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Patterns of physical and mental co-occurring developmental health among Chinese elderly: A multidimensional growth mixture model analysis

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ABSTRACT

Background: This study focuses on the heterogeneity, interaction, and imbalance in the concurrent development of physical and mental health trajectories among Chinese elderly.
Methods: The data used in this study are from four waves of the China Health and Retirement Longitudinal Study (CHRLS) conducted between 2011 and 2018. A multidimensional growth mixture model (MGMM) was employed to analyze the patterns and characteristics of co-occurring physical and mental health development. Additionally, multinomial logistic regression analysis was conducted to systematically investigate the factors that predict the conjoint trajectories of physical and mental health.
Results: The study findings reveal the presence of four distinct latent classes of conjoint trajectories for physical and mental health. These classes are categorized as follows: 'physical and mental health deteriorating', 'physical disease increasing & low mental vulnerability maintaining', 'low physical & mental vulnerability maintaining', and 'high physical disease increased & mental health moderate-stable'. Furthermore, demographic characteristics, socioeconomic status, family-society relations, health behaviors, and institutional factors were found to significantly predict these latent classes.
Conclusion: The study emphasizes the diversity and complexity of physical and mental co-occurring developmental health issues in the elderly population in China. These findings have significant implications for the development of targeted intervention strategies that take into account the unique health changes experienced by older adults. Additionally, they can serve as evidence for the establishment of a comprehensive long-term care system.

1. Introduction

The advancement of medical technology and improved living conditions have contributed to the increasing life expectancy of people today. Many developed countries have already transitioned into an ageing society, and some developing countries are also experiencing this demographic shift. It is well known that as individuals age, they may face challenges in both physical and mental functioning, which can result in various health issues (Jang, Jung, Chae, & Lee, 2023; Kumlin, Berg, Kvigne, & Hellesø, 2020; Seves et al., 2021). Physical and mental health issues among the elderly have significant implications, not only in terms of increased healthcare costs and long-term care needs, but also in terms of the added burden on providers, both financially and emotionally. These challenges are closely linked to family dynamics and intergenerational conflicts. Hence, it is important to note that health problems in old age not only impact the well-being and quality of life of individuals, but also contribute to social challenges.

Health is a dynamic process of change. Due to variations in individuals' initial health stocks, medical consumption preferences, health concepts and attitudes, and experience of lifecycle events, older adults exhibit diverse patterns and characteristics of health change, along with distinct health needs (Du & Wang, 2013). Focusing on the dynamic development of older people's health and accurately understanding the patterns and characteristics of health changes can facilitate the creation of effective geriatric wellness strategies. The trajectory of health change in older adults has been extensively discussed and researched due to its critical importance. Several empirical studies have examined the developmental health patterns and characteristics of older adults from a life-course perspective. These studies have consistently found that inter-individual health differences among older adults tend to change or

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gradually diminish over time (Chen, Yang, & Liu, 2010; Hong, Hasche, & Bowland, 2009). Additionally, there is heterogeneity in the health development process and pattern characteristics observed among elderly individuals (Link et al., 2017; Rohlfsen & Jacobs Kronenfeld, 2014). There is evidence suggesting that the degree and speed of physical health deterioration in older adults may vary based on individual characteristics such as gender, ethnicity, education level, and income (Han & Shibusawa, 2015; Wei & Wang, 2017). Similarly, studies have shown mixed results regarding changes in mental health among older adults. Some studies indicate a decline in mental health with age (Hong et al., 2009; Lee, 2013). while others suggest an improvement over time (Interian, Ang, Gara, Rodriguez, & Vega, 2011; Kim, Yoo, Lee, & Kim, 2014). Additionally, certain studies have found that changes in mental health among older adults follow a U-shaped pattern rather than a linear progression (Sun et al., 2012). These findings have sparked research interest in diversity of health trajectories in old age.

Several studies have suggested that the health trajectory in old age is not singular, and it is important to consider the heterogeneity of health trajectories (Kuchibhatla, Fillenbaum, Hybels, & Blazer, 2012; Taylor & Lynch, 2011; Wickrama, Mancini, Kwag, & Kwon, 2013). Subsequent studies have focused on examining the diverse patterns of health development trajectories among older adults. They have used cluster analysis methods to identify distinct patterns, also known as latent classes, of health trajectories (de la Torre-Luque et al., 2019; Hu et al., 2019; Lara et al., 2023; Lu, Lou, Zuo, & Chi, 2017; Wei & Wang, 2017, 2017, 2017). The results of these empirical analyses have shown slight variations depending on factors such as age, gender, and nationality of the population being studied. However, most studies have identified 3–6 different latent classes in the health trajectory. The most commonly observed classes include 'increasing health,' 'decreasing health,' 'high health maintaining,' and 'low health maintaining.' For instance, Lu et al. (2017) conducted a study on the self-rated health (SRH) trajectories of 60-year-old Chinese elderly individuals. They identified two latent classes of SRH trajectories: "good but declining SRH" and "maintaining poor SRH". Similarly, other studies have examined the trajectories of functional disability in older adults and identified different latent classes such as "low start and slow growth", "low start and rapid growth", "high start and rapid growth", and "high start and slow growth" (Hu et al., 2019; Wei & Wang, 2017). In some studies conducted in Canadian and UK, the mental health trajectories of older adults were found three latent classes were identified: "stable-low", "fluctuating-moderate" and "sustained-elevated" (de la Torre-Luque et al., 2019; Lara et al., 2023).

Scholars have extensively researched the dynamic evolution of health in aging, leading to improved systematic understanding of the changing patterns of health in the elderly and offering diverse perspectives on health inequalities. However, most existing studies have focused on a single health problem-specific model, which offers a unidimensional measurement and analysis of the evolution of health trajectories in elderly individuals. The health of older individuals undergoes a gradual and complex process, which is influenced by a combination of health behaviors, lifestyles, and productive practices throughout their lives (Sharifian, Spivey, Zaheed, & Zahodne, 2020). The development of health is primarily seen in the interplay and simultaneous changes in both physical and mental dimensions, suggesting that changes in physical and mental health are interactions. Moreover, the evolution of health in different domains is not completely aligned, and there may be an imbalance between changes in physical and mental health (Wickrama et al., 2013). There is evidence that mental health status does not necessarily deteriorate at the same time as an individual's physical disease (Maraldi et al., 2007). A single health problem-specific model has limitations in accurately representing the comprehensive changes in the health status of the elderly. It tends to overlook the complex interactions between the physical and mental dimensions, which can hinder the scientific prediction of future care service demands and the rational planning of healthcare systems for the elderly.

This study utilizes the China Health and Retirement Longitudinal Study (CHARLS) to examine the patterns and characteristics of physical and mental health conjoint trajectories among elderly individuals in China. To account for the interactions and imbalance nature of co-occurring physical and mental health development, a multidimensional growth mixture model (MGMM) is employed to identify complex trajectories. Additionally, multinomial logistic regression models are used to analyze factors that predict conjoint health trajectories, including demographic characteristics, socioeconomic status, family-society relations, health behaviors, and institutional factors. The objective of this study is to offer theoretical and empirical insights for the development of a comprehensive, precise, and dynamic geriatric health management and service system.

