

# Mediation Role of Health Service Use and Depression on Multimorbidity and Self-rated Health in Home-based Long-term Care Residents: a Cross-sectional Study

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## Research

**Keywords:** Multimorbidity, Self-rated health, Depression, Health Service Use, Mediation, Structural equation modeling

**Posted Date:** May 4th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-446881/v1>

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# Abstract

**Background:** Multimorbidity is common among older people and a major cause of reduced quality of life. The study aim was to investigate the relationship between multimorbidity and self-rated health and its mediators in home-based long-term care residents.

**Methods:** Participants were 1067 home-based long-term care residents covered by long-term care insurance in Shanghai. Stratified sampling was used to select participants from six Shanghai districts. Data were collected using face-to-face interviews. Multimorbidity was defined as co-occurrence of  $\geq 2$  chronic diseases in the same person. The 30-item Geriatric Depression Scale was used to assess depressive symptoms. Structural equation modeling was used for data analysis.

**Results:** The findings showed that 59.4% of participants had multimorbidity and 67.7% reported depressive symptoms. The mean self-rated health score was 1.97 (standard deviation [SD] = 0.861) and mean health service use frequency was 1.61 (SD = 3.406) per month. Compared with participants with no multimorbidity, those with multimorbidity were more likely to report low self-rated health ( $\beta = -0.141$ ,  $p < 0.001$ ), more severe depressive symptoms ( $\beta = 0.100$ ,  $p < 0.001$ ), and more health service use ( $\beta = 0.121$ ,  $p < 0.001$ ). Low self-rated health may be caused by depression and health service use ( $\beta = -0.280$ ,  $p < 0.001$ ). The effect of multimorbidity on self-rated health was significantly mediated by depression ( $\beta = -0.024$ ,  $p < 0.001$ ) and health service use ( $\beta = -0.034$ ,  $p < 0.001$ ).

**Conclusion:** Multimorbidity is associated with self-rated health, and depression and health service use mediate this association. Prevention and proper management of multimorbidity and depression in long-term care residents may help to maintain and improve quality of life.

## Introduction

The global population is rapidly aging; the number of older adults (> 60 years) has been estimated as 1049 million in 2020 (13.4% of the total global population). As one of the most rapidly aging countries in the world, China has an estimated 249 million older adults (> 60 years) in 2020 (17.3% of the total population), and the number will reach 363 million in 2030 (24.8% of the total population)[1]. However, increased life expectancy is not necessarily associated with better quality of life[2]; aging is generally associated with chronic multimorbidity[3]. Faced with an increase in the number of older adults and a decrease in quality of life, the Chinese Ministry of Human Resources and Social Security issued guidelines on June 27, 2016, about implementing a long-term care insurance (LTCI) policy in 15 pilot cities. The LTCI is a social insurance system that provides basic life care and daily nursing services to disabled and older adults[4]. Home-based long-term care is the main type of long-term care. It provides more than just illness care; it aims to enable individuals with multimorbidity or disabilities to live their lives as fully as possible[5].

Multimorbidity, the co-occurrence of two or more chronic physical conditions[6], is common among older people. As the global population ages, the prevalence of disease has been increasing[7]. A systematic

review of the prevalence of multimorbidity found that 6.4–76.5% of individuals aged 60 years or more in China had multimorbidity[8]. The growing epidemic of multimorbidity has posed tremendous challenges, not only for individuals and their families[9], but also for public health policy and health care systems[10]. The growing prevalence of multimorbidity demands a greater understanding of its effects on overall patient health[6]. Compared with people with a single illness, people with multimorbidity require more complex management of their medical needs that should entail consideration of social and emotional functions[11]. In addition, multimorbidity is associated with a wide range of disabilities, functional decline, and poor quality of life[12].

Self-rated health is a subjective assessment of mental and physical wellness, and is associated with morbidity, mortality, and health care utilization[13, 14]. For patients with a chronic disease and for long-term care residents, self-rated health tends to reflect reduced activities of daily living and long-term risk of mortality[15, 16]. Chronic diseases affect people's ability to perform daily activities, and such individuals usually experience a decline in their quality of life[17, 18]. Most studies on the association between self-rated health and multimorbidity focus on specific populations or specific diseases or disease groups. For example, among middle-aged and older adults, poorer self-rated health is strongly associated with single chronic diseases, particularly cardiovascular diseases, multimorbidity, and poor psychosocial function[19]. However, different groups may show differences in the validity of self-rated health as a predictor of mortality risk[20].

