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ARTICLE

A latent class analysis of health lifestyles and health outcomes among Chinese older adults

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Abstract

Prior analyses have repeatedly documented the association between individual health behaviours and health outcomes. Nonetheless, few studies have taken a health lifestyle theory approach to examine how health lifestyle behaviours have shaped Chinese older adults' health status. Using the most recent 2011–2012 data released by the Chinese Longitudinal Healthy Longevity Survey (CLHLS), latent class analysis was applied to identify predominant health lifestyles among Chinese older adults aged 65–105. Four distinct classes representing health lifestyles emerged. Furthermore, the research found the way in which the four classes representing older adults' health lifestyles can be predicted by the respondent's demographic and socio-economic characteristics. In addition, health lifestyles were found to be strongly associated with Chinese older adults' health outcomes which were measured by self-rated health, functional independence, cognitive function and chronic diseases, even after controlling for demographic features as well as individual and parental socio-economic disadvantage. Findings supported the cumulative disadvantage theory in health. The research highlighted the importance of promoting health lifestyles to improve older adults' health outcomes.

Keywords: health lifestyles; socio-economic status; latent class analysis; Chinese older adults; Chinese Longitudinal Healthy Longevity Survey (CLHLS)

Introduction

Previous studies have repeatedly shown that health behaviours influence individual health outcomes. Poor dietary habits, sedentary lifestyle, cigarette smoking and excessive alcohol consumption have been found to strongly link to higher risks of mortality and morbidity among adults (Preston and Taubman, 1994; Ebrahim *et al.*, 2000; Rogers *et al.*, 2005; Bots *et al.*, 2008; Bengtsson and Mineau, 2009; Erkki *et al.*, 2011; Biddle *et al.*, 2016). Most existing studies, however, have related health behaviours and individual health outcomes from single behaviours or one category of health-related behaviours. This approach offered limited explanatory power of one's health outcomes. This is because behaviours are not isolative, but co-occur with another (Vermeulen-Smit *et al.*, 2015). Health lifestyle theories

therefore argued that concentrating on single behaviours or small sub-sets of risky behaviours provides limited insight into health behaviour patterns (Frohlich *et al*., 2001). Focusing on single health behaviours cannot explain the way in which health behaviours tend to cluster in ways that reflect the social and structural contexts of individuals, which in turn affects individual health status (Cockerham, 2005). Scholars hence suggested that considering multiple behaviours simultaneously is a more appropriate strategy that creates larger and more enduring behaviour change to improve individual health (Spring *et al*., 2012).

In recent years, researchers have begun to use clustered health lifestyles to explain individual health (Conry, 2011; Vermeulen-Smit *et al*., 2015; Burdette *et al*., 2017; Lawrence *et al*., 2017). Nevertheless, there is hardly any research that has quantitatively examined how multiple health behaviours may cluster together to create health lifestyles among Chinese older adults. This article is a pioneer study that used a latent class analysis approach to examine classifications of health lifestyles and investigated how health lifestyle classifications have impacted health status among Chinese older adults, using the 2011–2012 wave of the Chinese Longitudinal Health and Longevity Survey.

In addition to investigating the link between health lifestyles and individual health outcomes, this research also examined how health lifestyle typologies vary across socio-demographic factors of Chinese older adults since those socio-demographic factors may reflect structural positions that shape the practice of health behaviours. The study aimed to show how high-risk behaviours are clustered and most prevalent among more disadvantaged groups of Chinese elders. Although previous studies have documented the relationship between socio-economic status (SES) and health in China, their findings seemed to be inconsistent and varied by type of health outcomes and measures of SES. For example, some studies found that people with higher education and income reported better health and experienced lower rates of chronic diseases (Feng *et al*., 2012; Wu and Zhang, 2016; Xu and Xie, 2017). Other scholars suggested that higher SES indeed led to high risky behaviours, such as smoking, heavy alcohol consumption, sedentary lifestyles and a poor diet (Kim *et al*., 2004; Chen *et al*., 2010; Streeter, 2017; Zhang *et al*., 2018), which resulted in a higher prevalence of chronic conditions (Zimmer and Kwong, 2004). Still others demonstrated non-significant effects of SES measures on health outcomes, such as the dynamics of disability (Gu and Zeng, 2004). By taking advantage of the cohort analysis approach, Chen *et al*. (2010) further emphasised that the health disparities caused by SES were not constant but varied across successive cohorts. Given the above inconsistent findings, the current research was interested in shedding light on the way in which SES has shaped the health lifestyles of Chinese older adults. In summary, the study has concentrated on three unanswered research questions:

- Research question 1: What are the health lifestyle patterns among Chinese older adults? Latent class analysis helped to analyse various health lifestyle indicators to explore the optimal number of distinct empirical patterns representing Chinese older adults' health lifestyles.
- Research question 2: How do individuals' demographic and socio-economic characteristics predict Chinese elders' health lifestyles? The research

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considered not only the respondent's current socio-economic characteristics but also his or her parents' family background, such as parental SES, to estimate one's odds of having certain predominant health lifestyles. The effect of parental SES on older adults' health lifestyles also helped to justify the cumulative advantage/disadvantage theory of health among the Chinese elder population.

- Research question 3: How do health lifestyles influence Chinese older adults' health status? This study considered elders' health outcomes by examining their self-rated health, cognitive function, activity of daily living (ADL) and chronic diseases. The research investigated the association between health lifestyles and elders' health outcomes by controlling for their demographic and socio-economic background.

Healthy lifestyles can be considered to be an important tool to prevent chronic diseases and postpone long-term care of older adults. Findings based on analysing nationally representative data in China will be valuable to address disease prevention and health promotion-related issues among Chinese older adults. The Chinese experience may also be helpful in terms of older adults' health promotion in other countries. Understanding how and why risk behaviours cluster together can also be beneficial to improve theories of engagement in risky health behaviours among seniors in general.

Health lifestyles

An important theoretical development in research of health disparities is health lifestyles perspectives. According to Bourdieu (1984), health lifestyles were broad and potentially unobservable orientations that organise patterns of behaviours. The concept was derived from Weber's idea of lifestyles as the interaction of life choices and life chances. Weber argued that lifestyles are not associated with individuals but groups of people with similar social status and backgrounds. Such a definition has been expanded further to include factors such as understandings of what good health means, health norms, policy environments, *etc*. (Krueger *et al*., 2009). Health lifestyle perspectives highlighted that social, cultural and economic forces have framed and constrained individual choices of health behaviours (Cockerham, 2005). Such perspectives emphasised more the patterns of behaviours rather than single behaviours.