2. Methods

2.1. Study population

This study utilized the China Health and Retirement Longitudinal Study (CHARLS) dataset, which consists of data from four surveys conducted between 2011 and 2018. CHARLS is a comprehensive national tracking survey that encompasses 28 provinces across the country. The baseline survey was conducted in 2011, followed by three subsequent waves of surveys in 2013, 2015, and 2018. The survey specifically targets middle-aged and elderly households and individuals aged 45 and above. It collects information on demographics, Socioeconomic status, family structure, health status, and lifestyle. The dataset provides valuable and extensive information for studying the health and trajectory characteristics of the elderly.

To ensure the robustness of our results, we excluded respondents who lost follow-up all four surveys and who did not answer questions related to physical and mental health. The detailed sample selection process is shown in Fig. 1. Therefore, our analyses focused on older respondents aged 60 years and older from the CHARLS wave 2011. We tracked changes in their physical and mental health until 2018, with a sample size of N = 5584.

2.2. Health status variables

In this study, the health variables encompassed both physical health and mental health. To measure physical health status, we utilized a question from the CHARLS survey. The question was phrased as follows: 'Have you been diagnosed by a doctor?' Respondents were asked to indicate whether they had been diagnosed with 14 diseases, including Hypertension, Dyslipidemia, Diabetes or high blood sugar, Cancer or malignant tumor, Chronic lung diseases, Liver disease, Heart problems, Stroke, kidney disease, Stomach or other digestive disease, Emotional or psychiatric problems, Parkinson, Arthritis or rheumatism, Asthma, etc. Out of these 14 diseases, 13 were selected as measures in this study, excluding Emotional or psychiatric problems. The total number of diseases experienced by older adults was calculated to reflect their physical health status. The physical health status score ranged from 0 to 13, with higher scores indicating a greater number of diseases and poorer physical health status. The mental health status was measured using the Depression Scale (CESD-10) for CHALRS. Mental health status is measured using the average of 10 question items on a score range of 0–4. Higher scores indicate more fragile mental health status. The coefficient (Cronbach's α) for this scale was found to be 0.808 in 2011, 0.762 in 2013, 0.795 in 2015, and 0.805 in 2018, respectively.

2.3. The predicting factor variables

He predicting factors used in this study mainly include demographic characteristics, Socioeconomic situation, family-society relations, health behaviors, and institutional factors.

Demographic characteristics consist of three variables: gender, age,

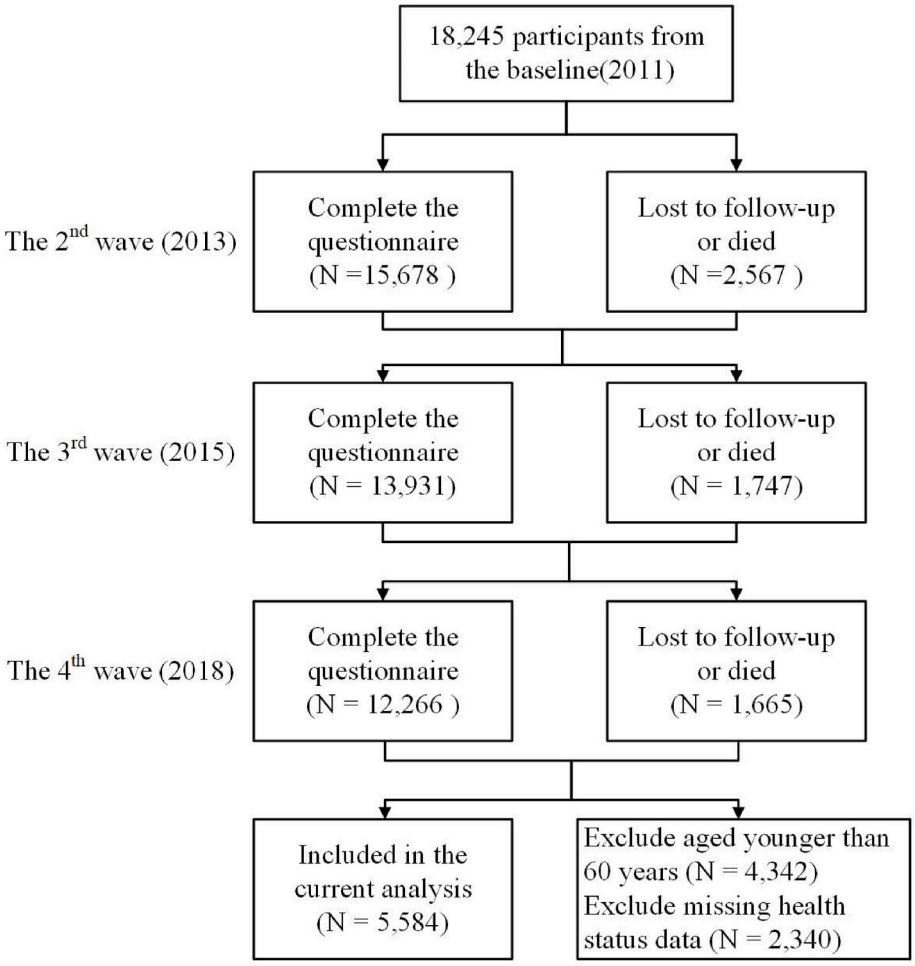

Fig. 1. Flow diagram of sample collection in current analysis.

and region of residence. Gender was measured as either female or male. Age was measured as a continuous variable. Region of residence was categorized as either rural (0) or urban (1) based on the current location of residence.

Socioeconomic status encompasses educational level, household income, and employment status. The educational level was assessed based on the number of years of education completed. Household income is quantified as the annual per capita income and then transformed into a logarithmic scale to account for income distribution. Employment status is represented as a dummy variable with 'working' coded as 1 and 'not working' coded as 0.

The factors related to family-society relations, including marital status, family support, and social participation. Marital status was categorized as married with a spouse or unmarried/divorced/widowed. Family support was assessed based on two dimensions: financial support and emotional support. A score of 0 indicated no family support, while a score of 1 indicated the presence of family support. Social activity was measured using a 3-point scale, with participants rating their participation in 10 different social activities. The average score of these items was used for the analysis.

In relation to health behaviors, the CHARL survey collected data on smoking, alcohol consumption, and exercise, which were all used as measures in this study. Specifically, the survey asked participants three questions: 'Do you currently smoke?', 'Did you drink any alcoholic beverages last year?', and 'Do you engage in physical activity or exercise (vigorous/moderate/walking) for at least 10 min continuously?' For the regression analyses, smoking and physical activity were represented as categorical variables with a code of 1 for yes and 0 for no. On the other hand, the drinking variable was treated as a continuous variable.

The institutional factor variable used in this study was whether enrolled in public health insurance. In China, public medical insurance is an essential part of the social security system and consists primarily of urban employee medical insurance and urban and rural resident medical insurance. Urban employee medical insurance covers employees of urban enterprises and institutions, government employees, and individual businesses. Resident medical insurance can be further divided into two categories. The first category is urban residence medical insurance, which covers urban non-employees, low-income recipients, and the severely disabled. The second category is the new rural cooperative medical insurance, which is designed for rural residents (Liang & Lu, 2014). In addition to these two major medical insurance schemes, there are two additional public medical insurance schemes available, namely government medical insurance and medical assistance. As social security systems, these medical insurance plans are universal and guaranteed (Liang, Liang, & Zhao, 2016). People can enroll in the public health insurance plan and receive the appropriate benefits, regardless of their health status.