Factors that mediate the association between multimorbidity and self-rated health in long-term care residents have rarely been explored. Identification of such factors is essential to develop effective measures to improve self-rated health in this population. Depression and health service use may mediate the relationship between multimorbidity and self-rated health. Depression is a clinically significant and growing public health issue and the third leading cause of disability worldwide[21]. Multimorbidity may increase the risk of depression in elderly people through physiological, pharmacological, or psychological mechanisms[22], and may thus affect self-rated health[23]. Furthermore, individuals with multimorbidity report poorer self-rated health with certain disorders because of depression[20]. Multimorbidity and self-rated health are closely related to health service use. Long-term care residents showed higher proportions of multimorbidity and health service use[24]. In addition, both multimorbidity and depression increase the frequency of health service use[22, 25], and frequent health service use is usually accompanied by lower self-rated health[26].

Thus, in this population-based study, we aimed to a) explore the associations between multimorbidity and self-rated health among Chinese community-based long-term care residents, and b) test the extent to which the association between multimorbidity and low self-rated health is mediated by depression and health service use. We hope that our findings will contribute to improving the quality of life of elderly people and help them to respond positively to the aging process.

## Methods

# Study Design and Population

The analyses were carried out using data from a cross-sectional study conducted in Shanghai. Shanghai, on the eastern coast of China, is one of the LTCI policy pilot cities and is divided into 17 districts, which are further grouped into eight central urban areas, and nine suburbs[27]. Shanghai is an aging city; there are 5.18 million older adults (> 60 years) in the city (35.2% of the total population). As a response to aging challenges, Shanghai introduced an LTCI program for elderly people in 2017. The program covers elderly people aged over 60 years who participate in public health insurance schemes, and it reimburses approximately 85–90% of health care costs[28].

Stratified sampling was used to select research subjects. We first selected three Shanghai LTCI pilot areas: Xuhui, Putuo, and Jingan districts. Then, considering the environmental, social, and economic differences between the centre, inner suburbs, and outer suburbs, we randomly selected Jinshan, Baoshan, and Songjiang districts from the above three areas. One street was selected from the six districts according to the stroke order of one Chinese character from the street name. Finally, one to three communities from the six streets were randomly selected and elderly people from those communities randomly selected according to their age. The exclusion criteria were (a) < 60 years old; (b) not covered by Shanghai LTCI; (c) unable to cooperate with the investigator owing to severe cognitive impairment or hearing, language, expression, or other deficits. The present analysis used data from 1067 participants with complete data for the variables analyzed.

The survey was conducted by trained investigators who provided guidance to participants in the form of one-to-one discussions or help filling out the questionnaires. All participants voluntarily participated in the survey after providing their informed consent.

## Measurement

### Multimorbidity

We assessed the presence of 17 self-reported diseases or conditions by asking “Have you been diagnosed with the following conditions by a doctor”: hypertension; diabetes or high blood sugar; cancer; heart disease; stroke; chronic lung disease; digestive disease; arthritis or rheumatism; intervertebral disk disease; chronic low back pain; eye disease; psychiatric disease; varicose veins; osteoporosis; cholecystitis; urinary tract stones; and anemia. Chronic lung diseases included medically diagnosed bronchitis, pneumonia, emphysema, chronic obstructive pulmonary disease, and tuberculosis. Eye diseases were defined as medically diagnosed cataract, glaucoma, or vision loss. Multimorbidity was defined as co-occurrence of two or more of the 17 chronic diseases in the same person [6].

### Self-rated health

Self-rated health was measured using an item that was developed and used by the World Health Organization[29]. Participants were asked, “Generally speaking, in comparison with other people of your age, how do you feel about your physical condition?” Possible responses were very good, good, fair, poor, or very poor.

