

Mental Health Classification and Quality of Life of Empty-nest Elderly in China: A Latent Profile Analysis

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Research

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Abstract

Background Latent profile analysis was used to identify the profiles of empty-nest elderly's mental health. Associations of the profiles with quality of life were then examined.

Methods: Three hundred and fifty empty-nest elderly adults in China were investigated with Elderly Mental Health Questionnaire and the Chinese version of the SF-36. Latent profile analysis was used to analyze the data.

Results: A three-profile mental health model provided the best fit to the data. The resulting profiles were low mental health, moderate mental health, and high mental health. There were significant differences in quality of life among different profiles of mental health.

Conclusion: The results provide a new and expanded view of empty nesters' mental health, which may be used to improve empty-nest elderly's quality of life.

Background

China has the world's largest elderly population. The China Statistical Yearbook reported that adults aged 60 and above accounted for 17.9% of the total population by the end of 2018[1]. Empty-nest elderly are a special group among the elderly, which refers to older adults who have no children or whose children have already left home and thus live alone or with their spouse or older parents[2]. According to statistics, the number of empty-nest elderly in China has reached 120 million by the end of 2017, accounting for about 51.3% of the total number of elderly people[3]. It was estimated that the proportion of families with empty-nest elderly will reach 90% of all families in China by 2030[4]. Due to the lack of care from their children, the mental health status of the empty-nest elderly is worse than that of the ordinary elderly[5], empty-nest elderly are more likely to suffer from physical, psychological, and social problems[6]. Poor mental health status reduces the quality of life of the empty-nest elderly, damages their social function, and leads to the decline of cognitive function, life satisfaction and well-being[7]. A great deal of theoretical and empirical work completed over the past few decades has substantially increased our understanding of the conditions and factors influencing mental health of empty-nest elderly.

Scholarly interest in mental health among empty-nest elderly continues to grow, yet most research has adopted a variable-centered approach which focuses on testing the relationships of each facet of mental health with other variables[8]. Although such an approach provides valuable information about the direct and unique association of each facet of mental health with other variables, it ignores the possibility that (a) distinct combinations of mental health profiles exist in the population and (b) these mental health profiles may correspond to differences in other variables. This perspective is consistent with taking a person-centered approach to conceptualizing mental health, which recognizes that distinct mental health profiles might exist. Investigation of these profiles through the person-centered approach might reveal unique insights into the effects of mental health profiles on other variables.

Data-driven techniques are a fruitful way of studying the psychosocial patterning evident during this life stage. Specifically, latent profile analysis (LPA) performs this process in a more rigorous statistical manner. LPA is a person-centered approach that classifies samples into more meaningful subgroups than variable-centered approaches, handles interaction effects, and is not affected by outliers[9]. Thus, this probability-based and individual-centered approach could yield lower misclassification and missing rates for participants[10]. LPA also facilitates the discovery of heterogeneous subpopulations with similar attributes across multiple dimensions of interest[11]. Use of a person-centered approach enables identification of how different subpopulations of empty-nest elderly characteristically use distinct combinations of different mental health to affect their quality of life.

Healthy aging is manifested in not only the extension of the life of the older people but also, more importantly, the improvement of their quality of life[12]. However, the overall health condition of older adults is not optimistic. Studies have showed that with the growth of age, the physical health, self-care ability and cognitive function of the older adults tend to decline[13]. As a vulnerable group, shrinking social resources and a lack of emotional support for empty nesters could lead to a greater risk of health and psychological problems[14]. According to the psychological stress theory, physical health is closely related to psychological factors. Long-term bad mood will lead to the decline of human immunity, affect people's physical function and reduce the quality of life[15].

Quality of life(QoL) refers to a person's personal perception of psychological, emotional, and social status[16]. As a special group of the elderly, the empty-nest elderly lacked family care for a long time, their emotional comfort was scarce and their ability to use all kinds of social basic resources independently was weak, so the QoL of them needs to be paid more attention. Mental health plays an important role in maintaining the quality of life of empty-nest elderly [17]. However, previous research has been limited as it has not examined the relationship between empty-nest elderly's mental health profiles and their quality of life.