Studies of health lifestyles have emerged under the guidance of the health lifestyles perspectives. Some analyses linked SES to clustered health behaviours among adults in different social contexts. It has been revealed that people from higher social classes tended to have healthier lifestyles than those with lower SES (Laaksonen *et al*., 2002; Pampel *et al*., 2010; Christensen and Carpiano, 2014; Glorioso and Pisati, 2014; Chan and Leung, 2015; Wang, 2019). Personal characteristics, such as gender and age, have also been found to be associated with individual health lifestyles (Cockerham, 2005; Dodd *et al*., 2010). Determinants of health lifestyle behaviours in adolescence have been explored and researchers highlighted that early age health lifestyle behaviours have imprints on one's health behaviours in adulthood (Sinha, 1992; Stefansdottir and Vilhjalmsson, 2007; French, 2012;

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McGovern *et al*., 2018). In addition to the analyses of health behaviour determinants, others explored the relationship between patterns of multiple behaviours with people's mental or self-rated health (Conry, 2011; Guallar-Castillón *et al*., 2014; Oftedal *et al*., 2019). The positive effects of health lifestyle behaviours on prevention of cardiovascular diseases and cancer have also been documented by prior literature (Khan *et al*., 2010; Claas and Arnett, 2016).

When it comes to older adults' health behaviours, epidemiological studies have done some work on healthy lifestyles and elders' health and mortality in a variety of countries. Through studying multiple lifestyle behaviours of older persons in Korea and Amsterdam, scholars highlighted that participation in healthy lifestyles may contribute to the maintenance of functional independence (measured as ADL and instrumental ADL) and cognitive function in later life (Lee *et al*., 2008, 2013; Visser *et al*., 2019). Martín-María *et al*. (2020) examined subjective wellbeing and healthy lifestyle behaviours among participants aged 50 and over in Spain. By operationalising healthy lifestyle behaviours as physical activities, consumption of fruits and vegetables, and whether smoking, they found significant effects of healthy lifestyle behaviours on subjective wellbeing among people aged 65 and over (Martín-María *et al*., 2020). Unhealthy lifestyles were also found to be a predictor of depressive symptoms among late middle-aged and older persons (van Gool *et al*., 2003). Rizzuto *et al*. (2019) traced lifestyle behaviours such as non-smoking and physical activity among elders from the Kungsholmen Project in Sweden. They revealed that a low-risk profile could add five years to women's lives and six years to men's after age 75 (Rizzuto *et al*., 2019).

As to health behaviours and health outcomes among Chinese older adults, abundant studies have been conducted in recent years (Zeng *et al*., 2002, 2010; Chen *et al*., 2010; Wen and Gu, 2011; Zhao *et al*., 2017; Ding *et al*., 2018). Even so, most research focused on single health behaviours without taking the health lifestyle perspective, *i.e.* a combination of multiple health-related behaviours, to a better understanding of health-related practices and their relationship with Chinese elders' health outcomes. This research intended to use nationally presentative data to include health behaviours from multiple domains to present a relatively more comprehensive picture of health behaviours among Chinese older adults. It also aimed to shed light on how SES has shaped Chinese elders' health lifestyles and how health behaviours have further determined older adults' health outcomes.

Data, measures and methods

Data

To explore the three research questions, this research analysed the 2011–2012 data released by the CLHLS that was conducted in a randomly selected half of the counties/cities in 22 provinces of China. Until now, seven waves (1998, 2000, 2002, 2005, 2008, 2011–2012 and 2014) of survey data have been collected. The survey was initially launched to meet the needs for scientific research on the oldest-old, a sub-population that is growing at extraordinary speed in China. The survey staff interviewed 9,093 voluntary participants aged 80+ in the baseline survey in 1998. In the second wave in 2000, among the 9,093 baseline interviewees, 4,831 (53.1%) survived to the time of the 2000 interview, 3,368 (37.0%) died before the

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time of 2000 interview and 894 (9.8%) were lost to follow-up. Similarly, in each of the following waves, there were respondents who died, were lost, or were added to replace the deceased and lost individuals. This study used 2011–2012 data to perform the analysis. This wave is commonly called the 2011 wave of CLHLS but here I indicate this wave to be the 2011–2012 wave because among the total number of 9,765 respondents, 7,328 of them were surveyed in 2011 and the rest, 2,437, were surveyed in 2012. Since 2002, the CLHLS has begun to collect information from those aged 65 and over. Thus, data from the 2011–2012 wave allow this study to trace information from those younger than 80. Previous literature showed that persons who reported age 106 or higher were considered as invalid cases (Zeng *et al.*, 2002). Therefore, persons aged 106 and higher were excluded from this study due to insufficient information to validate their reported extremely high age. The study eventually obtained 9,382 older adults aged 65–105, with 4,297 males and 5,085 females.

Measures

Health lifestyle indicators

Prior research generally operationalised health lifestyles into the following categories: dietary patterns (including eating fruits, vegetables, breakfast, *etc.*), smoking, alcohol consumption, sleep, obesity and physical activity (Daw *et al.*, 2017; Saint Onge and Krueger, 2017; Visser *et al.*, 2019; Wang, 2019; Martín-María *et al.*, 2020). Some researchers even used wearing a seat belt, media use, Body Mass Index (BMI) and regular physical examination as additional indicators of health lifestyles (Burdette *et al.*, 2017; Xiao *et al.*, 2019; Li, 2020). The selection of health lifestyle measures in this research fell closely in line with the commonly used four key domains in prior research, which were dietary behaviours, smoking and alcohol use, sleep, and physical and leisure activities.

Regarding the first domain, dietary behaviours, the CLHLS asked the respondent the frequency he or she ate or drank the following items: fresh fruit, fresh vegetables and tea. Previous analyses pointed out that tea drinking is related to longevity and reduced risk of mortality and death from cardiovascular diseases (Suzuki *et al.*, 2009; Ruan *et al.*, 2013). Tea consumption was therefore considered to be an important health lifestyle behaviour in this study. The original coding scales for drinking tea in the survey were: 1 = almost every day, 2 = not every day but at least once per week, 3 = not every week but at least once per month, 4 = not every month but occasionally, 5 = rarely or never. In this study, respondents who drank tea almost every day were coded '1', with less coded '0'. The initial coding scales for eating fruits and vegetables were: 1 = almost every day, 2 = quite often, 3 = occasionally, 4 = rarely or never. The study coded these two variables as dichotomous ones, labelling respondents answering 'almost every day' and 'quite often' as '1' and '0' if otherwise.

The second domain was smoking and alcohol use. In the CLHLS, there were no questions asking whether the respondent was a heavy smoker or drinker. But there were questions asking the respondent whether he or she smoked or drank alcohol 'in the past' and 'at present'. The respondent who never smoked in the past or at present was coded as '0' and '1' if otherwise. It was assumed that those individuals

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who smoked before and were still smoking when the survey was conducted were heavy smokers; the same rationale and coding strategy were also applied to the alcohol consumption variable. The CLHLS questionnaire did have questions asking how much the respondent drank or smoked per day, but the responding rates were less than 20.0 per cent of the total sample. Hence the study did not include any of those variables measuring the respondent's exact amount of cigarette or alcohol consumption due to an extremely large amount of missing values.

