Chronic condition change and its longitudinal association with health care utilization among rural older adults: intergenerational financial support as a possible moderator?

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Abstract

Background The prevalence of chronic conditions increases rapidly among older population. However, it is unclear how different chronic conditions progression contributes to the health care utilization, and whether intergenerational support modified this relationship. This study aimed to explore the longitudinal link between chronic condition progression and health care utilization, and examine whether intergenerational financial support is a moderator in this relationship among Chinese rural older people.

Methods Data was derived from the Shandong Rural Elderly Health Cohort (SREHC), which was conducted from 2019 to 2020. A total of 2,785 participants were included in this study. Kruskal-Wallis rank tests and generalized estimating equation (GEE) models were employed to analyze the association between chronic condition progression and health care utilization. Moderating effect analysis was performed using GEE model and margins plot.

Results Older people with progressive chronic conditions used more outpatient (no chronic condition to emerging multimorbidity: OR = 1.83; $p = 0.028$; one chronic condition to emerging multimorbidity: OR = 2.17; $p < 0.001$; remained multimorbidity while chronic conditions increased: OR = 3.26; $p < 0.001$) and inpatient services (no chronic condition to emerging multimorbidity: OR = 2.76; $p < 0.001$; one chronic condition to emerging multimorbidity: OR = 3.40; $p < 0.001$; remained multimorbidity while chronic conditions increased: OR = 5.32; $p < 0.001$) than those remained no chronic conditions. Intergenerational financial support may alleviate outpatient utilization of older people with multimorbidity (remained multimorbidity × intergenerational financial support: OR = 0.40; $p = 0.013$; remained multimorbidity while chronic conditions increased × intergenerational financial support: OR = 0.35; $p = 0.019$).

Conclusion This study showed that the changes of chronic condition were associated with health care utilization, and intergenerational financial support moderated this relationship. It is vital to continuously monitor and timely intervene the chronic condition progression among rural older people.

Keywords Chronic conditions change, Health care utilization, Older adults, Intergenerational financial support

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Introduction

With the rapid population aging and health care improvement, the global epidemiological pattern has progressively changed. Instead of acute diseases, most people are living with chronic conditions, which presents a great challenge to healthcare system worldwide [1]. One person with two or more types of chronic conditions is defined as having multimorbidity [2]. The prevalence of multimorbidity is increasing rapidly, especially among older population [3]. In China, there are 46% of older adults living with multimorbidity [4], which leads to poor quality of life, decrease in the ability of independent life, and increase in health care needs and utilization [5]. It brings great challenge and increasing burden to the health care system. The association between chronic condition and health care utilization among older adults has been widely explored by previous literature. A Chinese national study has indicated that the number of chronic conditions was positively associated with increasing utilization of outpatient and inpatient care [2]. Meanwhile, research in developed country also found that people with multimorbidity had higher consultation rates than those without multimorbidity, especially in rural areas [3, 6]. However, previous study mainly discussed the present status of chronic condition while neglecting the implication that different chronic condition progression on health care utilization among older adults.

Deterioration of health-related functions accompanied by multimorbidity was continuous and irreversible [7]. Studies have revealed the association between changes in multimorbidity and increasing long-term mortality risks among people with cardiovascular diseases [8] and cancer [9]. Stress process model revealed that the chronic condition progression of older adults was one possible stressor for their care provider, which was associated with health-related outcomes and healthcare utilization [10]. Without timely intervention and effective management, the development of chronic condition could lead to additional health problems [11], which might be related to more health care needs, higher health care costs and utilization among older people [1, 6, 12]. Previous research focused on the association using a cross-sectional study from a static perspective, and thus ignored changes in multimorbidity over time. To our knowledge, there is still a research gap in exploring the relationship between chronic condition progression and health care utilization in the longitudinal context. Chronic condition is a dynamic process, which has the possibility of both keeping unchanged and being progressive over time [13]. However, detailed knowledge about how chronic condition progression affects health care utilization is incomplete. To better understand the challenges on the healthcare system, the impact of the chronic condition progression on health care utilization should be carefully assessed [14].

