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Income, aging, and the gendered patterns of wellness: Physical health and subjective well-being in China

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ABSTRACT

This article investigates the impact of demographic and socioeconomic inequalities on wellness, composed of both physical health and subjective well-being. We examine how gender inequality moderates the joint effects of aging and income on wellness in China. Utilizing generalized linear mixed model (GLMM), we analyze data from the Chinese General Social Survey (CGSS) spanning from 2003 to 2021. Our results reveal that income inequality disproportionately affects physical health among older, underweight, lower-class females; males are more susceptible to negative impacts on subjective well-being, particularly among lower-class, middle-aged males. These gendered patterns are situated in the contemporary Chinese society and are explained in relation to intra-household distributional inequality and the gender role expectations in the Confucian culture. We also discussed the policy implications of how to reduce the gaps in wellness across social classes, age cohorts, and genders.

1. Introduction

Wellness, encompassing both physical health and subjective well-being, is crucial for individual and societal outcomes (Bakkeli, 2016; Eckersley, 2015; Ross & Bird, 1994; Wang et al., 2015). It not only affects social outcomes such as productivity and social harmony (Chen & Meltzer, 2008; Diener & Chan, 2011) but is also influenced by social factors, including but not limited to economic development, cultural and religious backgrounds, and social inequalities (Zhang et al., 2020). Consequently, social scientists have thoroughly explored factors influencing physical health and subjective well-being (hereafter SWB). Among the identified factors, age, gender, and social status are frequently identified as significant determinants of wellness (Asadullah et al., 2018; Blau & Kahn, 2017; Steptoe et al., 2015; Weitz & Estes, 2001). However, there is a gap in understanding how these factors interact, particularly in the context of East Asia, which has garnered less attention. This intersection and its implications for wellness in East Asian societies present a key area for further exploration.

In this study, we aim to answer key questions about wellness in China: How do socioeconomic status and aging impact wellness, and how do these effects differ between Chinese men and women? Using data from the Chinese General Social Survey (CGSS) spanning 2003–2021, we utilized generalized linear mixed models (GLMM) to investigate these questions. Our findings reveal a complex three-way interaction between aging, income levels, and gender in influencing both physical and subjective wellness. Specifically, we identified the most vulnerable groups in terms of

wellness: elderly, lower-class women for physical wellness, and middle-aged, lower-class men for SWB. We interpret these results within the context of modern China, suggesting that cultural gender-role expectations may account for these variations.

Based on our findings, we argue that their implications are relevant not only in China but also in societies with patriarchal traditions. In such societies, male dominance may confer material and physical advantages for men and disadvantages for women; however, the high societal expectations placed on males can be stressful for those males who are less successful unlike for successful males and women in general. In other words, promoting gender equality would benefit all genders. This study also enhances our understanding of social inequalities and intersectionality, showing that marginalized groups often confront multiple challenges simultaneously. Recognizing and addressing these challenges to improve wellness for marginalized groups is essential. We suggest several policy recommendations to support the vulnerable groups identified in our study, particularly the elderly, lower-class individuals, and, notably, senior women in rural China.

2. How age and socioeconomic status Affect wellness

2.1. Aging and wellness

The World Health Organization (WHO) defines health as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO, 2023). The overall health condition is alternatively called "wellness," which encompasses both physical health and SWB. Wellness is a multifaceted concept: the WHO further identified six main domains or indicators of wellness, including one's capabilities in terms of (1) mobility, (2) self-care; (3) usual activities; (4) pain and discomfort; (5) affect (anxiety/depression); and (6) cognition. Wellness can be influenced by a variety of factors, including age, genetic inheritance, biological decay, nutrition, environmental changes, and mental state. It is also influenced by individuals' work conditions, stress levels, living areas, and access to medical resources. Among these predictors, age, or the process of aging, is consistently identified as a crucial factor that impacts wellness. Aging refers to the process of getting older; it is one of the most fundamental processes affecting wellness, especially physical health. The aging process is usually negatively associated with physical health conditions. Though the changes are not linear and consistent, the elderly, on average, have poorer physical health than the middle-aged or the young (Marmot et al., 1997; Mora & Gil, 2013). Therefore, we believe that, as people age, they become progressively less healthy.

> **H1A:** (Aging effect) Physical health is lower among the elderly than other age groups.

Although the relationship between aging and physical health is widely accepted, the discussions on aging and SWB remain less conclusive. Social scientists have identified a U-shaped curve of happiness, in which middle-aged individuals are the least happy (Blanchflower, 2021; Karwetzky et al., 2022). Happiness falls and reaches a low point in middle age, subsequently increasing and reaching a high point again in old age. While the exact age at when the lowest level of happiness occurs varies across societies and cultures, evidence suggests that it typically takes place in the 40s or early 50s (Blanchflower, 2021). The drop in happiness at middle age can be attributed to several factors, including increased responsibilities for children and parents, work-related stress, fiscal burdens, and stressful social comparisons. Despite facing some challenges in recent years, the U-shaped curve is widely supported by both cross-sectional data (Blanchflower, 2021; Steptoe et al., 2015) and panel data (Baird et al., 2010; Cheng et al., 2017). It has also been supported by cross-cultural evidence (Blanchflower, 2021), as well as evidence from China. Hence, we propose the following hypotheses:

> **H2A:** (Aging effect) Subjective well-being is lower for middle-aged individuals than others.