The third domain, sleep, was represented by two indicators: sleep duration and sleep quality. Sleep duration refers to the usual number of hours the respondent slept each day. The study dichotomised the sleep duration variable as '1' indicating having eight hours or more sleep each day and '0' as having less than eight hours sleep. The sleep quality variable was dichotomised into good sleep quality (comprising 'good' and 'very good' categories) and poor sleep quality (including the categories that were originally coded in the survey as 'so so', 'bad' and 'very bad').

The fourth domain related to physical and leisure activities. The survey asked whether the respondent exercised regularly in the past and at present. Those who exercised regularly both at present and during the past were coded as '1' and '0' if otherwise. Those who were coded '1' were considered to be physically active. There were also survey questions that enquired into whether the respondent participated in any leisure activities on a regular basis. The activities included reading newspapers/books, raising domestic animals, playing cards and/or mah-jong, and watching television and/or listening to radio. This study generated a dichotomous variable which was coded as '1' if the respondent reported having any leisure activity almost every day and '0' if otherwise.

Health outcome measures

The selection of health outcome measures was based on the ways in which health status was operationalised in prior analyses. Although previous studies have applied a striking array of health outcome measures, these measures can largely be classified into four dimensions: (a) mortality, morbidity and frailty, including chronic illnesses (*see e.g.* Lauderdale, 2001; Dupre, 2007; Ueshima *et al.*, 2010; Wagner and Short, 2014; Chan *et al.*, 2015; Han *et al.*, 2017; Martinez-Gomez *et al.*, 2017; Smith and Victor, 2019); (b) perceived health or self-rated health (*see e.g.* Lynch, 2003; Chen *et al.*, 2010; Hong and Morrow-Howell, 2010; Meyer *et al.*, 2014; Wagner and Short, 2014; Ferraro *et al.*, 2016; Smith and Victor, 2019); (c) functional health which is indicated as ADL and recurrent falling (*see e.g.* Peres *et al.*, 2008; Morrow-Howell, 2010; Murtaugh *et al.*, 2010; Peeters *et al.*, 2010; Li *et al.*, 2013; Smith and Victor, 2019); (d) mental health, including physiological wellbeing, depression and cognitive function (*see e.g.* Wang *et al.*, 2002; McDonnall, 2011; Bielak *et al.*, 2012; Meyer *et al.*, 2014; Llamas-Velasco *et al.*, 2015; Chao, 2016).

Although the CLHLS questionnaire did not include all of the above health outcome indicators, it did have questions asking about older adults' chronic illness conditions, self-rated health, ADL as well as cognitive function. These measures are consistent with the above four dimensions of commonly used health outcome measures. Thus, they should be able to capture the health status of the respondent. In this research, the respondent's self-rated health was coded as a continuous

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variable (1 = very bad, 5 = very good). The chronic disease variable was measured by whether the respondent reported any chronic diseases (1 = yes, 0 = no). The CLHLS asked the respondent whether he or she was suffering from 24 types of chronic disease, including: hypertension, diabetes, heart disease, stroke/cerebrovascular disease, bronchitis/emphysema/asthma/pneumonia, pulmonary tuberculosis, cataracts, glaucoma, cancer, prostate tumour, gastric or duodenal, Parkinson's disease, bedsore, arthritis, dementia, epilepsy, cholecystitis/cholelith disease, blood disease, rheumatism or rheumatoid disease, chronic nephritis, galactophore disease, uterine tumour, hyperplasia of prostate and hepatitis. Since the missing values for prostate tumour, chronic nephritis, galactophore disease and hyperplasia of prostate exceeded half of the respondents, these four types of chronic disease were dropped from the analysis. As a result, the study included the remaining 20 types of chronic disease. If the respondent answered he or she was suffering from at least one of the 20 types of chronic disease, then the respondent was coded as '1' for the chronic disease variable and '0' if otherwise. Cognitive function of the respondent was measured by using the Chinese version of the Mini-Mental State Examination (MMSE). The MMSE was adapted from Folstein *et al.* (1975) and tested four aspects of cognitive functioning: orientation, calculation, recall and language. The total possible score on the MMSE is 30, with lower scores indicating poor cognitive ability. Based on recommendations in the literature, responses of 'unable to answer' were coded as incorrect answers (Herzog and Wallace, 1997). Thus, the values of the cognitive function variable ranged from 0 to 30. ADL disability was defined as self-reported difficulty with any of the following ADL items: (a) bathing, (b) dressing, (c) eating, (d) indoor transferring, (e) toileting, and (f) continence. To avoid problems of complications and small sub-sample sizes in the model estimation, the ADL functional capacity was dichotomised into '0', meaning 'active' (no ADL limitation) and '1', meaning 'disabled' (at least one ADL limitation).

Covariates

Demographic and socio-economic variables were also included as covariates. Demographic characteristics included age, gender, and rural or urban residence. Those who lived in cities and towns were classified as urban residents. Socio-economic measures were the respondent's years of schooling, per capita household income and occupation before age 60. The occupation variable was coded as a dichotomous one with '1' representing professional or administrative occupations and '0' otherwise. The research also controlled for the respondent's SES in early childhood (or parental SES) because socio-economic condition in early childhood has been shown to have a cumulative effect on one's later-life health status and mortality (Luo and Waite, 2005; Zeng *et al.*, 2007). The early childhood (or parental) SES was measured by three variables in this analysis: (a) whether the respondent frequently went to bed hungry as a child, (b) years of schooling of the respondent's father, and (c) the respondent's father's occupation before age 60 (1 = professional or administrative job, 0 = otherwise). Although the percentages of respondents and respondents' fathers who held professional or administrative jobs were low, the occupation measure has been repeatedly used as an indicator of SES in previous studies (*see e.g.* Shen *et al.*, 2016;

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Brashera *et al*., 2017; Lv *et al*., 2019). In this sense, the validity of the occupation measure representing SES has been proved by previous analyses. Descriptive statistics for all variables are presented in Table 1.

Methods

Latent class analysis

The study used latent class analysis in Stata 15.0 software to predict membership in latent or unobserved groups that share similar health lifestyle patterns among Chinese older adults. Latent class analysis differs from factor analysis in that it uses dichotomous, not continuous, indicators and assumes that there are underlying discrete groups or classes of respondents. Membership in sub-groups is based on the similarities in individual response to questions that are related to a set of observed behaviours. Latent classes in this research were created from the health lifestyle indicators described in the previous section. Each case was assigned a probability of membership in each class. Because the exact number of health behaviour typologies is unknown, an explanatory approach was used, which started with the most parsimonious one-class model and fitted successive models with increasing numbers of classes. Each latent class solution was replicated 20 times, beginning at random starting values. This method included a close examination of item loadings and model fit indices for estimating latent classes (Vermunt, 2010).