The aim of this study was to investigate whether different mental health profiles exist among Chinese empty-nest elderly. LPA was used to classify empty-nest elderly who showed similar mental health patterns into a certain profile. Associations of the profiles with quality of life were then examined.

Methods

Ethics statement

The study protocol was in accordance with the ethical standards and was approved by the Ethics Committee of Harbin Medical University. Written informed consent was obtained from each participant. Information collected from all participants was kept confidential and anonymous.

Study design and participants

A multistage stratified random sampling method was used. Step 1: We selected one region randomly from three regions of Chifeng City, and then six streets were selected from this region randomly. Finally, we selected three communities from each street randomly with a total of 18 residential committees extracted.

Step 2: Using simple random sampling in accordance with the information provided by community workers, empty-nest elderly were selected randomly from the 18 residential committees. All the respondents completed a household questionnaire survey and provided informed consent after receiving information about the goals and the methods of the investigation. Initially, 398 questionnaires were issued and 350 were received, for a recovery rate of 87.94%. Participants were measured between August 2016 to March 2018.

The inclusion criteria included: (1) local residents with age ≥ 60 ; (2) understand the survey content and agree to participate; (3) living alone or with their spouse or older parents. Exclusion criteria: (1) childless; (2) severe cognitive impairment or mental illness.

Measures

Demographic characteristics

The demographic characteristics were collected with a general information questionnaire designed by our panel, which included gender, age, education, marital status, household monthly income.

Measurement of Mental Health

The Elderly Mental Health Questionnaire, used to assess mental health status in the elderly, was developed by Zhenyun Wu[18]. Mental health was measured using five dimensions, which included ego, emotion, adaptive capacity, interpersonal communication, and cognitive function. The questionnaire consists of 68 items. Each item has four response categories ranging from "do not agree" (1 point) to "agree" (4 points), and higher scores indicated better mental health. The questionnaire has been used in Chinese older men and demonstrated good reliability and validity, with Cronbach's alphas for the total scale and subscales of 0.58-0.89.

Measurement of QoL

This study applied the Chinese version of the SF-36, which consists of 36 items to evaluate the quality of life (QOL) of participants[19]. One item assesses the perceived change in health status, and the remaining 35 items assess the physical and mental components of health[20]. The SF-36 included 8 dimensions: physical functioning (PF), role-physical (RP); bodily pain (BP); general health (GH); vitality (VT); social functioning (SF); role-emotional (RE) and mental health (MH). These 8 dimensions are summarized in 2 categories that physical component summary (PCS) and mental component summary (MCS). PCS includes PF, RP, BP and GH. MCS includes VT, SF, RE, and MH. Each dimension score was converted to a range from 0 to 100, with a high score indicating better levels of functioning. This scale has good reliability in the evaluation of the quality of life of the elderly, the Cronbach's α of the SF-36 was 0.780[21].

Data analyses

Means and standard deviations for all variables were computed with SPSS software version 22.0. Spearman correlations were used to analyse the correlation between age, gender, education level, marital status, household monthly income, mental health, and quality of life, P-values equal or lower than 0.05 were considered statistically significant.

The latent profile approach (LPA) was conducted in Mplus 7.4 in order to explore the potential classification of mental health among empty-nest older adults. The best-fitting model was selected by examining indices of model fit and interpretability of the model. To determine the model fit, Akaike information criterion (AIC), Bayesian information criterion (BIC), and adjusted BIC (aBIC), Lo-Mendell-Rubin (LMR), Bootstrapped Likelihood Ratio Test (BLRT), and Entropy were adopted and examined. The AIC provided a measure of fit considering the number of model parameters. The BIC and aBIC are indicators in which both sample size and number of model parameters are considered. Smaller values of AIC, BIC, aBIC suggest an improved model fit. Entropy is a means to evaluate how well each group originating from LPA, with values equal or greater than 0.80 demonstrating a better result[22]. LMR and BLRT are adopted to compare the estimated model and a model with k-1 profile(s), with k indicating the number of profiles (Nylund et al., 2007). For the LMR and BLRT, a lower and significant p-value signifies a superior estimated model compared to the model with one less profile[23].