It is also clear that private health insurance can affect the health trajectory of older people. However, our data show that the enrollment rate of private health insurance for the elderly is very low (refer to Appendix Table 4). Furthermore, the enrollment rate of private health insurance is closely associated with income, which may introduce multicollinearity issues. Considering all these factors, we have chosen not to include the private medical insurance variable in our analysis. CHARLS provides information on enrollment in 11 types of insurance, including the public health insurance mentioned above and several

private insurances. To measure institutional variables, a dummy variable is used to indicate enrollment or non-enrollment in public medical insurance. It is recorded as 1 if the individual is enrolled and 0 if they are not.

In this study, the main focus was to examine the relationship between the simultaneous development of physical and mental health and the characteristics of older adults. To analyze the predictors of patterns of conjoint health trajectory, time-invariant variables from the baseline (2011) were used in the final analytic model. These variables were inputted into the multinomial logistic regression model for the analyses.

2.4. Statistical analyses

The statistical analysis in this study was conducted in two stages. In the first stage, a multidimensional growth mixture model (MGMM) was used to identify different latent classes of conjoint physical and mental health trajectories. The analysis process of MGMM consisted of three steps (1) 1. Using Parallel Process Latent Growth Curve Model (PPLGCM) to examine the overall fit of the data to a trajectory with a single shape or form (e.g., linear, nonlinear, or quadratic), and to verify trajectory heterogeneity (Wang & Wang, 2019). The goodness-of-fit test results collectively indicated that the linear model was optimal. Additionally, heterogeneity was found in the health trajectories of older adults (see Appendix Tables 5–7). (2) Identification of distinct classes in the concurrent developmental trajectories of physical and mental health through a linear model of Multi-process Latent Class Growth analysis (MLCGA), based on the findings of the first step analysis (Jung & Wickrama, 2008). (3) Constructing the MGMM model with freely estimated variances-covariances for each latent class and performing the final clustering analysis to provide a more accurate characterization of the latent classes (Wickrama, Lee, O'Neal, & Lorenz, 2021).

An exploratory stepwise addition approach was employed to create a range of latent growth models. ranging from 2 to 6 class model during the cluster analysis. The fit index of each model was compared to determine the optimal number of latent classes comprehensively. The indicators used to determine the optimal number of latent classes included AIC, BIC, VLMR and Entropy (McLachlan, Lee, & Rathnayake, 2019). A smaller value of AIC and BIC indicates a better model fit. VLRT is a method used to determine the best-fit model based on the fit ratio of the K-1 class model. If the value of BLRT is statistically significant and refuses to support the null hypothesis of a K-1 class model, it implies that the K class model is a better fit. Entropy, which is an indicator of the clarity of potential type classification, is closer to 1, indicating a higher degree of correct classification (Nagin, 2005; Wang & Wang, 2019). When considering the representativeness of subgroups, models with a sample proportion of latent class greater than 5% were preferred (Wickrama et al., 2013). In the second stage, multinomial logistic regression analysis was performed to identify predictive factors that classify latent classes. The statistical analysis was performed using Stata 14.0 and Mplus 8.0 statistical software.

3. Result

3.1. The general characteristics and health status of baseline sample

The general characteristics of the baseline sample and the means of physical and mental health over time are illustrated in Table 1 and Table 2. The average age of the older adults was 70.03 (S.E. = 6.56), with 51.2% being men and 48.8% being women, resulting in a relatively balanced gender distribution. The average years of education were 4.8, indicating a relatively low level of education among the participants. In terms of income, the annual per capita household income in 2011 was CNY 13,476.11. In regard to the distribution of residential areas, the majority of older persons (63.5%) lived in rural areas, which was approximately twice the number of those living in urban areas (36.5%). Most older people were married and lived with a partner (86.9%), while only a small percentage were divorced, separated, or unmarried (13.1%). Regarding family support, 91.6% of the elderly reported meeting with relatives or children and receiving emotional support, while only 65.1% stated that they had received financial support. The average score for social activity participation was 1.04, indicating a generally low level of social participation among the elderly. 73.3% of participants reported being employed, while 26.7% stated that they were retired or not working. In terms of health behaviors, over 30% of the elderly population reported smoking and consuming alcohol, while 40% engaged in daily exercise. Furthermore, 93.6% of the sample indicated enrollment in public medical insurance.

Table 1
Baseline socio-demographic characteristics of participants.

Characteristics	Categories	N(%)/Mean(S.D.)
Age (years)		70.03(6.56)
Gender	Female	2723(48.8)
	Male	2859(51.2)
Education level(years)		4.80(4.6))
Household income		13476.11 (31801.68)
Region of residence	Rural	3548(63.5)
	Urban	2036(36.5)
Marital status	Married with spouse	4854(86.9)
	Divorced/Widowed/ Unmarried	730(13.1)
Emotional support	No	444(8.4)
	Yes	4848(91.6)
Financial support	No	3413(65.1)
	Yes	1827(34.9)
Social participation		1.04(1.18)
Work status	Not working	1489(26.7)
	Working	4095(73.3)
Smoking	No	3636(65.1)
	Yes	1948(34.9)
Drinking	No	3636(65.1)
	Yes	1948(34.9)
Physical exercise	No	3347(59.9)
	Yes	2237(40.1)
Public medical insurance	Uninsured	338(6.1)
	insured	5243(93.9)
Total		5584(100)

Table 2
Means and standard deviations of health status measurements Over Time.

Health status	2011	2013	2015	2018
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Physical disease	1.40(1.391)	1.65(1.513)	1.93(1.641)	2.50(1.96)
Mental vulnerability	1.82(0.623)	1.78(0.575)	1.80(0.640)	1.90(0.661)

The mean number of physical diseases increased from 1.4 in 2011 to 2.5 in 2018, indicating a deterioration in the physical health of older adults with aging. From 2002 to 2011, the mean values for mental health vulnerability were 1.82, 1.78, 1.8, and 1.9, suggesting a gradual weakening of mental health with age, although older adults generally maintain a moderate level of mental well-being.

3.2. Latent class analysis of physical and mental health conjoint trajectories

After conducting a thorough comparison of each model fit indicator, it has been determined that the optimal number of latent classes for physical and mental health conjoint trajectories is 4 (see Table 3). This conclusion was reached based on the relatively small AIC and BIC values for the 4-class models, the Entropy value being closest to 1, and the proportion of samples in subgroups being greater than 5%. The participants exhibited four distinct latent classes of physical and mental health conjoint trajectories, as depicted in Fig. 2. The four classes were named based on their respective characteristics.

Table 3
Latent class model fit (N = 342).