The final number of classes was determined by the conceptual meaning, and commonly used fit measures, including the Akaike information criterion (AIC), the Bayesian information criterion (BIC) and the value of entropy. The values of these indices for different class categories are presented in Table 2. The Stata software showed that convergence was not achieved when constructing five classes. Thus, Table 2 presents only the AIC, BIC and entropy values for the first four classes. Generally, smaller values of AIC and BIC are better. The four-class model has both the smallest AIC and BIC. The entropy for the four-class model (0.698) is beyond the criteria for good class separation cut-off point of 0.60 (Asparouhov and Muthén, 2014). Further, the four-class solution also provides the most conceptually coherent description of health lifestyles. It was then chosen as the most appropriate solution. Table 3 shows item response probabilities and shares for the analysis sample for each class.

Other analyses

Descriptive analysis was used to report means and percentage distributions of all variables (*see* Table 1). To address research question 2, multinomial logit models were constructed to investigate how demographic and socio-economic factors were related to Chinese older adults' class membership, that is, older adults' health lifestyles – a multinomial dependent variable. The regression equation is as follows:

$$\text{logit } k = \text{logit} \frac{\Pi_k}{\Pi_n} = \beta_k^{'} X,\ K = 1, 2, \ \ldots, n-1$$

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Table 1. Summary statistics for all variables: Chinese older adults aged 65–105

Variables	% or mean	SD	N
Health lifestyle variables:			
If R eats fresh fruit almost every day:			9,309
Yes	37.3		
No	62.7		
If R eats fresh vegetables almost every day:			
Yes	56.4		9,301
No	43.6		
If R drinks tea almost every day:			
Yes	23.7		9,297
No	76.3		
If R smoked before and is still a smoker:			9,382
Yes	34.3		
No	65.7		
If R drank before and is still a drinker:			9,382
Yes	31.4		
No	68.6		
R's quality of sleep:			9,357
Good	61.3		
Poor	38.7		
If R normally sleeps at least 8 hours:			9,286
Yes	56.6		
No	43.4		
If R exercised during the past and still exercises at present:			9,382
Yes	14.0		
No	86.0		
If R participates in leisure activities:			9,382
Yes	61.0		
No	39.0		
Health status variables:			
R's self-rated health (mean)	3.3	0.9	8,688
If R reports at least one type of chronic illness:			9,382
Yes	60.3		
No	39.7		

(*Continued*)

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Table 1. (*Continued.*)

Variables	% or mean	SD	N
If R has ADL disability:			9,382
Yes	25.2		
No	74.8		
R's cognitive function score (mean)	25.0	6.4	7,500
Control variables:			
R's characteristics:			
Age (mean)	85.3	10.7	9,382
Gender (male = 1):			9,382
Male	45.8		
Female	54.2		
Rural/urban residence (urban = 1):			9,382
Urban	47.6		
Rural	52.4		
R's reported years of schooling (mean)	2.3	3.5	9,342
R's household per capita income (RMB)	8,237.6	8,876.7	7,176
R had professional or administrative job before age 60:			8,834
Yes	7.5		
No	92.5		
R's parental characteristics:			
Whether R often went to bed hungry in childhood:			8,181
Yes	75.7	_	_
No	24.3		
R's father's years of schooling (mean)	0.8	2.1	8,151
R's father had professional or administrative job before age 60:			8,760
Yes	2.7		
No	97.3		

Notes: N = 9,382. Some sub-categories may not add up to 100 per cent due to rounding. SD: standard deviation. R: respondent. ADL: activity of daily living.
Source: Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2011–2012 data.

where

$$\prod_k = \frac{exp(\beta_k' X)}{1 + \sum_{k=1}^{n-1} exp(\beta_k' X)}$$

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Table 2. Summary of latent class model identification and statistics

Class number	AIC	BIC	Entropy	Likelihood ratio χ^2
1	102,727.1	102,791.2	–	6,310.2
2	99,958.9	100,094.3	0.693	3,522.1
3	98,605.3	98,812.0	0.730	2,148.5
4[1]	97,718.3	97,996.2	0.698	1,241.5

Notes: N = 9,193. 1. This row represents the identified model. AIC: Akaike information criterion. BIC: Bayesian information criterion.

$$\prod_n = \frac{1}{1 + \sum_{k=1}^{n-1} exp(\beta_k' X)}$$

In multinomial logit models, the dependent variable had four categories or classes. Class 3 was treated as the base category for comparison. Table 4 shows the multinomial logistic regression results when comparing class 3 with the other three classes.

Further, multiple regression models were constructed to predict Chinese older adults' health status on the basis of their health lifestyles, controlling for the respondent's demographic and socio-economic characteristics. This set of multiple regressions helped to address research question 3. Since the health outcome measures of ADL disability and chronic diseases were coded as dichotomous variables, logistic regressions were used to perform the analyses. The other two measures of health status, namely self-rated health and cognitive function scores, are continuous variables; ordinary least squared (OLS) regression was applied to show how health lifestyles predict older adults' health status.

Results

Descriptive statistics

Table 1 presents descriptive statistical results for all variables. Of the 9,382 respondents aged 65–105, 54.2 per cent of them were females. The percentage of rural respondents was higher than that of their urban counterparts (52.4 and 47.6%, respectively). The mean age of the sample was 85.3 with a standard deviation of 10.7 years. The SES of the studied sample appeared to be low. On average, the reported years of schooling among the studied sample was 2.3 with a standard deviation of 3.5. The mean household per capita income for the year before the survey was 8,237.6 RMB (which is equivalent to US $1,056), with a standard deviation of 8,876.7. Only 7.5 per cent of the respondents had professional or administrative jobs before retirement. The respondent's parental SES seemed to be even lower. Specifically, the average reported years of schooling for the respondent's father was 0.8 with a standard deviation of 2.1. About 75.4 per cent of the studied sample reported being hungry when going to bed in childhood. Less than 3.0 per cent of

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Table 3. Item response probabilities for health lifestyle indicators used in the latent class analysis: Chinese older adults aged 65–105