2.2. Socioeconomic status and wellness

Not only does the aging process affect wellness, but social factors can also impact the level of wellness as well. Most prominently, the individual socioeconomic status (SES)—including social class, occupation, income, educational attainment—is highly correlated with one's physical health conditions and life satisfaction and SWB (Lantz et al., 2001; Marmot et al., 1997). The relationship between social stratification and physical health inequality is known to intensify over the life course, resulting in what is referred to as the "cumulative disadvantage of health disparity." As individuals age, their physical health gradually declines, while the gap in wellness between the rich and the poor tends to widen. While poorer elderly individuals are more likely to experience health deterioration, wealthier individuals can mitigate this process through their access to better lifestyles, treatments, medicines, and professional services. As a result, we can anticipate that aging and income effects will work in tandem, leading to an increase in physical health disparities across income groups as people age.

> **H1B:** (Age-income effect) The health disparity will widen among different income strata with increasing age.

Socioeconomic status would affect SWB in profound ways. Lower-class individuals often endure psychological distress and social isolation, whereas those in higher SES brackets typically enjoy empowerment, career successes, and financial stability. Wealth provides not just material comforts but also psychological resilience and social opportunities, enhancing overall happiness. This includes access to leisure, self-care, and social activities. Since one's SWB is associated with his/her economic conditions, we will expect that the SWB in one's life course would show a more pronounced U-shape curve among lower-class and poorer individual than among the middle- and upper-class groups. However, we expect the high SES advantage in happiness to diminish later in life course. In sum, we hypothesize that SES, particularly income, will be linked to aging and its impact on SWB.

> **H2B:** (Age-income effect) The aging effect on subjective well-being is more salient among the poor than the rich.

3. Gendered patterns of wellness in the Chinese context

Gender significantly predicts wellness (Li et al., 2021; Zhang et al., 2020), influencing both physical health (e.g., longevity, illness risks, BMI) and SWB (Doll et al., 2000; Mora & Gil, 2013; Zhou, 2019). The social-causation theory explains these gender differences. Women, often disadvantaged in social stratification (Carrard et al., 2021), with lower education and unpaid household labor (Campero, 2021), face limited access to health resources (Ross & Bird, 1994). Despite advances in the West, women remain disadvantaged, affecting their physical health. The gender paradox in developed countries shows women reporting worse self-rated health than men but living longer (Chu, 2023). This paradox relates to gender stratification, meaning that women's lower socioeconomic status results in diminished health returns from education and income. The interplay of gender, age, and income on wellness is complex and culturally dependent (Jiao et al., 2021). In cultures where male advantages are higher, we expect the gender gap in wellness to be more salient. In China, traditional patriarchy and Confucian culture have historically emphasized male dominance. However, rapid economic growth and globalization have altered the status of professional, middle-class women, contrasting with older, rural, unemployed women's experiences. In the following sections, we will discuss further of how gender complicates the patterns of physical health and SWB, respectively.

3.1. Physical health: Unequal distribution of family resources

Gender disparities in physical health arise from micro-level factors like individual differences and family environment, and macro-level factors such as social and cultural influences (Kilpela et al., 2021). Women often live longer than men (Kroll, 2011) yet experience the "health-survival paradox," in which their health quality is not necessarily superior. Both biological and sociocultural factors influence gender differences in malnutrition and dietary behaviors, with women more affected by sociocultural factors in their food intake, impacting BMI (McLaren & Kuh, 2004; Olchowska-Kotala, 2018).

In societies with scarce resources and male-dominant cultures, gender affects access to nutrition and medical care. Males often receive priority in family micro-finances for essential resources (Eckersley, 2015). Household resource allocation, especially where males are the primary earners, is influenced by economic considerations (Becker & Tomes, 1986). In Chinese culture, resource distribution within families is gender-biased, often favoring men over women who still adhere to traditional norms (Bakkeli, 2016). This leads to a "male priority" in family resource allocation, contributing to the gender gap in physical health (Chen & Meltzer, 2008). Specifically, we speculate that such gender-discriminative patterns will be more prominent in poor groups, where traditional gender norms are more influential. Hence, our next hypothesis:

> **H1C:** (Male premium effect) The age-income interaction effect on the group of underweight females is stronger than on males.

3.2. Subjective wellbeing: Gender differences in social expectations

When it comes to SWB, China's cultural context may no longer be so friendly for males. China's Confucius tradition has long placed males under high social expectations and social pressures. In China, the famous "men in the world, women in the house" (*Nan zhu wai, nv zhu nei* 男主外, 女主内) ideal is prevailing (Ji & Wu, 2018). This image of males as primary breadwinners has been and is still the predominant family norm in China. Such a family model leads to gendered labor distribution (Li et al., 2021) in family and society, with men engaged in market activities and women in domestic labor (Choi et al., 2020).

Mao's socialist revolution and Deng's reforms lessened gender inequality in China, yet disparities persist. Despite men often having better education, employment opportunities, and income, high social expectations can still hurt their SWB (Cooper et al., 2013). Furthermore, working women could alleviate work pressure from family life (Gonalons-Pons & Gangl, 2021) but this does not apply to men (Kroll, 2011). Especially for dual-earner families, successful wives that outperform their husbands could alter household dynamics and the males will suffer from more stress (Blau & Kahn, 2017). As the society moves towards gender equality, the increase in wives' relative income boosts their independence and power, potentially leading to husbands' dissatisfaction due to reduced economic dominance (Asadullah et al., 2018). These shifts in traditional male dominance place additional pressure on husbands, potentially impacting their SWB. Consequently, we propose the following hypothesis:

> **H2C:** (Male stress effect) The age-income interaction effect on subjective well-being is stronger for males than females.