		Latent Classes				
		2	3	4	5	6
Model fit	LL	−57090.823	−54137.680	−52530.949	−51424.812	−50646.090
	AIC	114215.646	108319.359	105115.897	102913.624	101366.180
	BIC	114328.316	108465.168	105294.844	103125.709	101611.403
	Entropy	0.907	0.917	0.924	0.889	0.878
	VLMR+	−63575.420***	−57090.823***	−54137.680***	−52530.949**	−23998.781
n (%) according to latent class	1	1531(27.4)	2016(36.1)	747(13.7)	2558(45.8)	1310(23.5)
	2	4053(72.6)	2988(53.5)	1489(26.6)	701(12.6)	2197(39.3)
	3		580(10.4)	2791(49.8)	1220(21.8)	275(4.9)
	4			557(9.9)	835(15.0)	695(12.4)
	5				270(4.8)	48(8.3)
	6					649(11.6)

*p < .05 **p < .01 ***p < .001.
+: Ho = k-1 class; Loglikelihood Difference(P).

Table 4
Predicting factors of the latent class by physical and mental health conjoint trajectories.

Variable	Class 2+				Class 3				Class 4			
	B	S.E.	OR	95% CI	B	S.E.	OR	95% CI	B	S.E.	OR	95% CI
Intercept	−2.375*	0.854			0.573	0.766			−3.356**	1.026		
Male	0.618***	0.158	1.855	1.36–2.53	0.588***	0.147	1.800	1.35–2.40	0.470*	0.190	1.600	1.10–2.32
Age (years)	0.013	0.010	1.013	0.97–1.04	0.003	0.009	1.003	0.99–1.02	0.031**	0.012	1.032	1.01–1.06
Education (year)	0.210***	0.056	1.234	1.10–1.38	0.195***	0.052	1.216	1.10–1.35	0.153*	0.068	1.165	1.02–1.33
Household income	0.015	0.054	1.015	0.91–1.13	0.058	0.050	1.059	0.96–1.17	0.020	0.066	1.020	0.90–1.16
Working	−0.487**	0.152	0.614	0.46–0.83	−0.159	0.145	0.853	0.64–1.13	−0.817***	0.177	0.442	0.31–0.62
Urban residence	0.563***	0.145	1.755	1.32–2.33	0.393**	0.137	1.481	1.13–1.94	0.270	0.175	1.310	0.93–1.84
Married with spouse	0.460**	0.179	1.662	1.12–2.25	0.314*	0.159	1.365	1.01–1.88	0.400	0.214	1.493	0.98–2.27
Financial support	0.030	0.120	1.030	0.81–1.30	−0.173	0.111	0.841	0.68–1.05	−0.006	0.146	0.994	0.75–1.32
Emotional support	−0.061	0.194	0.940	0.64–1.38	−0.012	0.178	0.988	0.70–1.40	−0.124	0.236	0.883	0.56–1.40
Social participation	0.171**	0.051	1.186	1.07–1.31	0.119*	0.048	1.126	1.03–1.24	0.200**	0.060	1.222	1.09–1.38
Drinking	0.178	0.141	1.195	0.91–1.58	0.144	0.131	1.155	0.89–1.49	−0.166	0.176	0.847	0.60–1.20
Smoking	−0.320*	0.152	0.726	0.54–0.98	−0.035	0.140	0.965	0.73–1.27	−0.236	0.185	0.790	0.55–1.14
Physical exercise	0.131	0.117	1.140	0.91–1.43	0.016	0.108	1.016	0.80–1.22	0.088	0.141	1.092	0.83–1.44
Enrolled public medical insurance	0.369*	0.182	1.446	1.01–2.07	0.523*	0.264	1.688	1.01–2.91	0.403	0.335	1.497	0.78–2.89
-2LL/Chi-square	8128.627/272.589***											
Nagelkerke R2	.109											

*p < .05 **p < .01 ***p < .001.
+ Class 1 = Physical and mental health deteriorating; Class 2 = Physical disease increasing & low mental vulnerability maintaining; Class 3 = Low physical & mental vulnerability maintaining; Class 4 = High physical disease increased & mental health moderate-stable.
Reference variable = female, rural residence, divorced/widowed/unmarried, no financial support, no emotional support, not working, no drinking, no Smoking, no exercise, not enrolled social medical insurance.
Reference group = Class 1.

Class 1, which accounted for 13.7% (N = 747), was labeled as 'Physical and Mental Health Deteriorating'. In this class, older adults exhibited a high level of initial mental vulnerability and a moderate level of initial physical disease. As they age, there is a noticeable trend of rapid deterioration in both physical and mental health, making this group of older individuals particularly vulnerable in terms of their overall well-being. The health trajectory indicates that there is a time lag between changes in physical health and mental health. It is observed that mental vulnerability does not increase simultaneously with deteriorating physical health. Instead, it gradually increases after a period of heightened physical disease.

The class2 exhibits a high initial level of physical disease that consistently deteriorates over time. In contrast, mental vulnerability remains relatively stable and low. We have named this class 'physical disease increasing & low mental vulnerability maintaining'. This class represents 26.6% (1489) of the total sample. Class 3 is referred to as low physical and mental vulnerability maintaining (N = 2791, 49.8%). This type exhibits a lower incidence of physical disease and mental health vulnerability compared to other types, and this vulnerability tends to increase slowly with age. Elderly individuals in this class generally have good overall health, although their physical and mental health may weaken as they age, gradually. This type of aging development can be considered relatively favorable.

The class 4 has a high baseline level of physical disease that deteriorates with aging, while mental vulnerability remains at a moderate level. Therefore, this class is named 'high physical disease increased & mental health moderate stable'. Out of the total number of analyzed subjects, 9.9% (557) belonged to this class. It is important to note that the patterns of change in physical and mental health are not consistent across class 2 and class 4. Generally, as physical health declines (increase in disease), mental health also deteriorates (increase in vulnerability) among older adults. However, these two classes show an imbalance between physical and mental co-occurring developmental health. That is, while physical health is deteriorating, mental health remains relatively stable.

3.3. Predicting factors distinguishing latent classes in conjoint trajectories

In this study, the dependent variable was defined as the latent classes of conjoint trajectory. The independent variables consisted of demographic characteristics, socioeconomic situation, family-society relations, health behaviors, and institutional factors. The data was analyzed using multinomial logistic regression analysis. The results of the analysis are presented in Table 4. Compared with the physical and