	Class[1]			
Health lifestyle indicators	1	2	3	4
%	20.2	34.6	22.4	22.1
Eating fresh fruit almost every day				
Yes	0.250	0.285	0.640	0.339
No	0.750	0.715	0.360	0.661
Eating fresh vegetables almost every day				
Yes	0.434	0.481	0.791	0.584
No	0.566	0.519	0.209	0.416
Drinking tea almost every day				
Yes	0.117	0.092	0.406	0.416
No	0.883	0.908	0.594	0.584
Smoking				
Yes	0.819	0.863	0.723	0.036
No	0.181	0.137	0.277	0.964
Drinking				
Yes	0.860	0.838	0.750	0.147
No	0.140	0.162	0.250	0.853
Good quality of sleep				
Good	0.113	0.745	0.806	0.694
Poor	0.877	0.255	0.194	0.306
Normally sleeps at least 8 hours				
Yes	0.111	0.860	0.615	0.600
No	0.889	0.140	0.385	0.400
Exercising during the past and at present				
Yes	0.076	0.045	0.314	0.172
No	0.924	0.955	0.686	0.828
Participating in leisure activities				
Yes	0.492	0.368	0.965	0.764
No	0.508	0.632	0.035	0.236

Notes: 1. Class 1: less-healthy diet, not smoking, not drinking, poor sleep, low physical exercise and leisure activities; class 2: less-healthy diet, not smoking, not drinking, good sleep, lowest physical exercise and leisure activities; class 3: consistent engagement in healthy behaviours; class 4: moderate diet, smoking and drinking, moderate sleep, moderate exercise and leisure activity engagement. All variables are coded 1 = yes, 0 = no.
Source: Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2011–2012 data.

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Table 4. Multinomial logistic regression on respondents' health lifestyle latent classes: Chinese older adults aged 65–105

	Class 1[1] *versus* Class 3			Class 2 *versus* Class 3			Class 4 *versus* Class 3		
	RRR	SE	95% CI	RRR	SE	95% CI	RRR	SE	95% CI
R's demographic and SES variables:									
Age	1.02***	0.00	1.01–1.03	1.06***	0.00	1.05–1.07	1.01***	0.00	1.00–1.01
Sex (Ref. Female)	0.65***	0.06	0.54–0.79	0.81**	0.07	0.69–0.96	10.43***	1.09	8.49–12.82
Residence (Ref. Rural)	0.65***	0.06	0.55–0.78	0.60***	0.05	0.52–0.71	0.86	0.07	0.73–1.02
R's years of schooling	0.96**	0.02	0.93–0.99	0.92***	0.01	0.89–0.94	0.96***	0.12	0.93–0.98
R's natural logged per capita family income	0.68***	0.03	0.63–0.73	0.75***	0.03	0.07–0.81	0.79***	0.03	0.73–0.85
R's occupation before age 60 (Ref. Non-professional or non-administrative)	0.61**	0.12	0.41–0.90	0.64***	0.11	0.46–0.89	0.75*	0.11	0.57–0.98
R's parental SES variables:									
If R often went to bed hungry in childhood	1.15	0.11	0.95–1.40	1.31**	0.12	1.09–1.56	1.25*	0.12	1.04–1.51
R's father's years of schooling	0.96	0.02	0.92–1.00	0.99	0.02	0.95–1.02	0.98	0.02	0.94–1.02
R's father's occupation before age 60 (Ref. Non-professional or non-administrative)	0.84	0.23	0.49–1.43	0.73	0.18	0.46–1.18	0.58*	0.15	0.36–0.96
Constant	4.83***	2.35	1.86–12.52	0.20***	0.09	0.08–0.49	0.83	0.40	0.32–2.15
N	5,906			5,906			5,906		
Likelihood ratio χ^2	2,236.06			2,236.06			2,236.06		
Log likelihood	−6,927.35			−6,927.35			−6,927.35		

Notes: 1. For latent class details, *see* Table 3. RRR: relative risk ratio. SE: standard error. CI: confidence interval. R: respondent. SES: socio-economic status. Ref.: reference category.
Source: Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2011–2012 data.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the respondents reported their fathers having professional or administrative occupations before retirement.

As to health outcome variables, at first review, the average self-rated health score was fairly good with a score of 3.3 (between fair and good). Slightly over 60 per cent of the respondents reported having at least one type of chronic disease and about 25.2 per cent of the elders had ADL disability. The mean cognitive function score was 25, indicating a good cognitive function status of the studied Chinese older adults.

The health lifestyle measures showed that 37.3 and 56.4 per cent of the respondents reported that they ate fresh fruit and vegetables almost every day. Close to one-quarter of the elders drank tea almost every day. About one-third of the studied sample reported that they were smokers and still smoked when the survey was conducted. A similar percentage of the respondents reported they were drinkers and were still drinking in the survey year. Slightly over 60 per cent of the respondents reported good quality sleep and 56.6 per cent of them had eight or more hours of sleep each day. Among the studied seniors, 14.0 per cent of them reported doing physical exercise before age 60 and were still exercising when surveyed; and 61.0 per cent of the older adults participated in at least one leisure activity almost every day. After showing the basic statistics of the variables, the study began to address the three research questions that were raised at the beginning of the article.

Research question 1: What are Chinese older adults' health lifestyles?

After choosing the four-class model as the best fitted latent class model, the study estimated item probabilities for the four identified latent classes. Table 3 presents the four predominant Chinese older adults' healthy lifestyles (latent classes) and their share of the sample. Class 1 (less-healthy diet, not smoking, not drinking, poor sleep, low engagement in physical exercise and leisure activities; 20.2%) contained Chinese older adults who had poor sleep, exercised less and reported less-healthy diet behaviours. In this class, there were lower percentages of respondents eating fresh fruits almost every day and drinking tea almost every day. The elders in this class were more likely to be non-smokers or non-drinkers both currently and during the past; they had poor sleep and reported low engagement in leisure activities and physical exercise.

Class 2 (less-healthy diet, not smoking, not drinking, good sleep, lowest engagement in physical exercise and leisure activities; 34.6%) consisted of respondents who reported a less-healthy diet (low percentages of respondents drinking tea and eating fresh fruits/vegetables), were not smokers or drinkers previously or at the survey time, had good sleep but the lowest probabilities of exercising and leisure activity participation. This class though was the one that has the highest percentage of respondents among all four classes. It seemed to be the most prevalent health lifestyle among Chinese older adults.

Class 3 (consistent engagement in healthy behaviours; 22.4%) included Chinese older adults reporting the highest probabilities of healthy dietary patterns (eating fresh vegetables and fruits almost every day; drinking tea almost every day), not being smokers or drinkers, having enough sleep (eight or more hours per day) and reporting good sleep quality, participating in leisure activities and doing physical exercises.

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Class 4 (moderate diet, smoking and drinking, moderate sleep, moderate exercise and leisure activity engagement; 22.1%) comprised Chinese seniors who had a moderate diet (high probability of drinking tea but lower probabilities of eating fresh vegetables and fruits) but the highest probabilities of smoking and drinking. Older adults in this latent class also reported moderate sleep and relatively lower probabilities of exercising and engaging in leisure activities (17.2 and 76.4%, respectively).