In China, traditional filial piety culture plays an important role in the development of old-age care. It emphasizes that children provide intergenerational support including financial, labor, and emotional support for their parents [15, 16]. Intergenerational financial support refers to the economic support provided by offspring to parents, which is an important component of social support for older people [15]. With rapid socio-economic development and the trend of urbanization in Chinese rural areas, more and more young laborers migrate to urban areas while older adults are left behind. Children who live separately from their older parents are unable to provide labor and emotional support, and thus prefer to provide financial support to fulfill filial piety to their parents [15, 17]. Convoy Model of Social Relations proposed that the association between health-related stress and complicated medical regimens could be attenuated with crucial social ties, while intergenerational relationship was a vital social tie for older adults [18]. The intergenerational financial support was one of social support, and might impact the association between chronic conditions and health care utilization, which has been clarified in stress process model [10]. Higher level of intergenerational financial support has a positive effect on physical and mental health of older adults [17, 19]. But there is no consensus conclusion yet about the relationship between intergenerational support and health service utilization among older adults. Some studies found the strong association between weaker social relationships and increased hospital readmission [20]. Another research demonstrated that intergenerational financial support could improve health service utilization among rural older people [21]. However, few studies have examined whether intergenerational financial support moderates the relationship between chronic condition progression and health care utilization in later life.

According to stress process model and convoy model of social relations, the present study was to determine: (1) whether different chronic condition progression is associated with health care utilization. Specifically, how the chronic condition progression respectively contributes to the changes in health care utilization? (2) whether intergenerational financial support is a moderator in chronic condition progression-health service utilization relationship. Based on the findings of the current study, we can further confirm the crux of healthcare service delivery among rural older adults, and provide effective targeted intervention.

Methods

Study design and sample

We used data from the Shandong Rural Elderly Health Cohort (SREHC), an ongoing longitudinal study conducted in the second-most populous province in China. The baseline survey was conducted in 2019 and 3243 participants were recruited, and 2785 participants were included in the 2nd data collection in 2020.

A three-stage stratified random sampling method was employed to select participants at baseline. Firstly, based on GDP per capita in 2018, all counties of Shandong province were divided into three groups and 3 counties were randomly selected as the study sites (Rushan, Qufu, Laoling, respectively presented as high, medium, and low-level counties). Secondly, 5 townships were randomly chosen from each sampled county, and 4 villages were chosen randomly from each township. In each sample village, older people aged≥60 years were chosen by using random numbers. Finally, we recruited 3600 respondents. After data cleansing, 3243 participants completed the whole baseline survey, with a valid response rate of 90.05%. 2785 participants completed two rounds of survey (Supplementary Fig. 1). The response rate of follow-up survey was 85.88% (2785/3243). All variables have no significant difference between the respondents included in this study and those not.

Procedure

We collected information by employing a piloted structured questionnaire. Well-trained investigators conducted both two surveys via a face-to-face way after providing informed consent. Completed questionnaires checked by the supervisors each day to ensure quality. The research protocol was approved by the Ethical Committee of authors' University.

Measures

Health care utilization

In this study, health care utilization included: outpatient utilization, inpatient utilization, and unmet hospitalization needs. Outpatient utilization was measured by question: "Have you received any outpatient care in the past two weeks?" The answers included Yes (1) and No (0) [2, 22]. Inpatient utilization was measured by: "Have you received any inpatient care in the past year?" The options were Yes (1) and No (0) [2, 22]. The answer of "Yes" represented the utilization of outpatient service and inpatient service. Unmet hospitalization needs were measured by: "In the past year, have there been a doctor suggesting that you need inpatient care, but you did not get hospitalized?" The answers included Yes (1) and No (0) [22, 23]. The answer of "Yes" represented that the respondent had unmet hospitalization needs. The measurement

mentioned above had been widely used to assess health care utilization among Chinese population.

To validate the information quality in this study, the outpatient and inpatient record in the health management system was used by village doctors in the sampling villages to confirm the accuracy of self-reported health care utilization. Specifically, we implemented a two-step validation process. First, village doctors from the sampled villages were asked to retrieve outpatient and inpatient records from the health management system, which was regularly updated and maintained as part of routine health care services. Then, these records were cross-referenced with the self-reported data provided by the respondents. Any discrepancies between the self-reported data and health management system records were reviewed [22, 24]. Specifically, we implemented a two-step validation process. First, village doctors from the sampled villages were asked to retrieve outpatient and inpatient records from the health management system, which was regularly updated and maintained as part of routine health care services. Then, these records were cross-referenced with the self-reported data provided by the respondents. Any discrepancies between the self-reported data and health management system records were reviewed [22, 24].

Chronic conditions

We used the number of chronic diseases to represent chronic conditions, because the stable or increase number of chronic conditions was a directly perceived indicator of chronic condition progression. According to the recommendations of Chinese Centers for Disease Control and Prevention, a total of 12 types of chronic conditions (hypertension, diabetes, stroke, etc.) were included, which were self-reported by respondents [25].