## Mediating Variables

Depressive symptoms were assessed using the validated Chinese version of the 30-term Geriatric Depression Scale (GDS-30). The GDS-30 has been widely used in many countries and is an effective measure of depression in elderly people in long-term care[30, 31]. Each scale item is a question with the possible responses of “yes” or “no.” The total score ranges from 0 to 30 points; scores  $\geq 11$  are considered to indicate depressive symptoms. The GDS-30 has shown high sensitivity and specificity with older Chinese samples, and Cronbach’s  $\alpha$  is 0.890, indicating good internal consistency[32].

Health service use was measured using three indicators: average number of outpatient visits per month in the last year, number of hospitalizations in the last year, and average number of emergency department visits per month in the last year. The combined frequency of these three indicators was used as the measure of health service use.

## Covariates

To control potential confounding variables, age (years), gender, and income (yuan/per month) were examined as adjustment variables.

## Statistical Analysis

Descriptive statistics were used to summarize the distribution of participant characteristics, categorical variable frequencies (percentages), and the means of continuous variables (standard deviation, SD).

Structural equation modeling was used to investigate the associations between multimorbidity, self-rated health, and potential mediators. This is an excellent statistical technique to evaluate a priori models, identify mediators, and elucidate direct and indirect paths between variables. Multimorbidity was treated as an exogenous variable and used to estimate the following two variables: the latent variable (depression) and the observed variable (health service use) (Fig. 1). The maximum likelihood method was used to estimate model parameters. The model fit was estimated using the following indicators: (a) ratio of chi-square value to degrees of freedom ( $\chi^2/df$ )  $\leq 3$ ; (b) comparative fit index (CFI)  $\geq 0.90$ ; (c) standardized root mean square residual (SRMR)  $< 0.05$ ; (d) root mean square error of approximation (RMSEA)  $< 0.05$ [33]. Descriptive analyses were performed using SPSS 25.0 Statistics for Windows, version 25.0 (IBM Corp, Armonk, NY, USA) and Mplus, version 7.4 (Muthen & Muthen, Los Angeles, CA, USA) was used for the structural equation modeling.

## Results

### Characteristics of the Study Participants

For the 1067 participants, the mean age was 82.33 (SD = 8.010) years, the mean income was 3141.50 (SD = 2.379) yuan per month, and 58.8% were women. Of participants, 19.0% had no chronic disease, and 21.6%, 23.8%, 19.6%, and 16.0% had one, two, three, and four or more chronic diseases, respectively. The average number of chronic diseases per participant was 2.05 (SD = 1.648); 59.4% of participants had multimorbidity and 67.7% had depression. The mean self-rated health score was 1.97 (SD = 0.861) (the total possible score was 5). The mean frequency of health service use was 1.61 (SD = 3.406) per month (Table 1).

Table 1  
Baseline characteristics of participants

<b>Variables</b>	<b>Mean (SD)</b>	<b>N (%)</b>
<b>Age</b>	82.33(8.0)	
<b>Gender</b>		
Male		440(41.2)
Female		627(58.8)
<b>Income</b>	3141.50(2.4)	
<b>Chronic conditions</b>		
Numbers of chronic	2.05(1.7)	
No		203(19.0)
1		230(21.6)
2		254(23.8)
3		209(19.6)
≥ 4		171(16.0)
<b>Multimorbidity</b>		
Yes		634(59.4)
No		433(40.6)
<b>Depression</b>		
No		345(32.3)
Yes		722(67.7)
<b>Self-rated health</b>	1.97(0.9)	
<b>Health service use</b>	1.61(3.4)	
SD: standard deviation.		

Of the 17 chronic diseases examined, hypertension (58.58%) was the most common condition, followed by heart disease (38.61%) and diabetes (22.68%) (Fig. 2).

## Structural Equation Modeling

A structural equation model was built to estimate the relationships between multimorbidity, self-rated health, depression, and health service use (Fig. 1). The model fit indices, the standardized direct effects of four variables, and the indirect effects of two mediation variables are shown in Table 2 and Table 3 after adjusting for age, gender, and income. The model fit indices were as follows:  $\chi^2/df = 2.185$ , CFI = 0.987, SRMR = 0.023, RMSEA = 0.033, and indicate that the model had a good fit.

Table 2  
Model fit indices

Model Fit	Index
$\chi^2/df$	2.185
CFI	0.987
SRMR	0.023
RMSEA	0.033(0.020, 0.046)
CFI: confirmatory fit index; SRMR: standardized root mean square residual; RMSEA: root mean square error of approximation.	