4. Data and method

4.1. Data: Chinese general social survey (2003–2021)

In the present study, we analyze the Chinese General Social Survey (CGSS) 2003–2021 data to investigate factors influencing physical health and SWB. Launched by Renmin University of

China (RUC) and the Hong Kong University of Science and Technology (HKUST), the CGSS is one of the earliest nation-wide social surveys in mainland China. Comparable to the United States' General Social Survey (GSS), the CGSS has been collecting data annually since 2003 and is still ongoing. So far, the CGSS project has collected 12 waves of surveys data[1] in 31 provinces.[2] The CGSS project utilizes a stratified multi-stage PPS sampling design to secure a representative national probability sample. Crucially, CGSS data consistently collect information on physical wellness and SWB, aligning well with our research objectives.

4.2. Dependent variables: BMI and SWB

Many measures could be used to indicate physical wellness, such as self-reported health conditions or the existence of health problems. In this study, we employ body mass index (BMI) as a measure of physical health due to its widespread use and data availability. BMI, accounting for body weight and height, can indicate health risks; high BMI is linked to cardiovascular disease, hypertension, diabetes, and certain cancers, while low BMI may suggest malnourishment or insufficient body fat, leading to weakened immunity and osteoporosis (Doll et al., 2000; Zhou, 2019). Since BMI's distributions vary across the world, in accordance with the societal factors, such as economic development, public health investment, health education, and food culture, we need to set a country-specific standard for the Chinese society. Following BMI norms for the Chinese population, individuals are categorized as underweight (BMI < 18.5), overweight (BMI > 24) and the rest as normal (Jih et al., 2014). In our analyses, we use two dummy variables, in which we compare the normal group and the other two groups. In the normal vs. overweight analysis, we set normal as the reference group (= 0) and overweight as 1; in the normal vs. underweight analysis, the normal is still the reference group (=0) and the underweight individuals are coded as 1. These dummy variables will be predicted with logistic mixed models.

For SWB, we adopted self-reported levels of life satisfaction, which is a widely used indicator of happiness in previous research (Asadullah et al., 2018; Diener & Chan, 2011; Zhang et al., 2020). Participants rated their life satisfaction on a scale ranging from 1 (*very dissatisfied*) to 5 (*very satisfied*). This scale captures the individual's overall evaluation of their own life. When using this scale, researchers have the option to treat it either as an ordinal measure or a continuous measure. We compared them in modeling, and they do not show substantial differences in the main findings. In this article, we chose to use the latter approach and treat the self-reported happiness scale as a continuous variable for linear mixed modeling, which will be discussed later. We standardized the 1–5 scale so the mean of SWB will be 0 and the standard deviation equals 1. This facilitates interpretation of model estimates.

4.3. Independent variables

Our study focused on gender, age, and income as primary predictors. Gender was a binary variable with females as the reference group (= 0) and males as 1, comprising 52.29% females and 47.71% males. Age, a continuous variable, ranged from a minimum of 18 years, with an average age of 48.58 years (SD = 16.36). Personal annual income, measured in Yuan (RMB), varied mostly between 10,000 to 200,000 RMB. To mitigate outlier effects, incomes above six million Yuan were truncated. We examined various income-handling methods, including logged terms, quintiles, deciles, and percentiles. We use province-specific percentiles in our models to account for regional and temporal income variations in China. Choosing to use province-specific percentiles instead of percentiles based on the whole national sample is because China is a large country with huge gaps across different regions in wealth and income levels. The same income may mean quite different living standards and social statuses in metropolitans and rural areas. Using localized percentiles helps to avoid biases caused by this disparity.

We accounted for various covariates influencing physical health and SWB in China, including ethnicity, marital status, educational attainment, location of residence, and CCP membership. Ethnicity was binary, distinguishing the Han ethnic group (the reference group = 0) from ethnic minorities (= 1). Marital status differentiated unmarried (= 0) from married (= 1). Educational attainment was ordinal, categorized into "elementary school or less," "middle school," "high school," and "university or more," with the lowest category group coded as the reference. Residence location was a dummy variable, with rural as the reference and urban as 1. CCP membership was coded with non-members as the reference and members as 1. These covariates aimed to ensure our analysis accurately isolated associations between key predictors and health outcomes, avoiding confounding factors. The descriptive statistics of the abovementioned variables can be found in Table 1.

4.4. Model specifications

To examine the impacts of gender, aging, and socioeconomic status across China's regions, we used generalized linear mixed models (GLMM), a method suitable for addressing data clustering and analyzing nested data structures (Raudenbush & Bryk, 2002). Our study categorized respondents (Level 1) within provinces (Level 2), with 31 provincial units each containing about 200 to

Table 1. Descriptive statistics.