To examine the effect of age, gender, degree of education, marital status and household monthly income on mental health profiles, a three-step approach was adopted[24] based on a kind of regression mixture modeling with Mplus, including covariates[25]. Data analyses were performed in Mplus 7.4.

Results

Description of the participants

A total of 350 participants with a mean age of 71.05 years (SD = 6.22) completed the survey. The percentage of participants with an education level from primary school to university was 51.1%-8%. Of all the participants, 72.9% reported to be married. 154 (44%) were male, and 196 (56%) were female as shown in Table 1.

Table 1 Demographic characteristics.

Demographics	Classification	Frequency	Percent	Cumulative percent
Gender	Female	196	56	56
	Male	154	44	100
Age	60-70	155	44.3	44.3
	70-80	143	40.9	85.1
	≥80	52	14.9	100
Education level	Primary school and below	179	51.1	51.1
	Secondary school	93	26.6	77.7
	High school	50	14.3	92.0
	College graduate or above	28	8.0	100
Marital status	Married	255	72.9	72.9
	Single (never married, divorced, separated and widowed)	95	17.1	100
Household monthly income	Low (≤1000 rmb)	176	50.3	50.3
	Middle (1001–2000 rmb)	127	36.3	86.6
	High (>2000 rmb)	47	13.4	100

Correlation analyses between the variables

As presented in Table 2, total score of mental health of the elderly was positively related with education level, household monthly income, role-physical, physical functioning, general health, vitality, social functioning, role-emotional, mental health, total score of quality of life ($r=0.618^{**}, 0.407^{**}, 0.711^{**}, 0.869^{**}, 0.681^{**}, 0.554^{**}, 0.470^{**}, 0.649^{**}, 0.677^{**}$ and 0.701^{**} , respectively). The total score of mental health of the elderly was negatively correlated with gender, age, marital status, bodily pain ($r=-0.108^*, -0.395^{**}, -0.131^*$ and -0.303^{**} , respectively).

Table 2 Correlation analysis among variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.gender	1.000	.002	-.169**	-.013	-.062	-.108*	.051	-.056	.043	-.029	.199*	.206**	-.013	.129*
2.age	.002	1.000	-.431**	-.288**	.019	-.395**	-.372**	-.298**	.144**	-.332**	-.276**	-.261**	-.319**	-.336**
3.Eu	-.169**	-.431**	1.000	.576**	-.033	.618**	.575**	.551**	-.314**	.562**	.408**	.355**	.523**	.509**
4.Hmi	-.013	-.288**	.576**	1.000	.062	.407**	.400**	.409**	-.196**	.373**	.311**	.264**	.343**	.368**
5.Mar	-.062	.019	-.033	.062	1.000	-.131*	-.110*	-.130*	.016	-.071	-.126*	-.097	-.076	-.124*
6.EMH	-.108*	-.395**	.618**	.407**	-.131*	1.000	.711**	.869**	-.303**	.681**	.554**	.470**	.649**	.677**
7.RP	.051	-.372**	.575**	.400**	-.110*	.711**	1.000	.638**	-.382**	.728**	.826**	.730**	.720**	.925**
8.PF	-.056	-.298**	.551**	.409**	-.130*	.869**	.638**	1.000	-.328**	.615**	.509**	.417**	.584**	.608**
9.BP	.043	.144**	-.314**	-.196**	.016	-.303**	-.382**	-.328**	1.000	-.341**	-.285**	-.257**	-.343**	-.325**
10.GH	-.029	-.332**	.562**	.373**	-.071	.681**	.728**	.615**	-.341**	1.000	.483**	.390**	.976**	.581**
11.VT	.199**	-.276**	.408**	.311**	-.126*	.554**	.826**	.509**	-.285**	.483**	1.000	.800**	.469**	.933**
12.SF	.206**	-.261**	.355**	.264**	-.097	.470**	.730**	.417**	-.257**	.390**	.800**	1.000	.376**	.848**
13.RE	-.013	-.319**	.523**	.343**	-.076	.649**	.720**	.584**	-.343**	.976**	.469**	.376**	1.000	.564**
14.MH	.129*	-.336**	.509**	.368**	-.124*	.677**	.925**	.608**	-.325**	.581**	.933**	.848**	.564**	1.000
15.QOL	.143**	-.354**	.499**	.355**	-.135*	.701**	.891**	.616**	-.110*	.687**	.886**	.817**	.669**	.935**