Table 3  
Standardized direct and indirect effects

Variables	Standardized coefficient
<b>Direct effects</b>	
<b>Self-rated health</b>	
Multimorbidity	-0.141(-0.197, -0.086) **
Depression	-0.235(-0.295, -0.162) **
Health service use	-0.280(-0.333, -0.229) **
<b>Depression</b>	
Multimorbidity	0.100(0.039, 0.155) **
Health service use	0.075(0.014, 0.130) **
<b>Health service use</b>	
Multimorbidity	0.121(0.061, 0.181) **
<b>Indirect effects</b>	
Multimorbidity →Depression →Self-rated health	-0.024(-0.044, -0.005) **
Multimorbidity →Health service use →Self-rated health	-0.034(-0.059, -0.011) **
Multimorbidity →Depression →Health service use →Self-rated health	-0.002(-0.005, 0.000) *
<b>Total Indirect</b>	-0.141(-0.216, -0.069) **
** $p < 0.001$ , * $p < 0.05$ ; adjusted for age, gender, and income.	

## Relationships Among the Variables

The model showed that multimorbidity had a significant direct effect on self-rated health ( $\beta = -0.141$ , 95% CI = - 0.197 to - 0.086); participants with multimorbidity were more likely to report low self-rated health.

Multimorbidity was significantly associated with two mediating variables. Participants with multimorbidity were more likely to have depression symptoms ( $\beta = 0.100$ , 95% CI = 0.039 to 0.155) than those who did not have multimorbidity. Multimorbidity was also associated with more frequent health service use ( $\beta = 0.121$ , 95% CI = 0.061 to 0.181).

Associations were also found between self-rated health and the two mediating variables. Participants with higher GDS-30 scores had lower self-rated health ( $\beta = -0.235$ , 95% CI = - 0.295 to - 0.162). In

addition, self-rated health was significantly influenced by health service use ( $\beta = -0.280$ , 95% CI =  $-0.333$  to  $-0.229$ ); participants with lower health service use were more likely to report greater self-rated health.

Furthermore, the association between the two mediating variables of depression and health service use was significant: frequent use of health services was associated with greater depression ( $\beta = 0.075$ , 95% CI =  $0.014$  to  $0.130$ ). The direct effect and the indirect effect were significant both before and after the covariates were added to the model. (Table 3).

## Mediating Role of Depression and Health Service Use

The multiserial mediator model demonstrated that depression plays a potentially mediating role in the association between multimorbidity and self-rated health ( $\beta = -0.024$ , 95% CI =  $-0.044$  to  $-0.005$ ). Health service use also showed a mediating effect on the relationship between multimorbidity and self-rated health ( $\beta = -0.034$ , 95% CI =  $-0.059$  to  $-0.011$ ). In addition, the indirect effect of multimorbidity on self-rated health, via depression and health service use, was significant. Of the three potential mediating pathways, health service use had a stronger effect than the other pathways.

## Discussion

This study confirmed the correlation between multimorbidity and self-rated health in home-based long-term care residents: residents with multimorbidity were more likely to report low self-rated health. In addition to a direct association between multimorbidity and self-rated health, there was an indirect effect of multimorbidity on self-rated health through three potential pathways: via depression, via health service use, and via depression and health service use.

The results showed that 59.4% of home-based long-term care residents had multimorbidity, which is lower than the percentage of older people with multimorbidity in a previous longitudinal nationwide survey in China[34]. However, the difference may be a result of regional and participant differences. The mean self-rated health score in this study was 1.97, indicating that the health of home-based long-term care residents is poor. This result is the same as that of a previous study of long-term care residents in China[16]. We also found that 67.7% of home-based long-term care residents had depression, higher than in a previous study conducted with Chinese older adults[30]. This difference may reflect the poor physical condition of long-term care residents.

To our knowledge, this is the first population-based study of Chinese home-based long-term care residents to investigate the relationship between multimorbidity and self-rated health and the mediating role of health service use and depression. Previous studies have identified a correlation between multimorbidity and low self-rated health[17–19]. However, these studies have used different types of participants (e.g., older people in the community or in health facilities) or analytical methods (e.g., traditional regressions and correlations). Furthermore, the chronic diseases these studies focused on are frequently occurring diseases in the region. Although these studies differ in specific details, their findings

regarding the negative effect of multimorbidity on self-evaluated health are consistent, and are supported by the present findings.