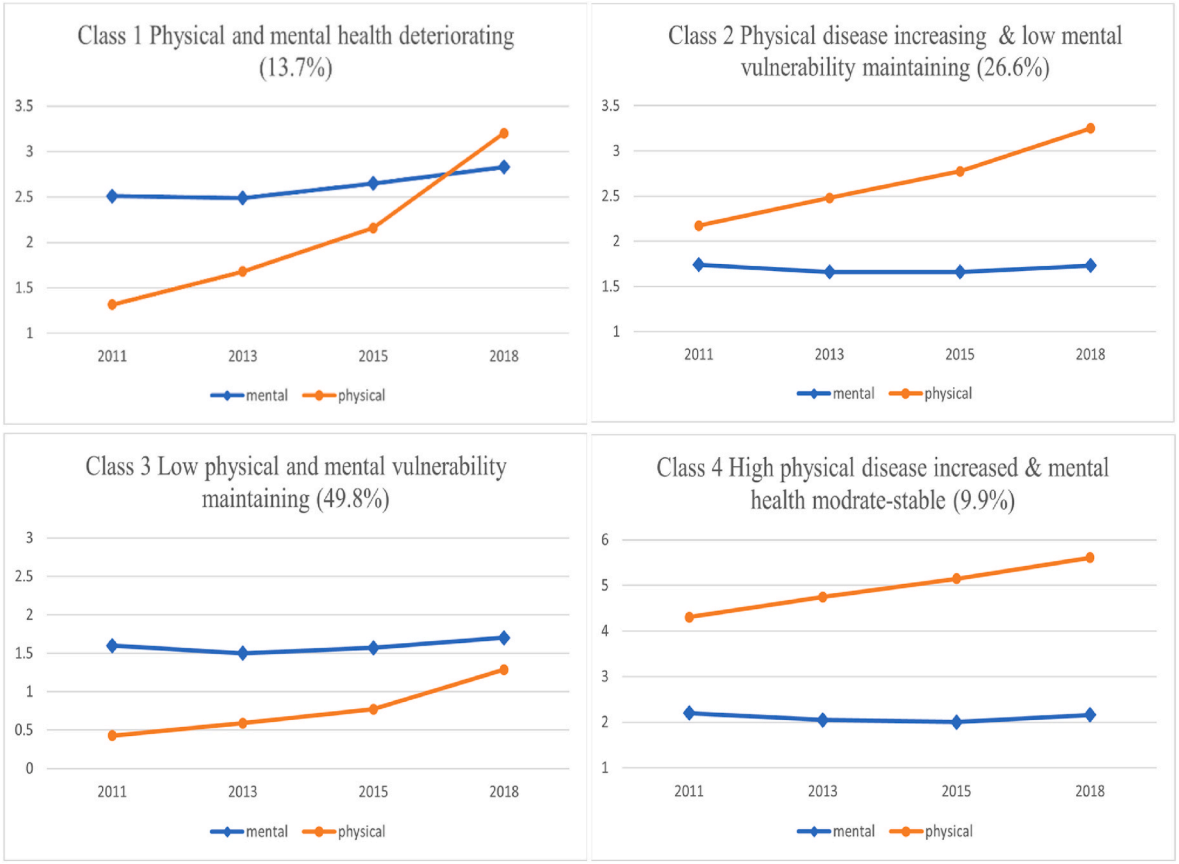

Fig. 2. Four latent classes by physical and mental health conjoint trajectories.

mental health deteriorating (class 1), for male (OR = 1.855, 95% CI = 1.36–2.53), higher education level (OR = 1.234, 95% CI = 1.10–1.38), urban residence (OR = 1.755, 95% CI = 1.32–2.33), married with spouse (OR = 1.662, 95% CI = 1.12–2.25), higher social participation (OR = 1.186, 95% CI = 1.07–1.31), still working (OR = 0.614, 95% CI = 0.46–0.83), Persistent smoking (OR = 0.726, 95% CI = 0.54–0.98), enrolled public medical insurance (OR = 1.446, 95% CI = 1.01–2.07) addressed the higher possibility of belonging to the physical disease increasing & low mental vulnerability maintaining class. This suggests that older adults who are female, live in rural areas, have low socio-economic status (e.g., education and income), low social participation, unemployment, unhealthy behaviors such as smoking, and lack of public health insurance are more likely to be exposed to a rapid deterioration in both their physical and mental health compared to experiencing an increase in physical disease and relatively well mental health.

Gender, education level, region of residence, marital status, social participation, and public medical insurance were found to be significant predictors of belonging to the Low physical & mental vulnerability maintaining class, as compared to class 1. Older adults who are male (OR = 1.8, 95% CI = 1.35–2.40), have a high level of education (OR = 1.216, 95% CI = 1.10–1.35), are married and living with a partner (OR = 1.365, 95% CI = 1.01–1.88), are socially active (OR = 1.126, 95% CI = 1.03–1.24), live in urban areas (OR = 1.481, 95% CI = 1.13–1.94), and are enrolled in public health insurance (OR = 1.688, 95% CI = 1.01–2.91) have a higher probability of experiencing favorable physical and mental co-occurring developmental health.

Factors such as gender, age, education level, social participation, and working status were found to be significant predictors of belonging to the class of high physical disease increased & mental health moderate-stable. Compared to class 1, participants who were male (OR = 1.6, 95% CI = 1.10–2.32), older (OR = 1.032, 95% CI = 1.01–1.06), had a higher education level (OR = 1.165, 95% CI = 1.01–1.06), had greater social participation (OR = 1.222, 95% CI = 1.09–1.38), and were not working (OR = 0.442, 95% CI = 0.31–0.62) were more likely to fall into this class.

4. Discussion

This study set out to identify patterns (latent classes) and characteristics of the conjoint trajectories of physical and mental health among Chinese elderly. Additionally, it sought to explore factors that predict the attribution of these patterns. With respect to the clustering analysis with multidimensional growth mixture model, it was found that there were four distinct latent classes of physical and mental health conjoint trajectories in older adults. That is, 'physical and mental health deteriorating', 'physical disease increasing & low mental vulnerability maintaining', 'low physical & mental vulnerability maintaining' and 'high physical disease increased & mental health moderate-stable'. This result further confirmed our hypothesis that the diversity of health trajectories in aging and the interactivity and imbalance of co-occurring developmental across different health domains. In the conjoint health trajectory of Chinese elderly, there are cases where both physical and mental health interact and change in a co-directional way, as well as cases where the patterns of change in physical health and mental health are inconsistent.

This finding contributes to the understanding of multidimensional trajectories of health change among the elderly and highlights the importance of considering the relationship between changes in different health domains during aging.To address the health needs of the ageing., it is necessary to develop comprehensive health assessments and long-term management plans that cover both physical and mental health. Additionally, medical institutions and local governments should take the lead in gathering information on the health status, healthcare utilization, and social resources of the elderly in the community. This

information can be used to create personal health profiles and tracking databases. It is important to ensure the security of the data while actively promoting the sharing of data across sectors (e.g. (Government agencies, medical institutions, academia, service providers, etc.). This will help establish a comprehensive healthcare service system for the elderly.

Secondly, health management programs tailored to the conjoint health trajectory patterns of older people are necessary to effectively address and improve their health. For the groups of 'physical disease increasing & low mental vulnerability maintaining' and 'high physical disease increased & mental health moderate-stable', their mental health status is relatively stable, while physical vulnerability is higher. Therefore, it is important to improve the physical health status through active intervention strategies such as providing income security, enhancing access to healthcare services, and offering medical information and health promotion programs. Additionally, interventions for Physical and mental health deteriorating group should focus on enhancing both aspects. Along with implementing physical health management and intervention approaches, providing emotional comfort, psychological counseling, and treatment services to older people, as well as increasing opportunities for social participation through hobbies, clubs, and volunteer work, can be more effective in providing emotional support and expanding social networks.

