. The estimation of coefficients in the fixed-effect model, however, is based only on within-person variation and, therefore, is free from bias due to unobserved time-constant variables, as these variables have been eliminated (Zhao et al., 2021). As with the random effect model, the within-between model includes fixed effects by modelling unobserved heterogeneity as a function of time-invariant characteristics, such as time-averaged regressors, together with an error term independent of the regressors (Muris, 2017). It allows the identification of the 'between' effects, that is, the effect of differences in SSS between persons, and the 'within' effects estimates illustrated the association between change in an individual's SSS over time and the corresponding change in health.

Our within-between model is specified as follows:

$$y_{it} = \beta_B \overline{\mathrm{SSS}}_i + \beta_W \left(\mathrm{SSS}_{it} - \overline{\mathrm{SSS}}_i\right) + \beta'_B \overline{x_i} + \beta'_W \left(x_{it} - \overline{x_i}\right) + \delta' y_{it-1} + c_i + \alpha_t + \varepsilon_{it}$$

SSS is decomposed into $\overline{\mathrm{SSS}}_i$, individual i's average over the sample period, and $\left(\mathrm{SSS}_{it} - \overline{\mathrm{SSS}}_i\right)$, i's difference from their average at time t. In addition, x_{it} is also decomposed two parts. Our coefficients of interest are β_B, the 'between-effect' and β_W, the 'within-effect'.

To identify nonlinear relationships, we added quadratic terms. Coefficients β_{Bq} and β_{Wq} capture the quadratic terms for the between and within effects, respectively.

$$y_{it} = \beta_B \overline{\mathrm{SSS}}_i + \beta_{Bq} \overline{\mathrm{SSS}}_i^2 + \beta_W \left(\mathrm{SSS}_{it} - \overline{\mathrm{SSS}}_i\right) + \beta_{Wq} \left(\mathrm{SSS}_{it} - \overline{\mathrm{SSS}}_i\right)^2 + \beta'_B \overline{x}_i + \beta'_W \left(x_{it} - \overline{x}_i\right) + \delta' y_{it-1} + c_i + \alpha_t + \varepsilon_{it}$$

One limitation of this approach is that it does not consider the trend of SSS over time. It might be important that individuals' SSS increases or decreases over time. To explore SSS mobility and trajectory, referring to the method of Parra-Mujica et al. (2021), we further decomposed SSS into lagged SSS and the change between the current and lagged SSS (mobility) and then further decomposed these terms into two parts:

$$\begin{aligned}
\mathrm{SSS}_{it} &= \underbrace{\mathrm{SSS}_{it-1}}_{\text{Lag}} + \underbrace{\left(\mathrm{SSS}_{it} - \mathrm{SSS}_{it-1}\right)}_{\text{Mobility}} \\
&= \underbrace{\overline{\mathrm{SSS}_{it-1}}}_{\text{Average-Lag}} + \underbrace{\left(\mathrm{SSS}_{it-1} - \overline{\mathrm{SSS}_{it-1}}\right)}_{\text{Within-Lag}} + \underbrace{\overline{\left(\mathrm{SSS}_{it} - \mathrm{SSS}_{it-1}\right)}}_{\text{Expected-Mobility}} \\
&\quad + \underbrace{\left(\left(\mathrm{SSS}_{it} - \mathrm{SSS}_{it-1}\right) - \overline{\left(\mathrm{SSS}_{it} - \mathrm{SSS}_{it-1}\right)}\right)}_{\text{Within-Mobility}}
\end{aligned}$$