To ensure the accuracy and consistency of the chronic condition information, a two-step validation process was conducted. First, respondents were asked to self-report their diagnosed chronic conditions. Subsequently, village doctors in the sampled villages were requested to retrieve corresponding chronic condition information from the health management system, which was a centralized system regularly updated with medical records from local healthcare providers. This system records diagnosed cases of chronic conditions as part of the national public health management program. The village doctors compared the self-reported chronic conditions with the records in the health management system. Any discrepancies identified between the self-reported data and the system records were addressed by re-contacting the respondents for clarification. If discrepancies remained unresolved, additional checks were conducted, such as consulting with local healthcare providers or reviewing historical medical records in the system. This thorough

validation process ensured that the chronic condition data used in our study was both accurate and reliable [24].

Based on previous studies, we defined multimorbidity as the condition that two or more chronic conditions occurred to one person [12, 25]. Chronic condition progression was mainly divided into two categories: unchanged or progressive [11, 13]. Each category was further divided into detailed processions. Specifically, unchanged chronic conditions included three categories: remained no chronic condition, remained one chronic condition, and unchanged multimorbidity (the number of chronic conditions not increased). Progressive chronic conditions included four categories: no chronic condition to one chronic condition, no chronic condition to emerging multimorbidity, one chronic condition to emerging multimorbidity, and progressive multimorbidity (the number of chronic conditions increased).

Intergenerational financial support
Intergenerational financial support was defined as regular/non-regular economic and in-kind support from the children, which was consistent with previous research [26]. In this study, intergenerational financial support was measured by question: "In the past 12 months, have your children ever given you (or your living spouse) money, food, or gifts?" The answers included Yes (1) and No (0) [27]. The answer of "Yes" represented that the respondent received intergenerational financial support.

Covariates
Covariates related to health care utilization were mainly sociodemographic characteristics, socioeconomic status, and health-related variables [22, 23, 28–30]. Sociodemographic characteristics included gender, age, marital status (single, married. single included unmarried, divorced, and widowed), and family residence. Socioeconomic status included the highest education level (illiteracy, primary school, and junior school or above), household income per capita (Quartile 1 was the poorest and Quartile 4 was the richest), and employment status (unemployed, agricultural work, and non-agricultural work). Health-related variables included health insurance coverage, distance to the nearest medical clinic, activities of daily living (ADL).

Statistical analysis
First, descriptive analysis was used to explore the characteristics of all respondents in the baseline. Then, we employed chi-square tests, Kruskal-Wallis rank tests, and univariate ordinal logistic regression to compare the respondents' characteristics across different chronic condition groups. Next, we compared the difference in health care utilization across different chronic conditions

by using Kruskal-Wallis rank tests. Further, considering the correlations of repeated measurements that appeared in the longitudinal study, the generalized estimating equation (GEE) model was employed to investigate the association between chronic condition progression and health care utilization. Time points (year) was one of the covariates to account for the probability of health care utilization changed over time. Finally, we explored whether intergenerational financial support is a potential moderator in this relationship. We included interaction terms (chronic condition progression × intergenerational financial support) in the GEE model to test moderating effects of intergenerational financial support. To explore the differential effect in population groups, we did subgroup analyses, stratified by whether received intergenerational financial support and basic characteristics, using the same regression analysis but with the stratification variable removed. Additionally, the margins plot would illustrate the prediction of health care utilization by chronic condition progression categories and intergenerational financial support. All statistical analyses set a statistically significant threshold with P-value < 0.05, two-tailed. STATA 14.2 (Stata Corp, College Station, TX, USA) was employed for all analyses.

Results
Characteristics of participants
Table 1 presents the general characteristics of older people with different chronic conditions in the baseline survey. Of the 3243 respondents, 27.7% had no chronic conditions, 37.2% had one chronic condition, and 35.1% had multimorbidity. Older adults with one or more chronic conditions were more likely to be female, illiterate, with agricultural work, with health insurance coverage, and with higher ADL score.

Association between chronic condition progression and health care utilization
Chronic conditions were associated with health care utilization in the baseline survey (Supplementary Table 1). Compared to those without chronic conditions, older people with one or more chronic conditions were more likely to use outpatient and inpatient services, especially those with multimorbidity.