We found that multimorbidity was associated with an increased likelihood of depression in home-based long-term care residents. One study conducted with community-dwelling elderly people in eastern China indicated that people with multimorbidity were more likely to have depressive symptoms (odds ratio = 1.42; 95% CI = 1.19 to 1.70)[35]. Previous research has suggested that some chronic diseases like diabetes, stroke, and thyroid disorders cause or contribute to depression by causing pathophysiological changes in the brain, endocrine system, or immune system[36, 37]. Our finding of a correlation between depression and self-rated health supports previous survey evidence of this association in African American men[20]. A study conducted in older people living in Shanghai found that both chronic disease and depression are predictors of self-rated health[22], and concluded that some depressive symptoms and depression-related negative emotions may lead elderly people to perceive their health negatively, thereby reducing their health satisfaction. These are possible explanations of our finding that depression mediates the association between multimorbidity and self-rated health. Some chronic diseases cause depression through pathophysiological changes, and multimorbidity aggravates depression symptoms (worse depression is associated with lower self-rated health).

We found that home-based long-term care residents with multimorbidity use health services more frequently, which has not previously been confirmed for long-term care residents, although previous studies on retired Chinese participants[38] and Canadian home care clients with dementia[39] have found such an association. Multimorbidity is associated with a wide range of disabilities and functional decline, which increase the demand for medical services. Unlike long-term health facility residents who have professional caregivers available 24 hours a day[40], people receive home-based long-term care services at a fixed time. This may explain the association between multimorbidity and health service use in home-based long-term care residents. This study showed an association between health service use and self-rated health, which reflects previous findings from Singapore[41]. Frequent health service use is often a result of poor health status, which is also the main reason for low self-rated health. In addition, health service use was also associated with depression in this study, indicating that depression may predict health service use to some extent. In a study on American older adults, depressive symptoms were positively related to health service use[42], which is consistent with our results. A possible reason for this association is that depressive symptoms lead older people to have a negative perception of their health, thereby increasing their use of health services. We found a mediating role of health service use and a multiserial mediation pathway by which depression and health service use affect the association between multimorbidity and self-rated health. These mediation pathways have been discussed in previous research[18, 25]. Multimorbidity may cause disability, functional decline, and depression and may increase the demand for medical services. Frequent health service use may lead elderly people to perceive their health negatively, thus reducing their self-rating of health.

There were several study limitations. First, there was a higher proportion of females (58.8%) than of males. This may be because individuals covered by LTCL are older; in this study, the mean age of

participants was 82.33 years. Second, a small number of participants with consciousness deficits were excluded, resulting in a slight decline in the efficiency of the questionnaire. Finally, the findings cannot be generalized to elderly people in long-term care facilities, and therefore cannot be used to provide guidance on improving the quality of life of elderly people in long-term care. These limitations need to be addressed in future research.

## **Conclusions**

The findings indicate that multimorbidity can aggravate depressive symptoms, increase the utilization of health services, and result in poor self-rated health. Furthermore, depression and health service use mediate the association between multimorbidity and poor self-rated health. This study explored possible pathways between multimorbidity and self-rated health. The findings may have implications for the proper management of chronic diseases, self-rated health, depression, and health service use. In the long term, our research findings may help to improve long-term care in elderly people with chronic diseases. Multimorbidity conditions, depressive symptoms, and access to health services should be assessed and considered when developing health management plans for long-term care residents. In addition, depressive symptoms and health service use frequency should be taken into consideration in efforts to prevent poor self-rated health in long-term care residents with multimorbidity.

## **Abbreviations**

LTCl: Long-term care insurance

## **Declarations**

### **Ethics approval and consent to participate**

The study was approved by the Fudan University Research Ethics Committee. (IRB# 2020-07-0840). Written informed consent was provided by all participants prior to answering the questionnaire, including consent for de-identified data to be used in publications arising from the research.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

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

### **Competing interests**

The authors declare that they have no competing interests.