Variables	Summary
Year of survey	
2003	5,894 (5.02%)
2005	10,372 (8.83%)
2006	10,151 (8.64%)
2008	6,000 (5.11%)
2010	11,783 (10.03%)
2011	5,620 (4.78%)
2012	11,765 (10.01%)
2013	11,438 (9.74%)
2015	10,934 (9.31%)
2017	12,582 (10.71%)
2018	12,787 (10.88%)
2021	8,148 (6.94%)
Gender	
Female	61,425 (52.29%)
Male	56,049 (47.71%)
Age	48.58 (16.36)
Marital Status	
Not Married	24,160 (20.57%)
Married or Cohabiting	93,314 (79.43%)
Educational Attainment	
Elementary School or Less	37,576 (31.99%)
Middle School	30,907 (26.31%)
High School	24,521 (20.87%)
University of More	24,470 (20.83%)
Personal Income (in CNY)	24,901.3 (60.986.61)
Location of Residence	
Rural	49,040 (41.75%)
Urban	68,434 (58.25%)
Political Status	
Not a CCP member	93,314 (79.43%)
CCP member	24,160 (20.57%)
Raw BMI	22.65 (3.50)
Underweight Group (DV1a)	0 (1)
Overweight Group (DV1b)	0 (1)
Raw SWB	3.72 (0.87)
Standardized SWB (DV2)	0 (1)
Num. of Obs.	117,474

Note: frequencies and percentages for categorical variables; mean and *SD* for continuous ones.

Table 2. Multilevel models predicting underweight group from BMI

	Model 1a	Model 2a	Model 3a
(Intercept)	−1.002***	−1.493***	−1.414***
	(0.078)	(0.094)	(0.105)
Individual-level predictors			
Male (Female = 0)	−0.398***	−0.397***	−0.571***
	(0.027)	(0.027)	(0.143)
Age, in years	0.036***	0.131***	0.106***
	(0.008)	(0.013)	(0.016)
Ethnic minority (Han = 0)	−0.096*	−0.082	−0.055
	(0.042)	(0.042)	(0.042)
Married (unmarried = 0)	−0.398***	−0.397***	−0.571***
	(0.027)	(0.027)	(0.143)
Educational attainment			
(Elementary school or Less = 0)			
Middle school	−0.674***	−0.660***	−0.694***
	(0.028)	(0.028)	(0.028)
High school	−0.287***	−0.249***	−0.259***
	(0.037)	(0.037)	(0.037)
University or More	−0.130**	−0.085	−0.093*
	(0.044)	(0.044)	(0.044)
Income (percentile, 1st–100th)	0.223***	0.225***	0.181***
	(0.044)	(0.044)	(0.044)
CCP (nonmember = 0)	−0.150**	−0.111*	−0.150**
	(0.049)	(0.049)	(0.049)
Urban	−0.180***	−0.153***	−0.140***
	(0.030)	(0.030)	(0.031)
Interaction terms			
Age × income percentile		−0.024***	−0.037***
		(0.003)	(0.003)
Age × male			0.072**
			(0.025)
Income percentile × male			−0.178***
			(0.027)
Income percentile × age × male			0.028***
			(0.005)
AIC	44,123.882	44,035.070	43,803.322
BIC	44,232.538	44,152.781	43,948.197
Log likelihood	−22,049.941	−22,004.535	−21,885.661
Num. obs.	63,239	63,239	63,239
Num. groups: PROV	31	31	31
Var: PROV (Intercept)	0.079	0.078	0.075

Note: Higher values = more deviant from average = less healthy. Sample from CGSS 2008–2021. Please note that CGSS earlier waves (2003–2006) include neither body weight or height, nor BMI itself, which leads to a smaller sample size in Study 1 than Study 2.

300 observations, aligning with the "30/30" principle in multilevel modeling (Maas & Hox, 2005). We conducted two sets of GLMMs for the physical health study: one comparing the normal and underweight groups, and another for the normal and overweight groups, using logistic mixed models due to the binary nature of these groupings. For the SWB study, we employed linear mixed models, as SWB is a continuous variable. All models controlled for ethnicity, marital status, education, and CCP membership at the individual level.

We started with a baseline model which contain the main effects of the abovementioned variables. This baseline models apply for both Study 1 and Study 2, assessing the aging effect and the income effect (Hypotheses H1A and H2A). We then add the age and income interaction terms to both studies to examine Hypothesis H1B and H2B. Finally, we included the three-way interaction terms of age, income, and gender, for Hypotheses H1C and H2C. Our modeling sequence is as follows:

M1a/M1b/M4: the baseline models (with the main effects of all predictors).

*M2a/M2b/M5: the baseline models, plus the age * income interactions.*

*M3a/M3b/M6: the previous models, plus the age * income * gender three-way interactions.*

5. Results

5.1. Study 1 on physical health

Modeling results of Study 1 are reported in Tables 2 and 3, addressing the risks of physical health problems—both underweight and overweight. We first investigate the risks of underweight with models in Table 2. Model 1a in Table 2 outlines the main effect coefficients for predictors and controls. The intercept indicates the baseline outcome level with all predictors at zero. Negative coefficients imply that the reference group (female, non-minority, unmarried, non-CCP member, rural, lowest income percentile) has lower log odds of being underweight. Females are significantly more likely to be underweight compared to males ($b = -0.398$, $p < 0.001$). Age notably influences health, with older individuals deviating more from normal BMI, reflecting poorer health. Model 2a introduces income-age interaction effects, revealing significant divergence in age effects across different income levels. To be more specific, the negative estimate ($b = -0.024$, $p < 0.001$) of age-income interaction tells us that higher income levels could offset the negative