Thus, class 3 was labelled as consistently positive, comprising 22.4 per cent of the sample. Elders in this class experienced healthier lifestyles relative to most of their peers across nearly all indicators and domains. The other three classes were differentiated by a particular domain of unhealthy behaviours. Specifically, class 4, smoking and drinking problems, comprised 22.1 per cent of the sample. Among this latent class, about 96.0 and 86.0 per cent of elders reported smoking and drinking behaviours. Class 1, sleep, exercise and dietary problems, comprised 20.2 per cent of the population. Elders in this latent class experienced the highest level of inadequate nighttime sleep since those who had eight hours or more sleep every day only counts for a mere 11.1 per cent of the sample. About 11.3 per cent of the elders reported having good sleep quality. Respondents in this class also showed the lowest probability (7.6%) of doing physical exercise. Class 2, sedentary lifestyle, contained the highest percentage of the studied sample (34.6% of the respondents), and was the most sedentary class among all four classes. Elders in this class showed inconsistent health lifestyle profiles. They reported modest diet behaviours, low probabilities of smoking and drinking, good sleep patterns, but they exercised the least and demonstrate the lowest probability of participating in leisure activities among all four classes.

Research question 2: Are demographic and socio-economic characteristics linked to Chinese older adults' health lifestyles?

Multinomial logistic regression results presented in Table 4 show the associations between older adults' demographic and socio-economic characteristics and their health lifestyles. Class 3, the consistently positive group, was treated as the baseline group and the other three classes were compared with class 3. Unsurprisingly, demographic and socio-economic characteristics played significant roles in predicting one's class membership in health lifestyles. The results indicated that with age increasing, Chinese older adults were more likely to be in the other three classes than in class 3. As compared to women, men were less likely to be in class 1 (less-healthy diet, not smoking, not drinking, poor sleep, low engagement in physical exercise and leisure activities) or class 2 (less-healthy diet, not smoking, not drinking, good sleep, lowest engagement in physical exercise and leisure activities) than in class 3. But men were 10.4 times more likely than women to be in class 4 (moderate diet, smoking and drinking, moderate sleep, moderate exercise and leisure activity engagement). Urban seniors were more likely to be in class 3 than in classes 1 and 2 compared to their rural counterparts. The significant rural–urban differences, however, were not significant when classes 4 and 3 were compared. As to the SES measures of the respondent, with every one year increase in education, the odds of the respondent being in classes 1, 2 and 4 rather than class 3 decreased by 4.0, 8.0 and 4.0 per cent, respectively. Similarly, higher family income

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and holding professional or administrative positions before retirement also pushed older adults to be more likely in class 3 than in other three classes.

Parental SES covariates did not show significant effects on predicting one's health lifestyles when classes 1 and 3 were compared. Yet those older adults who frequently went to bed hungry in childhood were 1.3 and 1.2 times more likely to be in classes 2 and 4 than in class 3. One's father holding a professional or administrative position before retirement dropped the odds of an individual being in class 4 than in class 3 by 42.0 per cent. These results clearly demonstrated that demographic features as well as individual and parental SES shaped Chinese older adults' health lifestyle class membership. The cumulative disadvantage theory was again supported by empirical findings in this case. That is, socio-economically disadvantaged groups were more likely to be in classes that had less healthy lifestyles.

Research question 3: Is Chinese older adults' health status influenced by their health lifestyles?

In order to answer the third research question raised at the beginning of the article, OLS regression analyses were performed to predict the respondent's health status that was measured by continuous variables (such as cognitive function and self-rated health) and logistic regression models were constructed to estimate whether older adults reported ADL disabilities and chronic diseases. Tables 5 and 6 reported the OLS and logistic regression results when controlling for demographic and socio-economic factors, respectively. In both Tables 5 and 6, two models were constructed. The first model included the health lifestyle classes as well as the respondent's demographic and SES characteristics; the second model further added the respondent's parental SES variables. Regression analyses were used to ascertain whether health lifestyles matter after accounting for demographic controls, and individual and parental SES. The purpose of constructing two models when predicting each health outcome measure was that the research was interested in knowing whether the impact of health lifestyles on elders' health may be modified when parental SES was considered.

As Table 5 shows, adding parental SES variables did not significantly alter the statistical results (*see* Models 1 and 2). Model 2 indicated that self-rated health scores for individuals in class 1 (less-healthy diet, not smoking, not drinking, poor sleep, low physical exercise and leisure activities) were 0.58 lower than the self-rated health scores of those in class 3 (consistent engagement in healthy behaviours). Self-rated health scores for older adults in class 2 (less-healthy diet, not smoking, not drinking, good sleep, lowest physical exercise and leisure activities) and class 4 (moderate diet, smoking and drinking, moderate sleep, moderate exercise and leisure activity engagement) were 0.24 and 0.17 lower, respectively, as compared to self-rated health scores reported by members in class 3. In addition, males, rural seniors, and individuals with higher education and income tended to report better self-rated health scores.

Models 3 and 4 in Table 5 show regression results when using health lifestyle measures as well as control variables to predict the respondent's cognitive function status. Clearly, including parental SES covariates did not significantly change the statistical results except that the effect of one's education on cognitive function

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Table 5. Ordinary least squared regression of self-rated health and cognitive function status on health lifestyle latent classes and other control variables: Chinese older adults aged 65–105

	Self-rated health				Cognitive function			
	Model 1		Model 2		Model 3		Model 4	
Variables	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Health lifestyle latent class (Ref. Class 3[1]):								
Class 1	−0.56***	0.04	−0.58***	0.03	−1.76***	0.24	−1.69***	0.24
Class 2	−0.24***	0.03	−0.24***	0.03	−2.19***	0.21	−2.02***	0.22
Class 4	−0.15***	0.03	−0.17***	0.03	−1.24***	0.23	−1.16***	0.23
Control variables:								
Age	0.01***	0.00	0.00**	0.00	−0.24***	0.01	−0.24***	0.01
Sex (Ref. Female)	0.06*	0.03	0.06*	0.03	1.74***	0.18	1.80***	0.19
Residence (Ref. Rural)	−0.08***	0.02	−0.08**	0.02	0.34*	0.16	0.29	0.16
R's years of schooling	0.01*	0.00	0.01**	0.00	0.09***	0.03	0.09***	0.02
R's natural logged per capita family income	0.1***	0.01	0.10***	0.01	0.39***	0.07	0.42***	0.07
R's occupation before age 60 (Ref. Non-professional or non-administrative)	−0.03	0.04	−0.03	0.05	0.19***	0.32	0.01	0.33
If R often went to bed hungry in childhood			0.02	0.03			−0.43*	0.19
R's father's years of schooling			−0.01*	0.01			0.05	0.04
R's father's occupation before age 60 (Ref. Non-professional or non-administrative)			0.03	0.08			0.33	0.51
Constant	2.42***	0.13	2.39***	0.14	42.45***	0.89	42.23***	0.94
N	5,975		5,501		5,206		4,795	