## Funding

This work was supported by the National Natural Science Foundation of China (No.71974034) and the Anhui Health Development Strategy Research Center (No.0503011216). The views expressed are those of the authors. The funder has no role in the conduct of the research or the decision to submit this report.

## Authors' contributions

Study concept and design: Y.W., Z.H. and X.J.; acquisition of data: M.L. X.L. and T. Y.; analysis and interpretation of data: H.Y., W.P., Z.W. and C.L.; Drafting of the manuscript: H.Y..

## Acknowledgements

The authors are grateful to all participants who voluntarily agreed to complete the survey.

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## Figures

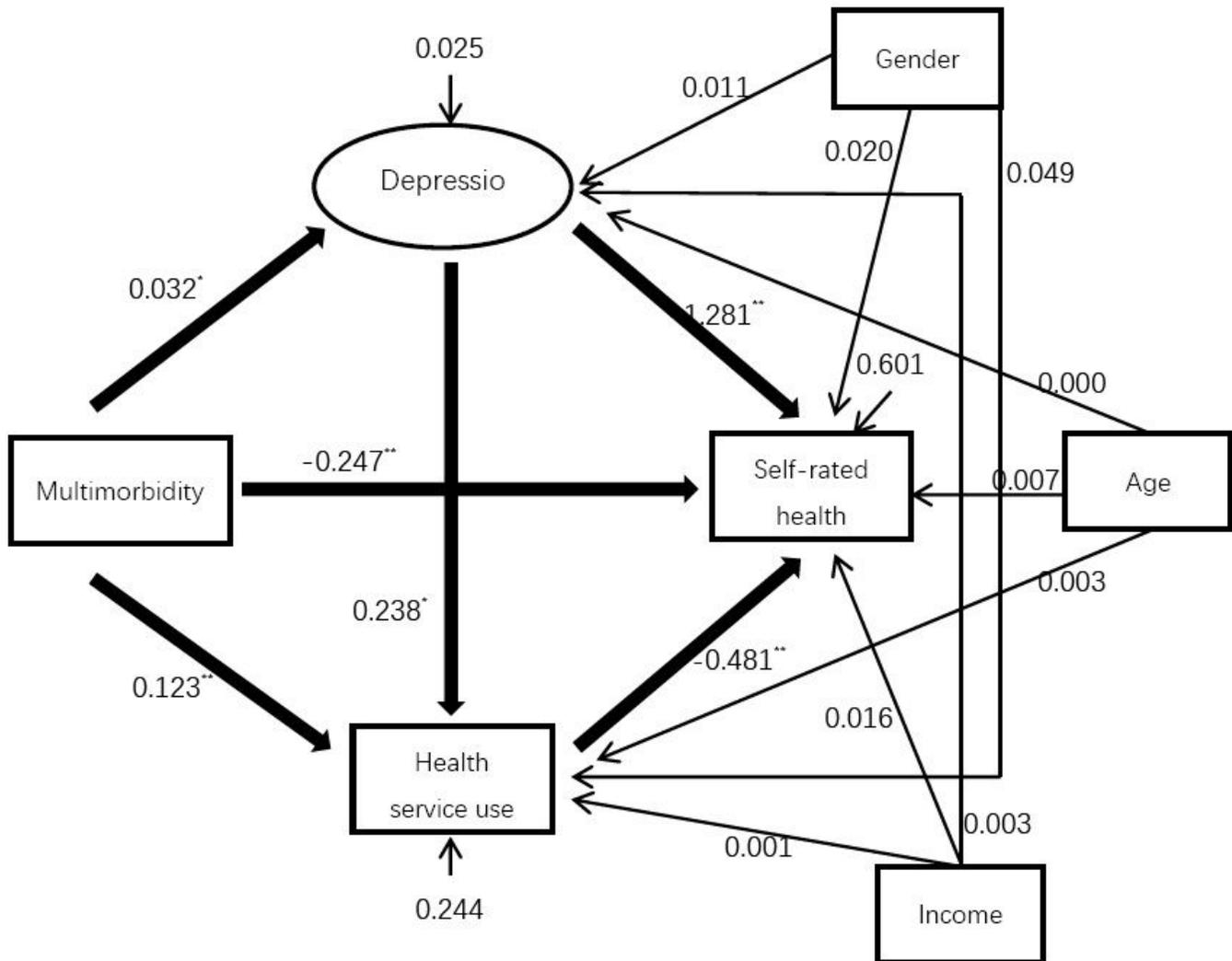


Figure 1

Results of the structural equation model. \*\* $p < 0.001$ , \* $p < 0.05$ ; adjusted for age, gender, and income.