Table 3. Multilevel models predicting overweight group from BMI

	Model 1b	Model 2b	Model 3b
(Intercept)	−1.550***	−1.385***	−1.504***
	(0.075)	(0.088)	(0.100)
Individual-level predictors			
Male (female = 0)	0.147***	0.150***	0.515***
	(0.016)	(0.016)	(0.113)
Age, in years	0.072***	0.040***	0.102***
	(0.005)	(0.010)	(0.013)
Ethnic minority (Han = 0)	0.090**	0.087**	0.072*
	(0.028)	(0.028)	(0.028)
Married (unmarried = 0)	0.327***	0.325***	0.384***
	(0.021)	(0.021)	(0.021)
Educational attainment (elementary School or Less = 0)			
Middle school	−0.014	−0.023	0.005
	(0.022)	(0.022)	(0.022)
High school	−0.153***	−0.162***	−0.140***
	(0.026)	(0.026)	(0.026)
University or more	−0.344***	−0.343***	−0.310***
	(0.028)	(0.028)	(0.029)
Income (percentile, 1st–100th)	0.037***	0.008	−0.119***
	(0.003)	(0.009)	(0.013)
CCP (nonmember = 0)	0.211***	0.202***	0.223***
	(0.025)	(0.025)	(0.026)
Urban	0.238***	0.233***	0.221***
	(0.019)	(0.019)	(0.019)
Interaction terms			
Age × income percentile		0.006***	0.020***
		(0.002)	(0.002)
Age × male			−0.184***
			(0.021)
Income percentile × male			0.160***
			(0.018)
Income percentile × age × male			−0.010**
			(0.003)
AIC	94,598.483	94,587.783	93,612.673
BIC	94,709.121	94,707.641	93,760.190
Log likelihood	−47,287.242	−47,280.891	−46,790.336
Num. obs.	74,596	74,596	74,596
Num. groups: PROV	31	31	31
Var: PROV (Intercept)	0.121	0.121	0.124

Note: Higher values = more deviant from average = less healthy. Sample from CGSS 2008–2021. Please note that CGSS earlier waves (2003–2006) include neither body weight or height, nor BMI itself, which leads to a smaller sample size in Study 1 than Study 2.

impact of aging and reduce the likelihood of underweight. These results align with previous research. They show that elders and poor individuals are vulnerable to the risk of underweight; the detrimental effects of aging and poverty will jointly result in health outcomes.

Model 3a, the last model for Study 1a, finds a three-way interaction between gender, income, and age ($b = 0.028$, $p < .001$). To aid in interpretation, these interactions are visualized in Figure 1. Figure 1 displays that, for males (the plot on the right), the aging process is associated with higher risks of underweight, and this effect is the most salient for those males at the bottom
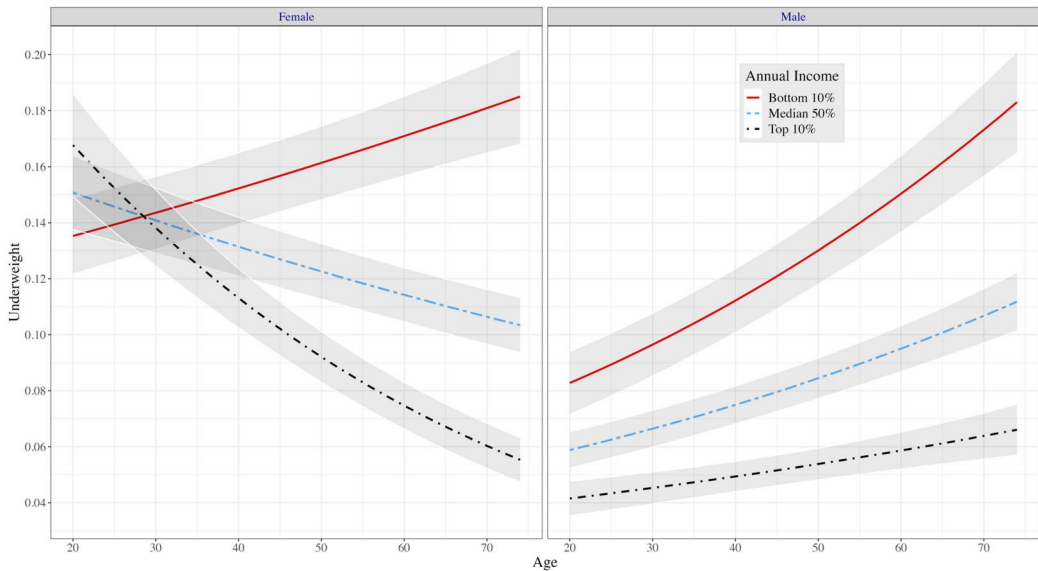
Figure 1. Study 1a: Joint effects of gender, age, and income on underweight group from BMI.
Note: Fitted values are from Table 2, Model 3a. All variables except are set to typical values (i.e., means for quantitative variables and proportions).
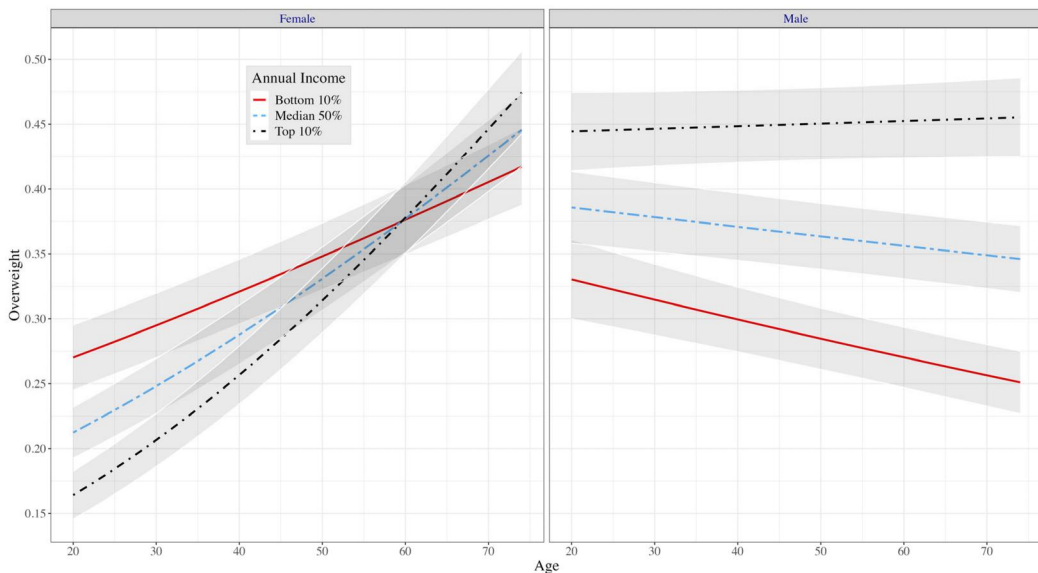
Figure 2. Study 1b: Joint effects of gender, age, and income on overweight group from BMI.
Note: Fitted values are from Table 3, Model 3b. All variables except are set to typical values (i.e., means for quantitative variables and proportions).