Edu: education level; Hmi: Household monthly income; Mar: Marital status; EMH: Elderly Mental Health, PF: Physical functioning, RP: role-physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role-emotional; mental health (MH); QOL: Total score of quality of life

* $p < 0.05$, ** $p < 0.01$.

Latent profile analysis

Table 3 provides the fit indices for the LPA models. Two- and three-class models both had significant LMR and BLRT results at $p < 0.05$. However, the three-class solution provided a better fit than the two-class model, as AIC and BIC for the former were lower, while also showing a good value of Entropy. Therefore, the three-class model was selected as most appropriate.

Table 3 Model fit indices for one- to five-profile pattern of Mental Health dimensions and profile prevalence (%) of LPA

Profiles	m	Log(L)	AIC	BIC	aBIC	Entropy	LMR	BLRT	Category probability (%)
1	10	-5452.36	10924.72	10963.30	10931.58				
2	16	-4500.29	9032.58	9094.31	9043.55	0.984	<0.01	<0.01	78.03/21.98
3	22	-4203.76	8451.51	8536.39	8466.59	0.952	<0.01	<0.01	61.29/22.63/16.08
4	28	-3992.92	8041.83	8149.85	8061.02	0.935	0.0665	<0.01	43.5/32.31/11.28/12.91
5	34	-3877.53	7823.07	7954.23	7846.37	0.932	0.4579	<0.01	24.86/38.12/15.70/9.20/12.14

Note. The values in the LMR and BLRT columns are the p values related to LMR and BLRT in comparing fit between models. m = the number of free parameters; AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; LMR = Lo-Mendell-Rubin; BLRT = Bootstrapped Likelihood Ratio Tests;

As shown in Table 4, the probabilities of Profiles 1, 2 and 3 of the three-profile model were 98%, 97% and 99.9%, respectively. These indices suggested a good discriminability and reliable classification of the three-profile model.

Table 4 Average latent profile probabilities for most likely profile membership (row) by latent profile (column)

Profile	1(n=217)	2(n=77)	3(n=56)
1	0.98	0.02	0.000
2	0.03	0.97	0.004
3	0.00	0.001	0.999

Note. The columns refer to latent class, and the rows refer to most likely profile membership.

The scores of the three potential categories of mental health of empty nest elderly are as follows (Figure 1, Table 5): Profile 1 was the group with low ego, emotion, adaptive capacity, interpersonal communication, and cognitive function. The participants who possessed this profile comprised 61.3% of the sample. All the dimensions are at a lower level. We named this profile "low mental health." Profile 2 was the group with a moderate level of ego, emotion, adaptive capacity, interpersonal communication, and cognitive function. We named this profile "moderate mental health". This group comprised 22.6% of the sample. Profile 3 was the group with high level of ego, emotion, adaptive capacity, interpersonal communication, and cognitive function. We named this profile "high mental health," and it comprised 16.1% of the sample.

Table 5 Mean, standard deviation, and normalized score for mental health dimensions of the three profiles

Dimension	Class1	Class2	Class3	Normalized score
Ego	18.47± 3.61	23.74± 6.44	32.50± 2.68	35.42±5.70
Emotion	32.66 ± 3.42	38.10 ± 6.49	46.41± 3.10	45.52±8.69
Adaptive capacity	43.68 ± 4.24	49.28 ± 5.59	57.85± 3.64	56.01±9.49
Interpersonal communication	16.672± 3.37	22.11± 6.65	30.98±2.87	30.27±6.16
Cognitive function	17.91± 3.68	22.76± 4.44	29.88± 3.00	26.36±5.46

Age, gender, marital status, degree of education, and household monthly income effect on the best-fitting latent profile of mental health's five dimensions

Gender, age, marital status, degree of education, and household monthly income were the independent variables; three potential categories of mental health were the dependent variable; and multinomial logistical regression was used to verify the significant factors that predicted potential categories of mental health, and take the Class1 as the reference group. The results of the three-step approach showed that when compared to the reference group, age, degree of education and marital status help to predict the potential categories of mental health, while other variables have no significant effect on the potential categories of mental health among empty-nest older adults, as shown in Table 6.