Finally, it is also important to consider appropriate interventions based on the time point of when changes occur. In the group experiencing deteriorating physical and mental health, it has been observed that the decline in mental health does not immediately follow the increase in physical disease. Instead, mental health problems tend to develop gradually after a certain period (typically after 1 wave). Therefore, it is important to address the possibility of delayed onset of mental frailty and provide appropriate mental health management and interventions, even if mental health problems are not identified at the time of an increase in physical disease. It is particularly important to focus on the mental health of older people who have had a chronic disease for 1–2 years. The intervention strategies should aim to alleviate anxiety and depression caused by the diagnosis of the disease. Additionally, long-term monitoring of mental health status and regular check-ups after the diagnosis of a physical illness are necessary (Rose et al., 2009).

The results of multinomial logistic regression indicate that various factors such as gender, education level, work status, region of residence, marital status, social participation, smoking, and enrollment in public health insurance significantly predicted the belonging of conjoint trajectory latent class. It is interesting to note that demographic and socioeconomic factors like gender, education level, work status, and region of residence have a greater influence in determining latent class belonging. This finding implies that health inequalities experienced by disadvantaged individuals extend beyond period-specific health disparities. Instead, they manifest as diverse classes of health trajectories. This finding reconfirms the importance of designing and implementing targeted health management and intervention strategies based on patterns of physical and mental co-occurring developmental health.

Enrollment in public health insurance and positive social participation have been shown to be effective in preventing and mitigating physical and mental health problems in aging individuals. A study conducted on Chinese elderly people found that public health insurance has a positive impact on both their health status and long-term health changes (Cheng, Liu, Zhang, Shen, & Zeng, 2015). By ensuring the accessibility of healthcare resources and reducing healthcare costs, public medical insurance can effectively address the negative impact of physical diseases on psychological and emotional well-being. It can also help alleviate the healthcare inequality caused by socioeconomic disparities (Liang & Lu, 2014; Zhou et al., 2017). Therefore, future reforms in public medical insurance policies should not only focus on subsidizing the cost of treatment for critical diseases, but also actively consider including coverage for chronic diseases in the elderly. Additionally, in order to maximize the benefits of public medical insurance, it is crucial to detect and manage chronic diseases among older individuals at an early stage.

Participation in community groups and organized social activities has been found to significantly decrease the likelihood of older individuals falling into the vulnerability class of combined physical and mental health trajectory. Additionally, it can mitigate the level of mental health deterioration in later life. This finding is consistent with previous research, which suggests that social activities for older individuals can alleviate life stresses and enhance their integration into society. As a result, it reduces their sense of relative deprivation caused by social isolation and positively impacts their overall health status (Han & Shibusawa, 2015; Zhang & Wu, 2017). To ensure the positive impact of social activities on older individuals' lives, policy and practice interventions are necessary. This can include providing administrative support for their volunteer activities and organizing cultural and entertainment programs that cater to the specific needs and preferences of older individuals.

We are aware that our research may have three limitations. First, our analysis only includes data from the surviving participants in four waves of the survey. our analysis only includes data from the surviving participants in four waves of the survey. This may introduce bias and limit the generalizability of our results, as it primarily reflects the health status of older adults who are in better health. It is common for studies using longitudinal survey data of seniors to encounter limitations due to missing data. Furthermore, more than 90% of the seniors in the sample were covered by public health insurance, which may have contributed additional bias to the findings. This is because older adults with health insurance are more likelihood to survive. Therefore, to draw broader conclusions about the composite trajectories of physical and mental health in aging, further comparative analyses using diverse longitudinal data from multiple countries are necessary. Furthermore, it is also important to analyze death samples and vulnerable populations without health insurance. These additional analyses will be the focus of our future work. Second, the limitations of our study in conducting secondary data analysis prevented us from considering other potential factors that could predict physical and mental co-occurring developmental health. These factors include living arrangements, quality of family relationships (such as spouses, siblings, children, grandchildren, etc.), dietary habits, quality of sleep, ability to manage stress or resilience, and health literacy, and others. Future research should focus on studying the contributions of these factors in understanding multidimensional conjoint health trajectories. Third, we employed two-step analytical methods (MGMM and multinomial logistic regression) to examine the relationship between predictors (such as demographic characteristics, socioeconomic status, family-society relations, health behaviors, and institutional factors) and latent classes of conjoint trajectories. This approach was chosen toto avoid overburdening the model. However, future studies should consider testing the relationships of these factors simultaneously in the same model to prevent potential methodological bias.

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Ethical statement

This paper was reviewed and considered human subjects exempt by Jiangnan University Medical Ethics Committee.

Author statement

Sun, Sheng: Conceptualization, Methodology, Data Curation,

Statistical analysis, Writing - Original Draft, Project administration, Funding acquisition.

An, Shanshan: Conceptualization, Writing - Review & Editing, Supervision, Project administration.

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Declaration of competing interest

None declared.

Data availability

Data can be obtained by applying on the CHALRS official website

Appendix

Appendix Table 1
Descriptive analysis for prevalence of physical diseases in the 60–69 age group (N = 2916)

	Male				Female			
	2011	2013	2015	2018	2011	2013	2015	2018
Hypertension	19.7	24.6	27.7	39.8	22.9	27.9	30.9	41.9
Dyslipidemia	9	11.9	14.3	21.8	9.7	13.2	17.1	28.6
Diabetes or high blood sugar	4.6	6.2	6.8	12.7	6.1	8.6	9.8	16.5
Cancer or malignant tumor	0.2	0.3	0.4	1.3	1.1	1.2	1.7	2.5
Chronic lung diseases	7.7	9.5	11.7	17.4	6.6	8.1	10.8	15.4
Liver disease	4.7	6.1	7	8.7	3.4	4.5	5.6	7
Heart problems	6.5	8.6	10	16	13.7	16.8	20.2	27.1
Stroke	1.3	2.2	2.6	7.9	0.8	1.1	1.5	6.7
kidney disease	6.9	8.7	10.2	12	5.7	7.5	8.8	10.6
Stomach or other digestive disease	18.8	21.3	24.4	27.2	24	27.8	32.3	35.7
Parkinson	0.6	1.3	1.4	3	0.3	0.7	1.1	3.1
Arthritis or rheumatism	26.8	30.1	35.2	35.7	36.6	40	45.5	48.7
Asthma	2.5	2.7	3.9	5.4	1.5	2	2.8	5.2

Appendix Table 2
Descriptive analysis for prevalence of physical diseases in the 70–79 age group (N = 2137)

	Male				Female			
	2011	2013	2015	2018	2011	2013	2015	2018
Hypertension	25.2	30.7	34	45.5	32.2	38.1	39.6	52.5
Dyslipidemia	10.8	14.2	15.9	23.2	11.5	15.7	17.6	27.1
Diabetes or high blood sugar	4.9	6	7.6	12.5	7	10	10.9	16.9
Cancer or malignant tumor	0.4	0.5	1	2.8	1.1	1.4	1.5	2.3
Chronic lung diseases	14.6	17.3	19.6	25.1	10.6	11.9	14.7	19.8
Liver disease	4.8	5.9	6.6	8.8	4.6	5.5	6.2	6.8
Heart problems	13.9	16.4	18.7	24.8	15.7	18.8	22.5	30.7
Stroke	2.1	2.7	3.9	8.9	2.7	3.3	3.5	9.4
kidney disease	8	10.1	11	14.4	5.5	6.6	8.9	11.1
Stomach or other digestive disease	23.1	24.7	28.9	30.6	25.7	29	33.1	35.5
Parkinson	2	2.4	3.4	5.1	1.3	2.1	2.7	4.8
Arthritis or rheumatism	33.9	35.8	43.4	42	43.7	47	52.3	53.1
Asthma	4.9	5.5	7.5	11.4	2.9	3.2	5.7	8.3