Table 4. Multilevel models predicting standardized subjective well-being.

	Model 4	Model 5	Model 6
(Intercept)	−0.426***	−0.431***	−0.399***
	(0.029)	(0.029)	(0.029)
Individual-level predictors			
Male (female = 0)	−0.102***	−0.105***	−0.186***
	(0.006)	(0.006)	(0.012)
Age, in years	17.618***	11.351***	7.038**
	(1.104)	(1.970)	(2.507)
Age, squared term	46.058***	63.734***	53.157***
	(1.095)	(1.897)	(2.427)
Ethnic minority (Han = 0)	0.051***	0.052***	0.053***
	(0.010)	(0.010)	(0.010)
Married (unmarried = 0)	0.250***	0.251***	0.246***
	(0.008)	(0.008)	(0.008)
Educational attainment (elementary school or less = 0)			–
Middle school	0.101***	0.096***	0.099***
	(0.008)	(0.008)	(0.008)
High school	0.086***	0.076***	0.080***
	(0.009)	(0.009)	(0.009)
University or more	0.224***	0.217***	0.219***
	(0.010)	(0.010)	(0.010)
Income (percentile, 1st–100th)	0.004***	0.004***	0.003***
	(0.000)	(0.000)	(0.000)
CCP (nonmember = 0)	0.122***	0.118***	0.116***
	(0.010)	(0.010)	(0.010)
Interaction terms			
Age × income percentile		0.126***	0.217***
		(0.034)	(0.047)
Age squared × Income percentile		−0.374***	−0.160***
		(0.033)	(0.046)
Age × male			13.227***
			(3.828)
Age squared × male			25.785***
			(3.685)
Income percentile × male			0.001***
			(0.000)
Income percentile × male × age			−0.223***
			(0.067)
Income percentile × male × age squared			−0.478***
			(0.066)
AIC	326,278.141	326,130.484	326,031.275
BIC	326,413.576	326,285.268	326,234.429
Log likelihood	−163,125.07	−163,049.242	−162,994.638
Num. obs.	117,474	117,474	117,474
Num. groups: provinces	31	31	31
Var: provinces (intercept)	0.022	0.023	0.022
Var: residual	0.94	0.939	0.938

Note: Higher values = happier. Sample is from the CGSS 2003–2021 data. ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

10% in the income distribution. For females displayed on the left panel, the aging effect varies between rich and poor women. Aging reduces the underweight risks for the top 10% income earners among the women, yet it boosts the risks for the bottom 10% female income earners. In other words, the aging effect works differently for rich and poor women, but its effects on males are similar regardless of which income group one comes from.