Notes: 1. For latent class details, *see* Table 3. *b*: regression coefficient. SE: standard error. Ref.: reference category. R: respondent.
Source: Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2011–2012 data.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6. Logistic regression of activity of daily living (ADL) disability and chronic disease status on health lifestyle latent classes and other control variables: Chinese older adults aged 65–105

	ADL disability				Chronic disease status			
	Model 1		Model 2		Model 3		Model 4	
Variables	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Health lifestyle latent class (Ref. Class 3[1])								
Class 1	2.14***	1.74–2.63	2.11***	1.70–2.62	1.70***	1.43–2.00	1.70***	1.43–2.03
Class 2	2.44***	2.02–2.93	2.39***	1.98–2.90	1.11	0.96–1.28	1.13	0.97–1.32
Class 4	1.75***	1.41–2.15	1.75***	1.41–2.18	1.23**	1.05–1.44	1.26**	1.07–1.49
Control variables:								
Age	1.10***	1.08–1.10	1.10***	1.09–1.10	0.98***	0.98–0.99	0.98***	0.98–0.99
Sex (Ref. Female)	0.84*	0.72–0.97	0.83*	0.71–0.96	0.83**	0.73–0.94	0.83**	0.73–0.94
Residence (Ref. Rural)	1.43***	1.25–1.62	1.45***	1.27–1.65	1.46***	1.31–1.63	1.40***	1.25–1.56
R's years of schooling	0.99	0.97–1.01	0.99	0.97–1.02	0.99	0.98–1.02	0.99	0.97–1.02
R's natural logged per capita family income	1.03	0.97–1.09	1.03	0.98–1.09	1.13***	1.08–1.18	1.14***	1.08–1.98
R's occupation before age 60 (Ref. Non-professional or non-administrative)	1.32*	1.01–1.74	1.36*	1.02–1.80	1.59***	1.26–2.00	1.52***	1.18–1.93
If R often went to bed hungry in childhood			1.05	0.90–1.23			0.88*	0.77–0.99
R's father's years of schooling			0.99	0.96–1.03			1.02	0.99–1.05
R's father's occupation before age 60 (Ref. Non-professional or non-administrative)			0.90	0.58–1.39			1.02	0.70–1.47
Constant	0.01***	0.00–0.00	0.01***	0.00–0.00	2.17**	1.21–3.91	2.26**	1.20–4.25
N	6,434		5,906		6,434		5,906	

Notes: 1. For latent class details, *see* Table 3. OR: odds ratio. CI: confidence interval. Ref.: reference category. R: respondent.
Source: Chinese Longitudinal Healthy Longevity Survey (CLHLS) 2011–2012 data.
Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

score turned out to be non-significant. As to the association between health lifestyles and cognitive function scores, Model 4 showed that compared to older adults in class 3, cognitive function scores for individuals in classes 1, 2 and 4 dropped by 1.69, 2.02 and 1.16, respectively. These results again suggested that less healthy lifestyles led to worse cognitive function among older adults. Moreover, being male, and having higher education and income showed significantly positive effects on the cognitive function scores of seniors. Going to bed hungry in childhood had a significantly negative effect on elders' cognitive function scores, supporting that childhood disadvantage was still able to explain part of the health disparities in older ages. In this sense, cumulative disadvantage theories predicting health outcomes were supported by the empirical findings.

In a similar vein, two models were constructed when predicting ADL disability and chronic disease status, with Models 2 and 4 adding parental SES controls. As Table 6 shows, adding parental SES covariates did not significantly change the regression results presented in Models 1 and 3. The results indicated that all the other three lifestyle classes were positively related to ADL disability and chronic disease status compared to the consistently positive class (class 3), meaning that less-healthy lifestyles led to higher odds of being functionally dependent and reporting chronic diseases. Non-significant relationships were found between class 2 (sedentary group) and chronic diseases. The odds of having ADL disability among elders in classes 1, 2 and 4 were 2.1, 2.4 and 1.8 times the odds for elders in class 3, respectively (*see* Model 2). As compared to individuals in class 3, elders in class 1 and class 4 were 1.7 and 1.3 times, respectively, more likely to have chronic diseases, controlling for other factors. These results again suggested that the health disparities among Chinese older adults can be explained by their health lifestyles.

Demographic and socio-economic characteristics were also important explanations for part of the health disparities. Being female, being urban, and having professional or administrative jobs before age 60 increased the risks of elders experiencing ADL disability and chronic diseases. An increasing age promoted the risk of having ADL disabilities but lowered the odds of reporting chronic diseases. Higher family income increased the likelihood of elders reporting chronic diseases. Among parental SES covariates, only the variable 'often going to bed hungry' showed a significantly negative effect on chronic diseases. The Discussion section explains why demographic and socio-economic characteristics showed such links with the two health outcome measures, namely ADL disability and chronic diseases. Overall, empirical results offered an answer to research question 3. That is, significant relationships between health lifestyles and ADL disabilities and chronic diseases remained; and the relationships were in the expected directions, after controlling for covariates.

Discussion

In the past half century, revolutionary changes along with economic and market reforms in China have powerfully shaped people's dietary patterns and lifestyles. The food landscape in China has altered dramatically, with substantial growth in production and affordability of a broad range of food categories. Changes in China's food industry have spurred a nutritional transition and concomitant shifts in patterns of food consumption (Batis *et al.*, 2014; Zhen *et al.*, 2018). People's

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health lifestyles, including dietary patterns, have transformed accordingly. Thus far, however, few studies have examined health lifestyles of Chinese older adults and the manner in which health lifestyles predict Chinese elders' health outcomes remains largely unknown. Under such a proceeding, it is interesting to know whether there are predominant empirical patterns representing health lifestyles among Chinese older adults. Through analysing a sample aged 65–105 from data of the CLHLS 2011–2012 wave, this research found that there are four latent classes representing four predominant health lifestyles among studied older adults. The four classes included one class specified as 'consistent engagement in healthy behaviour' (22.4% of total sample), one class with smoking and drinking problems (22.1%), one class with poor sleep issues (20.2%) and one class classified as the sedentary group (34.6%). The distribution of the sample across the latent classes indicates that the sedentary group, slightly over one-third of the studied sample, represents the most popular health lifestyle of Chinese older adults. Only one-fifth of the respondents demonstrated healthy lifestyles. The rest of them had either sleeping or drinking/smoking problems. The overall profile of health lifestyles of Chinese older adults was not very promising.