Appendix Table 3
Descriptive analysis for prevalence of physical diseases in the 80+ age group (N = 531)

	Male				Female			
	2011	2013	2015	2018	2011	2013	2015	2018
Hypertension	33.1	36.1	38.7	48.2	37.3	40.9	45.3	59.1
Dyslipidemia	8.9	10.8	12.1	19.3	14.2	16	19.1	25.3
Diabetes or high blood sugar	6.2	8.2	9.5	13.4	8.9	13.8	16	23.6
Cancer or malignant tumor	0.3	0.3	1.3	2.6	0	0	0.9	1.3
Chronic lung diseases	16.7	18	20.3	25.2	9.8	10.2	13.8	15.6
Liver disease	3.6	3.9	4.9	6.6	2.7	3.1	4.9	6.7
Heart problems	15.5	19.3	21.3	24.3	27.2	30.7	34.7	40.4
Stroke	4.3	4.9	5.9	11.1	2.2	2.7	4	11.1
kidney disease	9.9	11.8	14.8	17.7	4.4	8	6.2	9.8
Stomach or other digestive disease	23	24.6	29.5	31.1	23.6	27.6	32	31.1
Parkinson	1.6	3.6	3.3	7.5	1.3	1.3	3.6	4.9
Arthritis or rheumatism	29.9	30.8	36.4	39	39.6	41.8	49.8	50.2
Asthma	8.5	8.5	12.8	14.4	5.3	6.2	6.2	8

Appendix Table 4
Enrolment rates in public and private medical insurance (N = 5584)

Categories		N (%)
Public Medical Insurance	Urban Employee Medical Insurance	2851(51.1)
	Urban Resident Medical Insurance	320(5.7)
	New Cooperative Medical Insurance	1936(34.7)
	Government Medical Insurance & Medical Aid	136(2.4)
Private Medical Insurance		127(2.2)

Appendix Table 5
The Goodness-of-fit test of growth model

Model	χ^2	df	CFI	TLI	RMSEA	SRMR
Linear	446.566***	21	.980	.974	.060	.026
Nonlinear	589.494***	22	974	966	.068	.036
Quadratic	988.032***	23	955	945	.087	.040

*p < .05 **p < .01 ***p < .001.

Appendix Table 6
Time scores for nonlinear growth models

Factors	Time 1	Time 2	Time 3	Time 4
Physical health				
Intercept	1	1	1	1
Slope	0	1	2	4.562
Mental health				
Intercept	1	1	1	1
Slope	0	1	2	3.745

Appendix Table 7
The growth factors of physical and mental health trajectories

Factors	Mean	(S.E.)	Variances	(S.E.)	Correlation	S.E.
Physical health						
Intercept	1.399***	.019	1.935***	.049	−.028***	.006
Slope	.248***	.005	.075***	.004		
Mental health						
Intercept	1.782***	.008	.195***	.007	−.030**	.017
Slope	0.018***	.004	.015**	.005		

*p < .05 **p < .01 ***p < .001.

Appendix Table 8
The physical and mental health characteristics in four latent classes

Latent Class+		Claas 1	Class 2	Class 3	Class 4
Physical disease					
Intercept (S. E.)		1.236(0.072) ***	2.158(0.051) ***	0.392(0.013) ***	4.307(0.096)***
Slope (S. E.)		0.538(0.022) ***	0.333(0.013) ***	0.236(0.007) ***	0.429(0.026)***
Mean (S. E.)	2011	1.315(0.825)	2.173(0.678)	0.429(0.497)	4.305(1.09)
	2013	1.679(0.942)	2.480(0.730)	0.590(0.621)	4.745(1.127)
	2015	2.16(1.131)	2.775(0.856)	0.772(0.739)	5.145(1.207)
	2018	3.201(1.661)	3.250(1.467)	1.288(1.149)	5.611(1.834)
Mental Vulnerability					
Intercept (S. E.)		2.475(0.03) ***	1.7(0.018) ***	1.568(0.01) ***	2.156(0.039) ***
Slope (S. E.)		0.071(0.012) ***	−0.003(0.006)	0.02(0.004) ***	−0.007(0.011)
Mean (S. E.)	2011	2.511(0.614)	1.740(0.514)	1.591(0.476)	2.201(0.657)
	2013	2.499(0.571)	1.663(0.423)	1.573(0.419)	2.093(0.656)
	2015	2.624(0.593)	1.658(0.467)	1.575(0.477)	2.143(0.709)
	2018	2.703(0.585)	1.732(0.507)	1.657(0.530)	2.157(0.693)

*p < .05 **p < .01 ***p < .001.
+ Class 1 = Physical and mental health deteriorating; Class 2 = Physical disease increasing & low mental vulnerability maintaining; Class 3 = Low physical & mental vulnerability maintaining; Class 4 = High physical disease increased & mental health moderate-stable.

References

Cheng, L., Liu, H., Zhang, Y., Shen, K., & Zeng, Y. (2015). The impact of health insurance on health outcomes and spending of the elderly: Evidence from China's new cooperative medical scheme. *Health Economics, 24*(6), 672–691. https://doi.org/10.1002/hec.3053

Chen, F., Yang, Y., & Liu, G. (2010). Social change and socioeconomic disparities in health over the life course in China: A cohort analysis. *American Sociological Review, 75*(1), 126–150. https://doi.org/10.1177/0003122409359165

Du, B., & Wang, X. (2013). Health inequality among the Chinese elderly: Changes, regional disparities and determinants. *Population Research, 37*(8), 81–90.

Han, W.-J., & Shibusawa, T. (2015). Trajectory of physical health, cognitive status, and psychological well-being among Chinese elderly. *Archives of Gerontology and Geriatrics, 60*(1), 168–177. https://doi.org/10.1016/j.archger.2014.09.001

Hong, S.-I., Hasche, L., & Bowland, S. (2009). Structural relationships between social activities and longitudinal trajectories of depression among older adults. *The Gerontologist, 49*(1), 1–11. https://doi.org/10.1093/geront/gnp006

Hu, X., Gao, Q., Zhao, C., Wei, J., Sun, X., Gu, Y., et al. (2019). Disability and mortality trajectories of the Chinese oldest-old. *Population Research, 43*(5), 43–53.