Table 3 focuses on the analysis of overweight risks. Model 1b presents the main effect coefficients: we find that in China, males are more likely to suffer from overweight than females ($b = 0.147$, $p < 0.001$), and aging correlates with higher overweight odds ($b = 0.072$, $p < 0.001$). Married individuals, ethnic majority (Han), party members, urban residents, and higher-income earners are also more prone to being overweight. Model 2b introduces the income-age interaction
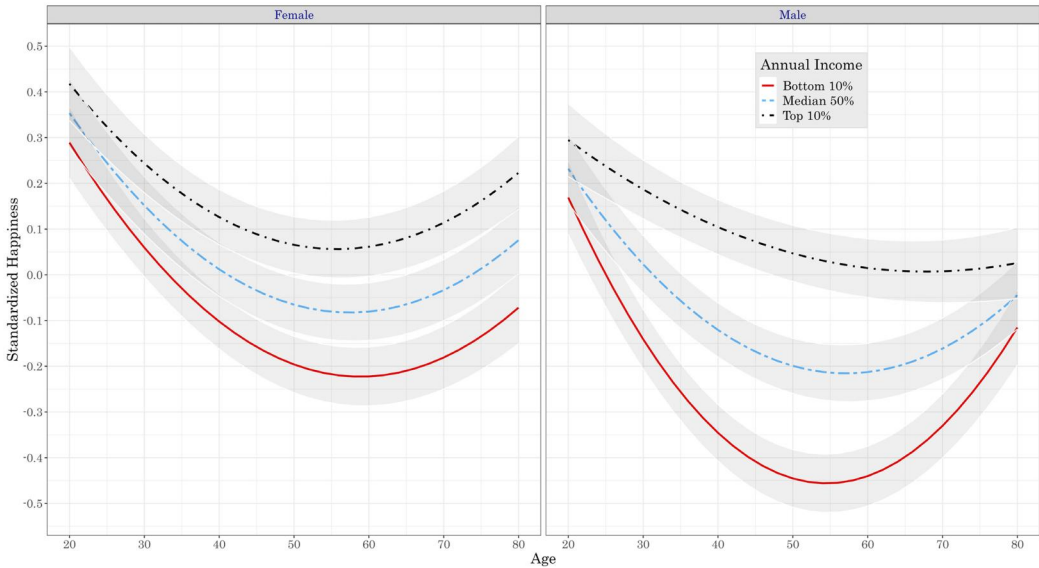
Figure 3. Study 2: The joint effects of gender, age, and income on subjective well-being in China.
Note: Fitted values are from Table 4, Model 6. All variables other than the focal variables are set to typical values (i.e., means for quantitative variables and proportions).

($b = 0.006$, $p < 0.001$), indicating that higher income will enhance the aging effect on escalating overweight risk, supporting our research hypotheses.

Model 3b, the final model, explores the three-way interactions between gender, income, and age ($b = -0.010$, $p < 0.05$). This three-way interaction is visualized in Figure 2, where we can tell that, for women, the low-income status is associated with high risks of overweight, yet the aging process converges the trends of the high-, mid-, and low-income groups. In other words, women's overweight risks will be similar when they are getting older. Conversely, males in the bottom income bracket show a decreasing overweight probability with age; rich males will have higher obesity problems as they age. This finding among males echoes previous findings that, as the economy grows in developing countries, overweight will increasingly become a problem for the public, and richer individuals will face such risks first (Bakkeli, 2016). Only when the country becomes one of the advanced industrial societies will the top earners to care about healthy lifestyles and outperforms their poorer fellow citizens in the same society (Zhou, 2019).

5.2. Study 2 on subjective wellbeing

Modeling results of Study 2 are reported in Table 4. Model 4 in Table 4 displays the coefficients of all predictors and control variables' main effects. The intercept shows the baseline level is −0.426 deviations from the standardized subjective well-being (SWB). On average, females are slightly happier than males ($b = -0.102$, $p < 0.001$). Age's quadric item is significant; age's effect on subjective well-being is a U-shaped curve where people in their fifties show the lowest life satisfaction. For the other covariates, married persons, minorities, the better-educated, city residents, CCP members, and high-income individuals are happier overall than unmarried individuals, the ethnic majority (Han group), the less-educated, and low-income individuals. Model 5 added the interaction effect between income and age. The interaction terms, both linear and quadric, are significant (linear: 0.126, $p < 0.001$; quadric: −0.374, $p < 0.001$). The results confirm previous findings, and middle-aged persons show the lowest subjective well-being; poorer individuals will suffer more when they reach the bottom of SWB in their middle age.

Table 5. Multilevel models for robustness checks by excluding income outliers

	Model 7 (Model 3a Excluding extreme income)	Model 8 (Model 3b Excluding extreme income)	Model 9 (Model 6 Excluding extreme income)
(Intercept)	−1.408***	−1.502***	−0.394***
	(0.105)	(0.100)	(0.029)
Individual-level predictors			
Male (female = 0)	−0.557***	0.524***	−0.185***
	(0.144)	(0.113)	(0.012)
Age, in years	0.106***	0.102***	6.762**
	(0.016)	(0.013)	(2.505)
Age, squared term			51.945***
			(2.415)
Ethnic minority (Han = 0)	−0.058	0.069*	0.053***
	(0.042)	(0.028)	(0.010)
Married (unmarried = 0)	−0.695***	0.382***	0.242***
	(0.028)	(0.022)	(0.008)
Educational attainment (elementary school or less = 0)			
Middle school	−0.258***	0.006	0.098***
	(0.037)	(0.022)	(0.008)
High school	−0.089*	−0.140***	0.079***
	(0.044)	(0.026)	(0.009)
University or more	0.181***	−0.311***	0.218***
	(0.044)	(0.029)	(0.010)
Income (percentile, 1st–100th)	0.104***	−0.119***	0.003***
	(0.016)	(0.013)	(0.000)
Urban	−0.142***	0.221***	−0.035***
	(0.031)	(0.019)	(0.007)
CCP (nonmember = 0)	−0.140**	0.228***	0.118***
	(0.049)	(0.026)	(0.010)
Interaction terms			
Age * male	0.070**	−0.184***	13.185***
	(0.025)	(0.021)	(3.829)
Age squared × male			26.499***
			(3.690)
Income Percentile × male	−0.183***	0.158***	0.001***
	(0.027)	(0.019)	(0.000)
Age × income percentile	−0.037***	0.020***	0.217***
	(0.003)	(0.003)	(0.047)
Age squared × income percentile			−0.157***
			(0.045)
Income percentile × male × age	0.028***	−0.010**	−0.212**
	(0.005)	(0.003)	(0.067)
Income percentile × male × age squared			−0.474***
			(0.066)
AIC	324,055.993	43,478.935	92,719.381
BIC	324,259.009	43,623.682	92,866.751
Log likelihood	−162,006.996	−21,723.467	−46,343.690
Num. obs.	116,712	62,735	73,913
Num. groups: PROV	31	31	31
Var: PROV (Intercept)	0.022	0.076	0.125