Secondly, the study investigated whether demographic and socio-economic characteristics were linked to Chinese older adults' health lifestyles. The research found compelling empirical evidence of demographic and socio-economic characteristics determining individual health lifestyle classification. Increasing age was a factor pushing people to be in less-healthy lifestyle classes; being male and being urban, on the other hand, were pull factors to pull older adults to be in the 'consistent engagement of healthy lifestyle' class. Socio-economically disadvantaged groups were more likely to fall into less-healthy classes. Meanwhile, parents' disadvantaged backgrounds could also be more or less reflected in an individual's health lifestyles – even in later life. Such a result supported the cumulative disadvantage theory in health.

Prior research indicated that in developed countries such as the United States of America, higher SES led to healthier lifestyles, indicated by a healthier diet, more frequent exercise, and lower prevalence of excessive smoking and drinking. In developing countries, however, rapid economic development often made the groups with higher SES have unhealthy lifestyles, such as consuming high-fat foods, engaging in sedentary forms of leisure activities, and more frequent drinking and smoking. This is because with their rising purchasing power, the socio-economically advantaged groups adopted unhealthy behaviours and considered their choices to be privileges (Chen *et al.*, 2010; Streeter, 2017). The findings of this research generally echo results from more-developed countries. That is, socio-economically more-advanced groups tended to have healthier lifestyles. It could be the case that higher-SES older adults in China are more conscious about their health, which has fostered healthier lifestyles. The inconsistency between the findings of this research and prior analyses drawn from developing countries (including China) may lie in two reasons. The first reason is that most of the previous studies focused on adults or adolescents, whereas this research studied elders aged 65 and over who may have dissimilar health lifestyle patterns compared to younger individuals. The second reason relates to the analytic strategy applied. Using latent class analysis, health lifestyles in this research were not characterised by a single health

behaviour, but rather, by multiple health behaviour domains. This approach allowed researchers to consider a single factor's contextualisation within a landscape of diverse and comprised closely related behaviours as an individual's health lifestyles. If the inconsistent findings between this research and prior analyses based on the Chinese social context are indeed caused by analytic strategies, then latent class analysis is again proved to be a superior method than treating health lifestyles as single health behaviours.

The third research question asked if health lifestyles could predict Chinese older adults' health outcomes. Findings generally supported the idea that healthier lifestyles resulted in better health outcomes. The health disparities by lifestyle were unsurprisingly consistent across four health outcome measures, *i.e.* self-rated health, cognitive function, functional dependence and chronic diseases. The findings showed that consistent engagement in healthy behaviours resulted in better self-rated health, higher cognitive function scores and a lower likelihood of being functionally dependent and suffering chronic conditions. Such findings highlighted that practising healthier lifestyles can be an effective way to improve older adults' health outcomes. Meanwhile, these findings also suggested that the approach of contextualising health behaviours within a cohesive lifestyle is an appropriate method for understanding health disparities. Recent research has emphasised that multiple health behaviour change interventions outperformed single-behaviour interventions in health promotion (Prochaska *et al.*, 2008; Wilson *et al.*, 2015). This study apparently provided strong proof for using an integrative approach assessing patterns of health behaviours rather than individual health behaviours to achieve a more effective health promotion.

This analysis also controlled for the respondent's demographic as well as individual and parental SES. The results visibly depicted the way in which these covariates predicted Chinese older adults' health outcomes. Age generally showed significantly negative effects on health, except for chronic conditions. This exception can perhaps be explained by the survival selection theory that individuals with severe chronic illnesses had already died or been censored. Thus, older ages showed a negative effect on chronic conditions among surviving individuals. Males tended to be better off than females when it comes to all four health outcome measures. Urban residents showed significantly lower self-rated health scores and higher odds of suffering ADL disability and chronic conditions. This finding seemed to be incongruous to our common understanding of urban privileges. As prior literature has repeatedly documented, the rural–urban divide has been one of the most salient features in China. The living standards, access to health care and lifestyles between urban and rural areas differ dramatically. As a whole, urban residents enjoy higher salaries, guaranteed employment and more benefits from health-care systems. Thus, it was expected that there would be substantial rural–urban differentials in health lifestyles, SES, as well as health outcomes; and health outcomes of urban residents were expected to be better than those of their rural counterparts. Nonetheless, the empirical results of this analysis showed that although urban seniors were more likely to be in a latent class that consistently engaged in healthier behaviours, they reported worse health outcomes. What can possibly explain this reversed finding? The answer perhaps lies in Chinese society's unique social, economic and political contexts. Urban seniors enjoy better health-

care systems and higher living standards; they may have a higher expectation of health conditions. As self-rated health is a quite subjective measure of health, it is not surprising to see lower self-rated health scores among urban than rural seniors. Similarly, due to better access to health-care services, more urban than rural elders could be diagnosed with chronic illnesses with everything else being equal. Underreporting of chronical illnesses among rural elders may partially explain why a relatively higher prevalence of chronic conditions occurred in urban elders. Additionally, farming and labouring work could have beneficial effects on postponing the onset of ADL disability among rural seniors.

Taken together, results drawn from this research showed that specific health risks co-occurred in predominant health lifestyles. Targeting a specific behaviour without understanding health lifestyles may lead to less-effective policy interventions. Secondly, the results from analysing the Chinese sample showed that both individual and parental SES were important predictors of class membership. Those with lower SES tended to be in less healthy lifestyle classes. Some of the parental SES measures were also found to have significant effects on older adults' health outcomes. These results supported the cumulative disadvantage theory. Meanwhile, people with higher SES could also be those who are more conscious about their health, which fosters their healthier lifestyles. The strong association between SES and Chinese elders' health lifestyles suggest that interventions which help seniors to shape healthier lifestyles should first focus on disadvantaged families with lower SES. This approach will eventually have a positive influence on individual health outcomes.

The study also has limitations. Although the multiple regression results showed strong effects of health lifestyles on Chinese older adults' health status, the issue of causality cannot be easily sorted out. For example, it could be the case that healthier individuals are more likely to have healthier lifestyles, which in turn advances one's health. Thus, the relationship between health lifestyles and health outcomes is complex; future research needs to disentangle the interconnectedness of health lifestyles and health outcomes. In addition, the CLHLS questionnaire was not able to exhaust all possible health lifestyle measures. Some important health lifestyle indicators, such as vaccination injections, wearing a seat belt, dental visits, *etc*. have not been included in this research. Measures of one's health status were also relatively crude. Some leisure activity measures, such as playing cards and/or mah-jong, reading and watching television, were sedentary behaviours, which prevents them representing an individual's physical activity level well. Expanded research on other domains of health outcomes and health lifestyles is warranted to yield a more comprehensive understanding of Chinese older adults' health lifestyles and their association with individual health outcomes.

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