Interian, A., Ang, A., Gara, M. A., Rodriguez, M. A., & Vega, W. A. (2011). The long-term trajectory of depression among Latinos in primary care and its relationship to depression care disparities. *General Hospital Psychiatry, 33*(2), 94–101. https://doi.org/10.1016/j.genhosppsych.2010.12.001

Jang, J., Jung, H.-S., Chae, K., & Lee, K.-U. (2023). Trajectories of self-rated health among community-dwelling individuals with depressive symptoms: A latent class growth analysis. *Journal of Affective Disorders, 332*, 83–91. https://doi.org/10.1016/j.jad.2023.03.089

Jung, T., & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass, 2*(1), 302–317. https://doi.org/10.1111/j.1751-9004.2007.00054.x

Kim, D., Yoo, B. S., Lee, K. W., & Kim, H. J. (2014). The impact intergenerational family characteristics and longitudinal changes of psychological health of the elderly in Korea. *Korean Journal of Social Welfare Research, 39*, 91–120.

Kuchibhatla, M. N., Fillenbaum, G. G., Hybels, C. F., & Blazer, D. G. (2012). Trajectory classes of depressive symptoms in a community sample of older adults. *Acta Psychiatrica Scandinavica, 125*(6), 492–501. https://doi.org/10.1111/j.1600-0447.2011.01801.x

Kumlin, M., Berg, G. V., Kvigne, K., & Hellesø, R. (2020). Elderly patients with complex health problems in the care trajectory: A qualitative case study. *BMC Health Services Research, 20*(1), 595. https://doi.org/10.1186/s12913-020-05437-6

Lara, E., Matovic, S., Vasiliadis, H.-M., Grenier, S., Berbiche, D., De La Torre-Luque, A., et al. (2023). Correlates and trajectories of loneliness among community-dwelling older adults during the COVID-19 pandemic: A Canadian longitudinal study. *Archives of Gerontology and Geriatrics, 115*, Article 105133. https://doi.org/10.1016/j.archger.2023.105133

Lee, H.-J. (2013). Longitudinal changes in depression in older adults: Differences across age groups and risk factors. *Journal of Welfare for the Aged, 61*, 291–318.

Liang, Y., Liang, H., & Zhao, D. (2016). Influence of medical insurance on health disparities over the life course and social change. *Medicine in Society, 29*(2), 24–28. https://doi.org/10.13723/j.yxysh.2016.02.007

Liang, Y., & Lu, P. (2014). Medical insurance policy organized by Chinese government and the health inequity of the elderly: Longitudinal comparison based on effect of New Cooperative Medical Scheme on health of rural elderly in 22 provinces and cities. *International Journal for Equity in Health, 13*(1), 1–15. https://doi.org/10.1186/1475-9276-13-37

Link, B. G., Susser, E. S., Factor-Litvak, P., March, D., Kezios, K. L., Lovasi, G. S., et al. (2017). Disparities in self-rated health across generations and through the life course. *Social Science & Medicine, 174*, 17–25. https://doi.org/10.1016/j.socscimed.2016.11.035

Lu, N., Lou, V. W. Q., Zuo, D., & Chi, I. (2017). Intergenerational relationships and self-rated health trajectories among older adults in rural China: Does gender matter? *Research on Aging, 39*(2), 322–344. https://doi.org/10.1177/0164027515611183

Maraldi, C., Volpato, S., Penninx, B. W., Yaffe, K., Simonsick, E. M., Strotmeyer, E. S., et al. (2007). Diabetes mellitus, glycemic control, and incident depressive symptoms among 70-to 79-year-old persons: The health, aging, and body composition study. *Archives of Internal Medicine, 167*(11), 1137–1144. https://doi.org/10.1001/archinte.167.11.1137

McLachlan, G. J., Lee, S. X., & Rathnayake, S. I. (2019). Finite mixture models. *Annual Review of Statistics and Its Application, 6*, 355–378. https://doi.org/10.1146/annurev-statistics-031017-100325

Nagin, D. S. (2005). *Group-based modeling of development*. Harvard University Press.

Rohlfsen, L. S., & Jacobs Kronenfeld, J. (2014). Gender differences in trajectories of self-rated health in middle and old age: An examination of differential exposure and differential vulnerability. *Journal of Aging and Health, 26*(4), 637–662. https://doi.org/10.1177/0898264314527477

Rose, J. H., Kypriotakis, G., Bowman, K. F., Einstadter, D., O'Toole, E. E., Mechekano, R., et al. (2009). Patterns of adaptation in patients living long term with advanced cancer. *Cancer, 115*(S18), 4298–4310. https://doi.org/10.1002/cncr.24584

Seves, B. L., Hoekstra, F., Hettinga, F. J., Dekker, R., van der Woude, L. H. V., & Hoekstra, T. (2021). Trajectories of health-related quality of life among people with a physical disability and/or chronic disease during and after rehabilitation: A longitudinal cohort study. *Quality of Life Research, 30*(1), 67–80. https://doi.org/10.1007/s11136-020-02647-7

Sharifian, N., Spivey, B. N., Zaheed, A. B., & Zahodne, L. B. (2020). Psychological distress links perceived neighborhood characteristics to longitudinal trajectories of cognitive health in older adulthood. *Social Science & Medicine, 258*, Article 113125. https://doi.org/10.1016/j.socscimed.2020.113125

Sun, F., Park, N. S., Roff, L. L., Klemmack, D. L., Parker, M., Koenig, H. G., et al. (2012). Predicting the trajectories of depressive symptoms among southern community-dwelling older adults: The role of religiosity. *Aging & Mental Health, 16*(2), 189–198. https://doi.org/10.1080/13607863.2011.602959

Taylor, M. G., & Lynch, S. M. (2011). Cohort differences and chronic disease profiles of differential disability trajectories. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 66*(6), 729–738. https://doi.org/10.1093/geronb/gbr104

de la Torre-Luque, A., de la Fuente, J., Prina, M., Sanchez-Niubo, A., Haro, J. M., & Ayuso-Mateos, J. L. (2019). Long-term trajectories of depressive symptoms in old age: Relationships with sociodemographic and health-related factors. *Journal of Affective Disorders, 246*, 329–337. https://doi.org/10.1016/j.jad.2018.12.122

Wang, J., & Wang, X. (2019). *Structural equation modeling: Applications using Mplus*. John Wiley & Sons.

Wei, M., & Wang, H. (2017). The gender, urban and rural areas, cohort differences of disability trajectory of the elderly in China. *POPULATION & DEVELOPMENT, 23*(5), 74–98.

Wickrama, K., Lee, T. K., O'Neal, C. W., & Lorenz, F. O. (2021). *Higher-order growth curves and mixture modeling with Mplus: A practical guide*. Routledge.

Wickrama, K., Mancini, J. A., Kwag, K., & Kwon, J. (2013). Heterogeneity in multidimensional health trajectories of late old years and socioeconomic stratification: A latent trajectory class analysis. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 68*(2), 290–297. https://doi.org/10.1093/geronb/gbs111

Zhang, W., & Wu, Y. Y. (2017). Individual educational attainment, neighborhood-socioeconomic contexts, and self-rated health of middle-aged and elderly Chinese: Exploring the mediating role of social engagement. *Health & Place, 44*, 8–17. https://doi.org/10.1016/j.healthplace.2016.12.006

Zhou, Z., Fang, Y., Zhou, Z., Li, D., Wang, D., Li, Y., et al. (2017). Assessing income-related health inequality and horizontal inequity in China. *Social Indicators Research, 132*, 241–256. https://doi.org/10.1007/s11205-015-1221-1