Table 6 Multinomial logistical regression results of demographic data on the three-profile model

Variable	Class2				Class3			
	β	SE	β /SE	P	β	SE	β /SE	P
Gender	-0.68	0.35	-1.92	0.06	-0.81	0.50	-1.62	0.11
Age	-0.08	0.03	-2.97	0.00	-0.13	0.05	-2.68	0.01
Degree of education	1.26	0.32	3.99	0.00	2.57	0.52	4.99	0.00
Marital status	0.08	0.23	0.34	0.73	-0.78	0.39	-2.02	0.04
household monthly income	0.35	0.32	1.10	0.27	0.07	0.48	0.14	0.88

Comparing quality of life of mental health profiles

To examine the outcomes of the three profiles, we compared the differences between quality of life and the related dimensions of each profile on the SF-36.

Table 7 presents the comparison of SF-36 outcome means among the three profiles

Variable		low mental health		moderately mental health		high mental health		F	η^2	Post hoc
M	SD	M	SD	M	SD	M	SD			
RP	62.95	5.26	70.53	4.98	75.91	6.72	149.72**	0.46	C1<C2<C3	
PF	53.12	2.97	58.10	2.74	64.64	5.04	283.55**	0.62	C1<C2<C3	
BP	73.58	13.18	69.27	11.66	62.57	16.50	15.58**	0.08	C1<C2<C3	
GH	54.65	3.78	60.40	4.84	66.54	6.48	168.06**	0.49	C1<C2<C3	
VT	59.58	12.02	69.29	10.60	76.68	11.12	57.12**	0.25	C1<C2<C3	
SF	61.34	9.70	67.56	10.08	74.25	10.48	41.70**	0.19	C1<C2<C3	
RE	64.81	4.99	72.47	6.52	77.86	8.96	120.63**	0.41	C1<C2<C3	
MH	58.16	6.86	65.97	6.31	72.57	6.50	119.26**	0.41	C1<C2<C3	

* $p < 0.05$, ** $p < 0.01$.

PF: Physical functioning, RP: role-physical; BP: bodily pain; GH: general health; VT: vitality ;SF: social functioning; RE: role-emotional; mental health (MH);

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*p < 0.05, **p < 0.01.

Discussion

The purpose of this article was to identify latent profiles of empty-nest elderly's mental health and then to examine how these different profiles were associated with empty-nesters' quality of life. In this study, we used latent profile analysis (LPA) to detect latent classes of mental health among empty-nest elderly. This classification method was objective which used five factors of the mental health, including ego, emotion, adaptive capacity, interpersonal communication, and cognitive function. This approach resulted in division of the data collected from 350 empty-nest elderly adults into three distinct profiles. The three-cluster model proved to be the best solution based on the model accuracy indices and with regard to reflections on the findings. A total of 217 cases experienced poor mental health, accounting for 61.29%; 77 experienced moderate level of mental health, accounting for 22.63%; 56 cases experienced a higher level of mental health, accounting for 16.08%.

Empty nesters with low mental health (Profile 1) represented the largest group (61.3% of the total sample), and they reflected just below-average scores on all five components, were characterized by low level of ego, disharmonious interpersonal communication and poor cognitive function, the main manifestations are emotional instability, poor adaptability, difficult to cope with stress events, weak frustration tolerance and resilience, inappropriate self-evaluation, easy to underestimate themselves, and poor interpersonal skills. The result shows that low mental health group is psychologically fragile, has certain risks in the face of stress or setbacks, and may develop into serious psychological problems. Therefore, this group is the object that needs special attention in practical work, and early targeted intervention is helpful to improve the mental health level of the empty-nest elderly adults. Community workers should give them mental health education in time, prevent psychological obstacles and, if necessary, carry out psychological counseling to improve their mental health status[26].