The model is:

$$\begin{aligned}
y_{it} &= \beta_{B-\mathrm{lag}} \overline{\mathrm{SSS}}_{it-1} + \beta_{B-\mathrm{Mo}} \overline{\left(\mathrm{SSS}_{it} - \mathrm{SSS}_{it-1}\right)} \\
&+ \beta_{W-\mathrm{lag}} \left(\mathrm{SSS}_{it-1} - \overline{\mathrm{SSS}}_{it-1}\right) + \beta_{W-\mathrm{Mo}} \left(\left(\mathrm{SSS}_{it-1} - \overline{\mathrm{SSS}}_{it-1}\right) - \overline{\left(\mathrm{SSS}_{it} - \mathrm{SSS}_{it-1}\right)}\right) \\
&+ \beta'_W \overline{x_i} + \beta'_B \left(x_{it} - \overline{x_i}\right) + \delta' y_{it-1} + c_i + \alpha_t + \varepsilon_{it}
\end{aligned}$$

The coefficients of primary interest are β_{B-Mo} and β_{W-Mo}. β_{B-Mo} denotes expected socioeconomic mobility. This captures the direction and average value of SSS mobility in a given individual over a certain period of time. β_{W-Mo} is a within-individual deviation from their expected trajectory. This represents the change in an individual's SSS in the most recent period relative to the average SSS over all periods and the average SSS mobility, which measures the trajectory of SSS change.

RESULTS

The results of pooled OLS and fixed effect

In Tables 2 and 3, we present results of pooled OLS model and fixed-effect model. OLS regression on cross-sectional associations adjusted for controls and OSS. There were significant positive associations between health and SSS, without and with controlling OSS. This suggests that higher SSS is initially associated with better health.

In order to examine the effect of adjusting for all time-invariant confounding variables and wave (or year) effects on the simultaneous associations between SSS and health, we estimated fixed-effect models (Tables 2 and 3). Controlling for fixed effects, the association between health and OSS disappears, suggesting that some unobservable factors may have caused the simultaneous association. In addition, this result may be due to inadequate within variation of OSS. In terms of SSS, we continued to find a significant positive correlation between health and SSS. To a certain extent, it could be concluded that SSS is associated with health independent of OSS, and SSS was a unique correlate of health.

The results of within-between models

Table 4 presents results for within-between models. Columns 1 and 3 report estimates based on the within-between model. Overall, there was a positive relationship between SSS and health (physical health and mental health), not only when an individual's SSS changed (i.e., within-person effects) but also between those lower SSS and higher SSS (i.e., between-person effects).

The within-effect shows the difference in health for an individual whose SSS level changed from lower to higher. For example, in terms of within-effect for physical health, person was with an increase of 0.019 standard deviation in physical health when his/her SSS level increases by one point (within effect: Coeff = 0.019, SE = 0.004, $p < .01$).

TABLE 2 Pooled OLS and fixed-effect model for physical health

	Pooled OLS		Fixed effect	
Variables	**Without SSS**	**With SSS**	**Without SSS**	**With SSS**
SSS		0.050***		0.019***
		(0.003)		(0.004)
OSS	0.023***	0.022***	0.009	0.009
	(0.004)	(0.004)	(0.011)	(0.011)
Controls	Yes	Yes	Yes	Yes
Individual	No	No	Yes	Yes
Year	No	No	Yes	Yes
Mean	−0.018	−0.018	−0.018	−0.018
Observations	77,790	77,790	77,790	77,790

Note: Standard errors in parentheses are clustered at individual level: ***$p < .01$, **$p < .05$, *$p < .1$.

TABLE 3 Pooled OLS and fixed-effect model for mental health

	Pooled OLS		Fixed effect	
Variables	**Without SSS**	**With SSS**	**Without SSS**	**With SSS**
SSS		−0.065***		−0.132***
		(0.020)		(0.025)
OSS	−0.270***	−0.272***	−0.003	−0.002
	(0.023)	(0.023)	(0.063)	(0.063)
Controls	Yes	Yes	Yes	Yes
Individual	No	No	Yes	Yes
Year	No	No	Yes	Yes
Mean	13.952	13.952	13.952	13.952
Observations	36,097	36,097	36,097	36,097

Note: 1. Standard errors in parentheses are clustered at individual level: ***$p < .01$, **$p < .05$, *$p < .1$.