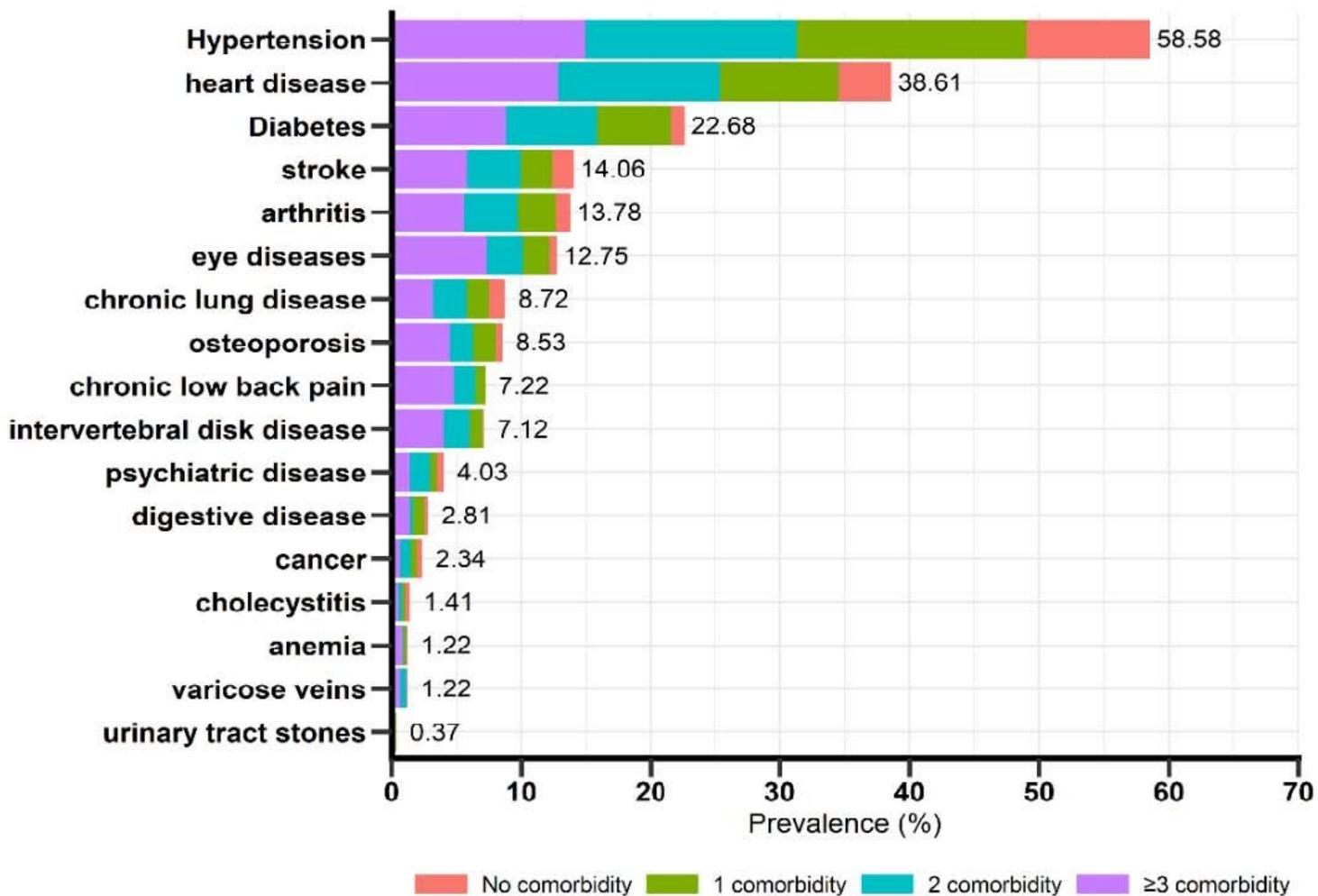


Figure 2

Prevalence (per 100 population) and multimorbidity (N = 1067).