The group situated between the low and high mental health empty-nest elderly (Profile 2) represented 22.6% of the total sample. They demonstrated a moderate level of mental health, however, the score of interpersonal communication ability dimension is low[27]. The interpersonal relationship of the empty-nest elderly adults is mainly reflected in the relationship between husband and wife, with their children and friends. Due to the narrowing of the scope of social communication, elderly parents turn their attention to their children, but empty-nest elderly's families weaken the emotional relationship between elderly parents and their children to a certain extent, because lack the companionship of their children, empty-nest elderly are prone to negative emotions such as anxiety, pessimism and loss, which are strong or lasting repeated experiences, that is, they become a kind of long-term spiritual stimulation. It is bound to cause varying degrees of harm to the mental health of the empty nest elderly. And with the increase of age, the lack of physical strength and the inconvenience of movement will seriously affect the interpersonal communication of the elderly[28]. Therefore, the establishment of good interpersonal relationship is of great significance to the maintenance of mental health of the general empty nest elderly. The community should actively organize various types of activities for the elderly and distribute small gifts to provide the enthusiasm of the elderly to participate in activities and expand the scope of

interpersonal communication. Empty-nest elderly are encouraged to increase their social participation through the Internet or telephone, so as to enrich their inner life and improve their mental health.

Empty-nest elderly with high mental health (Profile 3) represented nearly 16.1% of the total sample, but the score of cognitive function dimension was lower than that of the norm, which is consistent with a previous study[29]. Cognitive function is not only a sensitive index of normal aging of psychological function, but also a measure of pathological aging (such as Alzheimer's disease). Cognitive aging has a negative impact on the quality of life and mental health of empty-nest elderly. According to the emotional ABC theory[30], if the belief and cognition of the empty nest elderly can be corrected, the negative life experience will be weakened, which shows that the cognitive correction and self-regulation of the empty nest elderly is very important. Empty-nest elderly actively participate in various sports and intellectual activities and maintain an optimistic and cheerful state of mind, which plays a promoting role in delaying the decline of cognitive function[31]. Therefore, delaying cognitive aging will be an important aspect of mental health maintenance for empty-nest elderly. Regarding quality of life, our profile-based findings mirror the results of studies using other approaches (i.e. variable-centered approach, which dominated empirical nursing care research) that have found that empty nesters with higher levels of mental health tend to enhance their quality of life.

This study further discussed the differences of mental health potential categories of empty nest elderly in related demographic variables. The distribution of mental health subtypes of empty-nest elderly has no significant difference in gender and family monthly income, but has significant difference in age, education level and marital status. With advanced age and low level of education, single empty nesters are more likely to be distributed in "low mental health" groups. With the growth of age, the physical health and mental health of the elderly have appeared a series of problems, and the special group of empty-nest elderly due to aging and family factors, their mental health status is more worrying. Previous studies have shown that the negative detection rates of depression and anxiety among community empty nesters are 23.2%[32] and 24.7%[33], respectively. Poor mental health significantly reduces the quality of life of empty-nest elderly, and is also closely related to senile dementia, chronic disease and death[34]. The empty-nest elderly with a higher level of education have more ways of entertainment and a richer life; at the same time, they can master some psychological common sense and adjust their bad mood in time, so as to effectively dispose of loneliness and loneliness in life[35]. Marital status has a significant effect on the subgroup classification of mental health of the empty-nest elderly. The mental health level of the single empty-nest elderly is lower than that of the married empty-nest elderly, which may be related to their living alone and lack of family warmth[36]. A sound family structure can give adequate support to the elderly at the material and spiritual levels. At the same time, full communication and emotional sharing with spouses also reduce the loneliness of the elderly to a certain extent, which is conducive to improving the mental health of the elderly. Age, education level and marital status are not only important factors affecting mental health, but also important factors of potential category differentiation of empty nest elderly.