TABLE 4 Within-between model for physical health and mental health (with quadratic term)

Variables	Physical health		Mental health	
Within				
SSS	0.019***	0.105***	−0.132***	−0.278***
	(0.004)	(0.017)	(0.025)	(0.101)
SSS Sq.		−0.014***		0.024
		(0.003)		(0.016)
Between				
SSS	0.030***	0.118***	−0.267***	−0.662***
	(0.004)	(0.016)	(0.019)	(0.083)
SSS Sq.		−0.015***		0.065***
		(0.003)		(0.013)
Controls	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Mean	−0.018	−0.018	13.952	13.952
Observations	77,790	77,790	36,097	36,097

Note: 1. Standard errors in parentheses are clustered at individual level: ***$p < .01$, **$p < .05$, *$p < .1$.

The between effect shows the difference in health between an individual who always had the lower SSS and an individual with the higher SSS. In terms of the between-effect for mental health, the significant and negative coefficients show that people who with higher SSS are more likely to be mentally healthier than people whose SSS was lower (between effect: Coeff = −0.267, SE = 0.019, $p <$ .01).

Columns 2 and 4 report estimates adding quadratic terms. For physical health, we observed an inverse-U effect of average SSS, while for mental health, we found a monotonic decrease with increasing marginal benefit. This implies that for a positive association between SSS and physical health before some point (SSS = 3.93), while after this point, the relationship is negative. However, higher levels of SSS are associated with a decrease in mental health. The results for the within effects have a similar trend for physical health (SSS = 3.75) but are non-significant for mental health.

Further analysis

First, we estimated separate within-between models grouped by gender. Next, we investigated whether the association is significantly different between urban and rural individuals. We introduced the terms interacting SSS with gender and SSS with residency.

The estimation results are reported in Figures 1, 2 and Table 5. For both physical health and mental health, between effects are significantly greater for males, but the within effects are not significantly different.

For physical health, the within and between effects of the urban are larger, and for mental health between effect is similar for the rural and urban people, but are significantly higher for the urban. For mental health, the within effect was significant in urban areas.

In addition, in order to determine whether there are any age-related changes in the relationship between SSS and health, the interaction term between SSS and age is added. As shown in columns 5 and 6, for physical health, with age, within- and between-effects decreases. However, for mental health, we could not find such a relationship.

Mobility

It is not just SSS level differences between (or within) individuals, differences in mobility also drive health inequalities, which were shown in Table 6. The coefficients of the lagged SSS variables show that there are significant effects for within and between effects for both physical (0.022 and 0.020) and mental health (−0.292 and −0.258).