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Model 6, the final model in Study 2, examines the three-way interaction effects between gender, income, and age (linear: −0.223, $p < 0.001$; quadric: −0.478, $p < 0.001$). Both the higher-order term (three-way) and lower-order term are significant. Since interpreting the result directly from the numbers is less intuitive, we visualize the three-way interaction effects in Figure 3. As the

figure shows, there is a life-course effect (aging) and a class effect (income), and those effects vary across males and females. Specifically, middle-aged individuals deviate more from the average subjective well-being than older and younger individuals; richer individuals are happier than poorer ones. This age-income link is more salient for males than females. Lower-income middle-aged men face the lowest SWB, while males from higher social statuses and female fellow citizens do not suffer from the same situation. In other words, the midlife crisis hits poor men harder than poor women. All the abovementioned results are robust after excluding outliers in income; the sensitivity test results can be found in Table 5, which lists all three robustness tests for Model 3a, Model 3b, and Model 6, respectively.

6. Discussions and conclusion

In our study, we aim to reveal how gender, aging, and social statuses contribute to wellness in the context of China. We utilized generalized linear mixed models (GLMM) in CGSS data from 2003 to 2021 to investigate how the three focal variables shape physical health and subjective well-being. We hypothesized that the vulnerable groups, including females, elders, and lower-income groups would have lower wellness conditions in both physical health and SWB. Our findings support our hypotheses and lend support to some more detailed patterns in how the mechanisms work in China. We find that the effects of poverty and aging are quite consistent with existing literature and evidence in China and elsewhere: poverty hurts wellness; being older is associated with lower physical wellness, measured by the risks of either underweight or overweight; falling in the middle-aged groups is associated with low levels of SWB.

Our most noteworthy finding is that gender interacts with the above aging and social status effects. On one hand, for women, the main challenge is in their physical wellness: women in the bottom 10% income-level group constantly show higher risks in both underweight and overweight problems. Specifically for the underweight problem, low-income women will suffer more than mid-class and high-class women as they grow old. This implies that, during times of economic scarcity, women may not receive an equitable distribution of family resources, such as access to medical care or adequate nutrition.

On the other hand, for men, their main challenge is in the domain of SWB, especially for lower-class males. Though all males face the U-shaped curve in their life course and will have low SWB in their fifties, the bottom 10% income earners have the more dramatic drop from their early 20s to 50 years old. This is potentially due to societal expectations of men as breadwinners and associated financial pressure. The effects of income on physical health and subjective well-being may vary by gender, particularly in societies where gender discrimination, poverty, or traditional values are prevalent. These gender differences may be more pronounced in areas with significant gender gaps in labor-force participation, income, or gender ratios. Our study contributes to the understanding of regional differences by showing the negative impact of traditional gender ideologies on subjective well-being and physical health.

Our research highlights the need for gender-sensitive policies that specifically improve health outcomes for the vulnerable groups indicated in the present study: elder women from the underweight groups and low-income families. Essential actions include setting up specialized healthcare programs and community health centers, ensuring access to medical services and nutritional support, especially for women in poverty. Such programs would provide direct and accessible resources to women, preventing the possible intra-household transfer that dilute the help. Moreover, such efforts should primarily be paid to the underdeveloped regions and neighborhoods in China. Additionally, the governments and the public should seek to modernize traditional gender roles and shift toward more progressive social norms, which not only helps women but also assist males to alleviate social pressures.

Our findings address the intricate relationship between gender, income, and health in China, underscoring the importance of fostering a more equitable and healthier society. While our study sheds light on the relationship between income and well-being in the Chinese context, we acknowledge that there are several limitations and propose a research agenda which may be of potential. For instance, the use of repeated cross-sectional data restricts our ability to establish causality. Future research could supplement this with longitudinal studies. Additionally, while our study has focused on the Chinese context, it would be beneficial to consider other Asian Confucian contexts to fully understand the results. We believe that addressing these limitations in future research can further enhance our understanding of the complex interplay between gender, aging, class, and wellness.

Notes

1. The 12 waves that have been made publicly available include the CGSS 2003, 2005, 2006, 2008, 2010, 2011, 2012, 2013, 2015, 2017, 2018, and 2021.
2. The CGSS project does not include Taiwan, Macau SAR, and Hong Kong SAR in its sampling frame.

Contribution and credit of authors

The authors share equal authorship and the names are displayed in alphabetical order. The specific responsibilities are as follows: Jinjin Liu (literature review and the first draft write-up), Yue Liu (literature review; data collection, and analysis), Yingzhu Pu (data collection and analysis), and Tony Huiquan Zhang (research idea and design, theorization, final draft write-up).

Disclosure statement

No potential conflict of interest was reported by the authors.

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Data availability statement

The data that support the findings of this study are available at http://cgss.ruc.edu.cn/. All the data used in this study are available to the public and, hence, no ethical or governmental permissions were required for this study.

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