Limitations

Although the current study yielded important and practical findings on the targeted intervention and guidance, several limitations should be noted. First of all, cross-sectional data limits the interpretation of the findings as causal claims cannot be made. Where possible, future research should aim for longitudinal data collection to better understand the process of mental health development among empty-nest elderly. Second, the sample population of empty-nest elderly included only a few selected communities of Chifeng City in Inner Mongolia. Thus, these findings may not be representative of the older adults in other geographic areas within the province.

Conclusions

The results of this study suggest that there are three profiles of empty-nest elderly in regard to mental health: low mental health, moderate mental health, and high mental health. In addition, our study has shown that empty-nest elderly with low mental health, moderate mental health, and high mental health have significant differences in their quality of life. As such, this study provides compelling evidence that focusing on the specific dimensions of mental health, and the patterns in which they actually occur in empty-nest elderly people. Therefore, different interventions for different profiles of empty-nest elderly are beneficial to raise all the empty-nest elderly's mental health and quality of life. These results provide a new and expanded view of empty-nest elderly's mental health, which can help China's leaders better target investments and create policies aimed at improving the mental health and quality of life among empty-nest elderly in China.

Abbreviations

LPA: latent profile analysis; QoL: Quality of life; AIC: Akaike information criterion, BIC: Bayesian information criterion, aBIC: adjusted BIC, LMR: Lo-Mendell-Rubin, BLRT: Bootstrapped Likelihood Ratio Test.

Declarations

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Authors' contributions

Hong Su made the contributions on study design, data collection, analysis, interpretation, and wrote the paper. Yuqiu Zhou provided guidance in the study design, and is the corresponding author. Yunjiang Cai made contributions on investigation execution and data analysis. Yun Wang assisted with the data interpretation. All authors have read and approved the final version of the manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

All patients provided their informed written consent. The study was approved by the Ethics Committee of Harbin Medical University and was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

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Figures

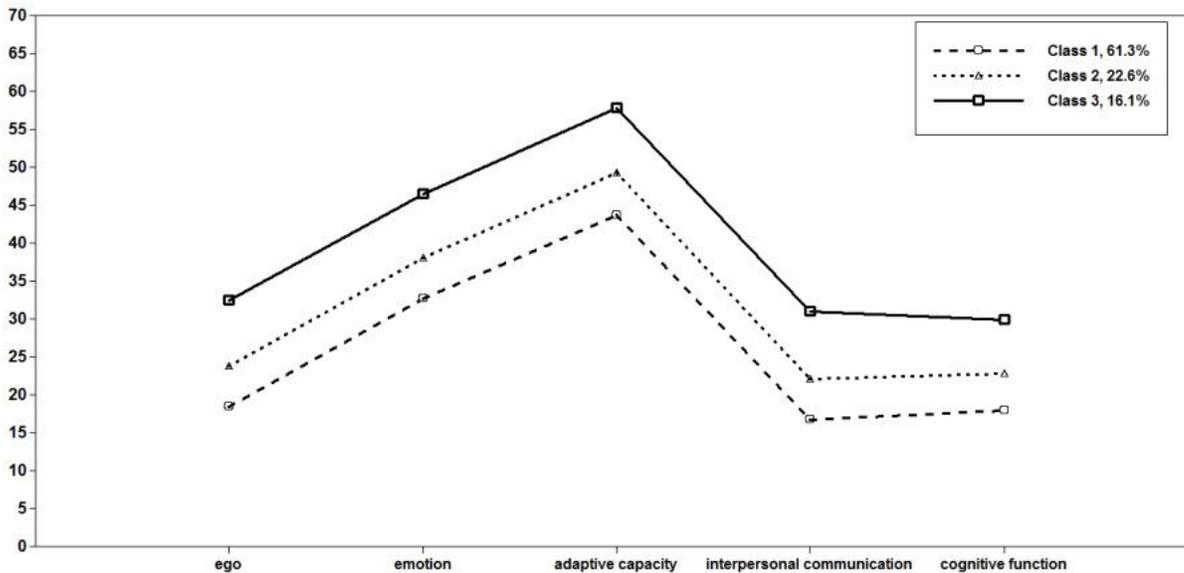


Figure 1
Mean scores on ego, emotion, adaptive capacity, interpersonal communication, and cognitive function of mental health in Chinese empty-nest older adults