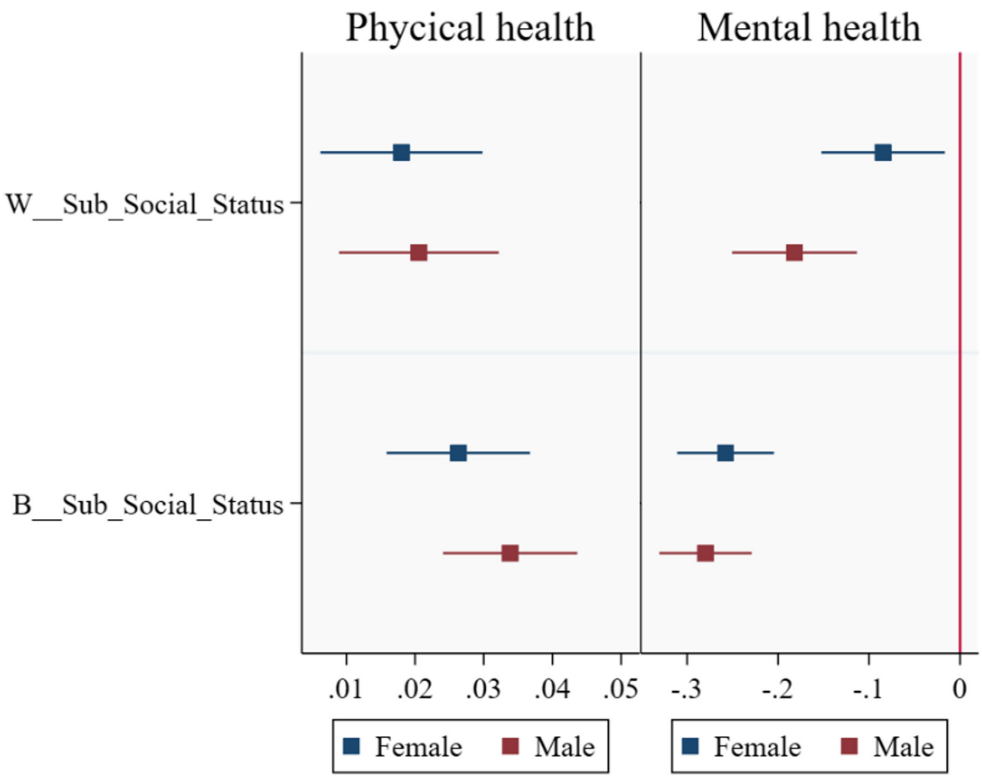

FIGURE 1 Within-between forest plot (stratified by gender)

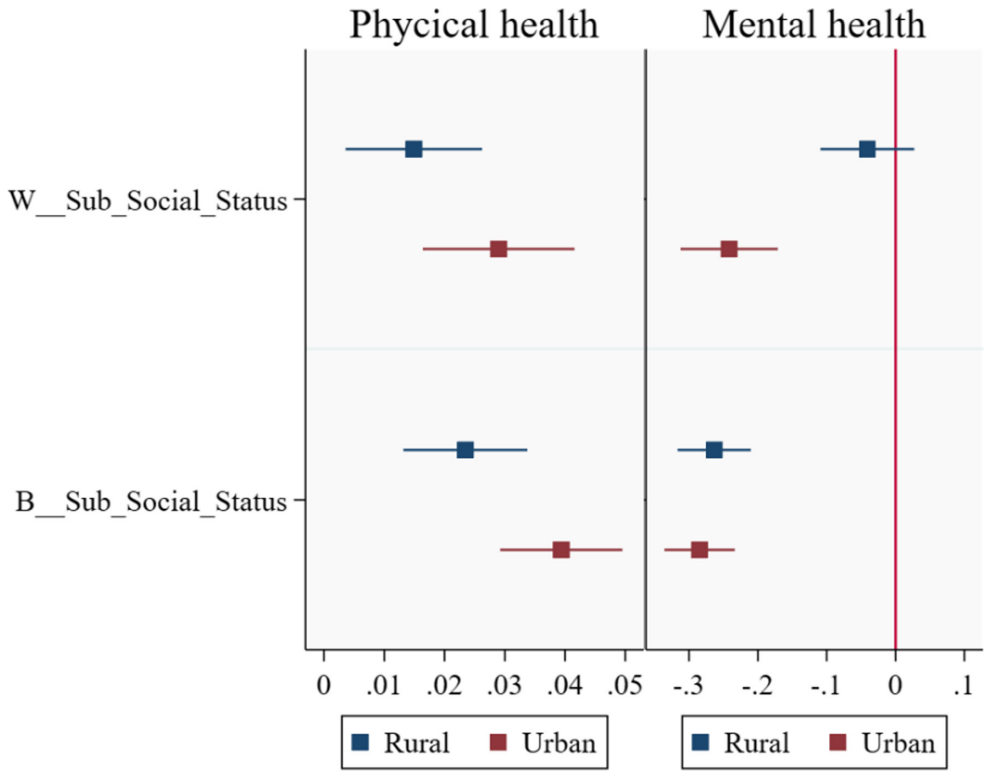

FIGURE 2 Within-between forest plot (stratified by residency)

Individuals who are, on average, highly mobile (i.e., those who expect an increase in their SSS from one year to the next) have significantly better health.

In years where the SSS increase from the previous year is particularly high compared to the average mobility, this entails a large and significant effect on both physical and (0.020) mental health (0.182).

Sensitivity analysis

A number of robustness and sensitivity checks are conducted, which are briefly discussed below. The details are reported in the Appendix S1–S3.

First, to estimate that our results were robust to an alternative specification of the outcome, we used self-rated health as a proxy variable for health. The results from this analysis are nearly identical to our primary results.

Furthermore, we used an imputation strategy to determine how much our estimates may be influenced by possible sample selection resulting from these missing values. That is, we impute the missing values with answers randomly drawn from the subsample that answered this question and add a dummy variable indicating whether the individuals' outcomes were missing into regressions.

Finally, we check for robustness to cohort or generation effects. In our analysis, we allow respondents to enter and leave the panel based on their age or other reasons, that is, we used a dynamic sample. In order to determine whether there are any cohort or generational effects that may be hindered by this method, we estimated our primary results using a balanced study population. We found that the results were almost consistent when using the balanced study population.

TABLE 5 Within-between model for physical health and mental health (Heterogeneity analysis)

Variables	Physical health	Mental health	Physical health	Mental health	Physical health	Mental health
Within						
SSS	0.016***	−0.090***	0.016***	−0.100***	0.076***	−0.118
	(0.006)	(0.034)	(0.005)	(0.030)	(0.017)	(0.105)
SSS *gender	0.008	−0.088*				
	(0.008)	(0.047)				
SSS*urban			0.008	−0.072**		
			(0.006)	(0.033)		
SSS *age					−0.001***	−0.000
					(0.000)	(0.002)
Between						
SSS	0.024***	−0.212***	0.027***	−0.243***	0.113***	−0.264***
	(0.004)	(0.020)	(0.004)	(0.019)	(0.006)	(0.030)
SSS *gender	0.012***	−0.114***				
	(0.002)	(0.013)				
SSS*urban			0.005***	−0.052***		
			(0.002)	(0.011)		
SSS *age					−0.002***	−0.000
					(0.000)	(0.000)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Mean	−0.018	13.952	−0.018	13.952	−0.018	13.952
Observations	77,790	36,097	77,790	36,097	77,790	36,097

Note: 1. Standard errors in parentheses are clustered at individual level: ***$p < .01$, **$p < .05$, *$p < .1$; 2. Controls included OSS.

DISCUSSION

We are among the first to systematically investigate the relationship between SSS and health among Chinese adults using a nationally representative sample. Some scholars have analysed the relationship between SSS and health using Hong Kong (Kwong et al., 2020), Taiwan (Hu et al., 2005), and Shanghai (Rarick et al., 2018) as examples, and a relatively small number of studies have also been based on national data (Han, 2014; Zou et al., 2020), but all of these have used cross-sectional data. Our analysis is most closely related to recent work by Zou et al. (Han, 2014; Zou et al., 2020). Compared with that study, we have considered the dynamic nature of SSS and provided an in-depth analysis to confirmation of the role of SSS.

To our knowledge, this is also the first study to examine the association between SSS and SSS mobility and health by adopting a between–within model. Our results corroborate previous analysis and expand it as previous studies were primarily focused on the between effects, while we took a further analysis. In general, we found that SSS was positively associated with health, but this was not a linear relationship. Moreover, between-individual differences had stronger relationships with health outcomes than within-individual variations. People who are upward mobility have better health. Additionally, we found that age moderated the relationship between SSS and physical health, and the relationship differed significantly between rural and urban areas.

There are two causal models most commonly explaining the effect of SSS on health. The first is SSS as a partial mediator in the causal link between OSS and health. The second is SSS as a unique and

TABLE 6 Within-between model for physical health and mental health (with lagged SSS and mobility term)

Variables	Physical health	Mental health
Within		
SSS_{t-1} (within-lag)	0.022***	−0.292***
	(0.008)	(0.046)
Mobility (within-mobility)	0.020***	−0.182***
	(0.005)	(0.028)
Between		
SSS_{t-1} (average-lag)	0.024***	−0.258***
	(0.004)	(0.021)
Mobility (expected-mobility)	0.042***	−0.276***
	(0.006)	(0.022)
Controls	Yes	Yes
Individual	Yes	Yes
Year	Yes	Yes
Mean	−0.018	13.952
Observations	77,790	36,097

Note: 1. Standard errors in parentheses are clustered at individual level: ***$p < .01$, **$p < .05$, *$p < .1$; 2. Controls included OSS.

separate cause of variations in health (Cundiff & Matthews, 2017). The second model is supported by our findings. In our study, we found that, after adjusting for OSS, the association of SSS with health remained. This confirms that the SSS can capture some dimensions of social status that OSS cannot and can capture relevant psychological variables, including respect and influence in social groups, more accurately (Anderson et al., 2012; Hoebel & Lampert, 2020; Zell et al., 2018).Overall, this partially confirms our H1.

An inverted U-shaped curve was found between SSS and physical health. The results of this study can be interpreted in part in light of social comparison theory (Festinger, 1954). As a result of research, upward social comparison have a negative effect on self-evaluation, while downward comparison have a positive impact (Collins, 1996; Wheeler & Miyake, 1992). There is some evidence that upward social comparisons are not always detrimental to health (Taylor & Lobel, 1989). People with lower social status may benefit from living with those with higher social status since they are inspired to achieve greater economic success, which can in turn positively impact their health. (Easterlin, 2001; Firebaugh & Schroeder, 2009). Individuals with low-SSS may be affiliated with their high-SSS 'neighbours' in situations of relative disadvantage, thereby reducing health damage regardless of their OSS. In addition, some studies have found that high-SSS 'neighbours' may provide additional health-promoting resources for individuals with low-SSS, and the support from others was protective for physical health (Heinze et al., 2015; Marcus et al., 2015; Roy et al., 2016).

In terms of physical health, within and between effects were also found to interact with an individual's age. H2 is also supported by our findings. With age, the relationship between SSS and physical health will gradually weaken. As people grow older, the desire to gain and maintain SSS is getting lower (Garstka et al., 2005; Robertson & Weiss, 2017; Weiss & Kunzmann, 2020), and changes in SSS may be less impactful in old age. Additionally, although the loss of SSS will increase with age, individuals were 'immune' from SSS loss as people grew older, their physical health might benefit from 'immunity' to SSS loss. Taken together, changes in SSS seemed to become less relevant as a positive factor of physical health in older individuals (Weiss & Kunzmann, 2020). This gender-specific difference could be explained in part by the fact that men's identities are often shaped by socioeconomic hierarchies, as well as workplaces, as they are subjected to stereotypical societal pressures including career development and the primary breadwinner role (Freeman et al., 2016).

In addition, it is important to discuss the observed differences between urban and rural areas. For the between-person effect, we found urban-rural heterogeneity in both mental health as well as somatic health, and we shifted our attention to the within-person effect due to confounding factors. Within-person effect differences were only shown for mental health, and within-person effect only appeared in the urban sample, which is consistent with H3 partly. In fact, in contrast to the between-effects results, we found that mental health was more affected in the short term compared to somatic health, which is consistent with the properties of both, and it facilitates our confirmation of the relationship between SSS and mental health. Our data did not allow us to further explore the mechanisms, but we can speculate about some possibilities. On the one hand, the within-effects in urban areas could be explained partly by rural-to-urban migrants. An estimated 200 million rural residents have migrated into urban China in the past three decades (Guan, 2017). Rural-urban migration is a significant factor in explaining the within-urban inequality, accounting for more than 40% (Chen et al., 2018). Due to their unfavourable socioeconomic status, the lack of social support and lower social benefits, these migrants are in a disadvantaged social position, which leads to the experience of personal relative deprivation (Smith et al., 2012) and there was a higher level of psychological disorder in the group than in the general population. In addition, mental health systems in urban China are facing migrant challenges (Guan, 2017), making them unable to receive adequate mental health services. On the other hand, in China, mental health services are mainly concentrated in cities (Que et al., 2019), and the SSS gap for urban residents is larger than rural residents. In other words, within-urban inequality was greater than within-rural inequality. Therefore, although there are sufficient resources for mental health services in urban, those with higher SSS will have more opportunities to use better health services due to the greater within-urban inequality in SSS, which will further exacerbate mental health inequality.

We also found evidence supporting H4, namely, *the intra-individual SSS expected mobility is associated with health status positively*. By including social mobility in our specification, we additionally found that individuals with higher expected mobility (between-effect) in SSS have significantly higher levels of both physical and mental health. Furthermore, we found that the sharp increase in SSS during the last wave (the most recent wave) contributed significantly to health, but the magnitudes were lower than expected. Based on the above findings, it appears necessary to consider the dynamic nature of SSS (mobility and trajectory), focusing instead on intraindividual changes over time, rather than treating it as a static construct (Weiss & Kunzmann, 2020).

Implications

Findings from this study contribute to a greater understanding of health disparities and strengthen the evidence base for prevention strategies aimed at reducing health disparities.

First, through rigorous modelling, we highlight that SSS is a unique correlate of health. It might be useful in understanding socioeconomic-related health inequities in the health gradient framework. Second, with limited resources, focusing on those who perceived a 'lower' or 'downward' in SSS may assist in identifying those who are most at risk of poor health and require supportive interventions.

Our work has significant implications for public health. First, a simple SSS evaluation could also provide useful information regarding health care delivery.

Current health records and case information focus on basic information about the individual, which in turn reflects the OSS. If SSS evaluation is included in the health records, a lower SSS may indicate an increase in future health risks; measured over time, the decline in SSS might signal the high–low trajectory, therefore, additional health risk (Goodman et al., 2015). Second, policy makers should pay more attention to the effects of SSS among urban residents, especially rural-urban immigrants. There is an increasing need to create a social atmosphere that supports migrants and lessen their relative deprivation.

Limitations and future directions

There are several weaknesses in our paper that should be considered. First, our findings rely on self-reported measures, which may lead to inflating associations between SSS and health due to the fact that self-reports share variance. However, previous studies have shown that the relationship between SSS and health could not be fully confounded by individual differences in general dispositional tendencies do not (Lundberg & Kristenson, 2008), which provide some assurance that the results are not due solely to variances resulting from shared methods. In addition, in this paper, physical health was measured by some relatively objective indicators. Second, although we selected the control variables carefully and fully considered the characteristics of the longitudinal data, our study was unable to establish a strong causal connection between SSS and health because of some unknown third variables. Experimental study would provide stronger evidence but are challenging to implement with respect to SSS. Third, in our study, we found that there was a unique correlate between SSS and health, but the underlying mechanisms were rarely tested. In future research, causal mediation analyses could be conducted to provide some evidence. In conclusion, although our sample is representative of Chinese, its generalizability to other nations remains uncertain. Finally, although we use data representative of China, extrapolation of our results to other countries (especially developed countries) requires caution. This is because the Chinese context (e.g., urban-rural dichotomy) is quite different from that of other countries.

CONCLUSION

The perception of relative position within the social hierarchy has a particularly salient and distinct impact on the health of the Chinese population. Policies and interventions should not focus exclusively on economic factors, but should also consider SSS, given the clear associations between SSS and health. It requires the efforts of multiple stakeholders, including the health and non-health sectors. Health professionals and public health agencies have social and professional responsibility to lead and advocate for these policy changes. The role of SSS in the causal chain between socioeconomic inequality and health disparities should also be explored in more detail, both from a theoretical and empirical standpoint.

AUTHOR CONTRIBUTIONS

Yanshang Wang: Formal analysis; writing – original draft. **Mingzheng Hu:** Writing – review and editing. **Ruoxi Ding:** Writing – review and editing. **Ping He:** Conceptualization; supervision; writing – review and editing.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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