As shown in Figs. 1 and 1953 (70.1%) of the respondents' chronic condition unchanged, and 832 (29.9%) of the respondents' chronic condition progressed. Supplementary Tables 2 and Table 2 present the results from crude and adjusted GEE models. Older people remained no chronic conditions were chosen as the reference group. After adjustment for confounders, the results showed the odds ratio (OR) of outpatient, inpatient, and unmet hospitalization in those older people with different chronic condition progression. Specifically, older

Table 1 General characteristics of participants included in baseline survey

	Total (%) N=3243	Chronic conditions			
		No chronic condition (*n*=897)	One chronic condition (*n*=1205)	Multimorbidity (*n*=1141)	*P*
Gender					**<0.001**
Male	1180 (36.39)	361 (40.25)	457 (37.93)	362 (31.73)	
Female	2063 (63.61)	536 (59.75)	748 (62.07)	779 (68.27)	
Age					**0.001**
60–65	825 (25.44)	256 (28.54)	315 (26.14)	254 (22.26)	
65–70	989 (30.50)	251 (27.98)	363 (30.12)	375 (32.87)	
70–75	822 (25.35)	213 (23.75)	286 (23.73)	323 (28.31)	
>75	607 (18.72)	177 (19.73)	241 (20.00)	189 (16.56)	
Marital status					0.342
Married	2415 (74.47)	678 (75.59)	880 (73.03)	857 (75.11)	
Single	828 (25.53)	219 (24.41)	325 (26.97)	284 (24.89)	
Education					
Illiteracy	1353 (41.72)	391 (43.59)	513 (42.57)	449 (39.35)	**0.002**
Primary school	1258 (38.79)	309 (34.45)	468 (38.84)	481 (42.16)	
Junior school or above	632 (19.49)	197 (21.96)	224 (18.59)	211 (18.49)	
Economic status					0.099
Quartile 1 (Poorest)	815 (25.13)	240 (26.76)	295 (24.48)	280 (24.54)	
Quartile 2	804 (24.79)	184 (20.51)	346 (28.71)	274 (24.01)	
Quartile 3	815 (25.13)	211 (23.52)	303 (25.15)	301 (26.38)	
Quartile 4 (Richest)	809 (24.95)	262 (29.21)	261 (21.66)	286 (25.07)	
Employment status					**<0.001**
Unemployed	1365 (42.09)	339 (37.79)	489 (40.58)	537 (47.06)	
Agricultural work	1618 (49.89)	469 (52.29)	624 (51.78)	525 (46.01)	
Non-agricultural work	260 (8.02)	89 (9.92)	92 (7.63)	79 (6.92)	
Health insurance coverage					**0.035**
Yes	3227 (99.51)	888 (99.00)	1202 (99.75)	1137 (99.65)	
No	16 (0.49)	9 (1.00)	3 (0.25)	4 (0.35)	
Intergenerational financial support					**0.001**
Yes	1851 (57.08)	469 (52.29)	694 (57.59)	688 (60.30)	
No	1392 (43.92)	428 (47.71)	511 (42.41)	453 (39.70)	
Distance to the nearest medical clinic					0.479
<1 km	2934 (90.47)	808 (90.08)	1088 (90.29)	1038 (90.97)	
≥1 km	309 (9.53)	89 (9.92)	117 (9.71)	103 (9.03)	
ADL, M (P25, P75)	16 (14,18)	15 (14, 17)	16 (14, 18)	16 (14, 19)	**<0.001**
Family residence					**<0.001**
Qufu	1006 (31.02)	323 (36.01)	383 (31.78)	300 (26.29)	
Laoling	1181 (36.42)	333 (37.12)	465 (38.59)	383 (33.57)	
Rushan	1056 (32.56)	241 (26.87)	357 (29.63)	458 (40.14)	

Note: ADL, activities of daily living

M, Median; P25, 25th percentile; P75, 75th percentile

people with different chronic conditions progression used more outpatient services than those remained no chronic conditions (remained one chronic condition: OR=1.72; 95%CI=1.23, 2.40; *p*=0.002; unchanged multimorbidity: OR=2.39; 95%CI=1.74, 3.29; *p*<0.001; no chronic condition to emerging multimorbidity: OR=1.83; 95%CI=1.07, 3.13; *p*=0.028; one chronic condition to emerging multimorbidity: OR=2.17; 95%CI=1.50, 3.14; *p*<0.001; progressive multimorbidity: OR=3.26; 95%CI=2.18, 4.87; *p*<0.001). Inpatient utilization of

those older adults with different chronic condition progression were more than those remained no chronic conditions (remained one chronic condition: OR=1.93; 95%CI=1.43, 2.61; *p*<0.001; unchanged multimorbidity: OR=3.83; 95%CI=2.88, 5.09; *p*<0.001; no chronic condition to emerging multimorbidity: OR=2.76; 95%CI=1.63, 4.64; *p*<0.001; one chronic condition to emerging multimorbidity: OR=3.40; 95%CI=2.47, 4.67; *p*<0.001; progressive multimorbidity: OR=5.32; 95%CI=3.69, 7.68; *p*<0.001). Compared to those remained no chronic
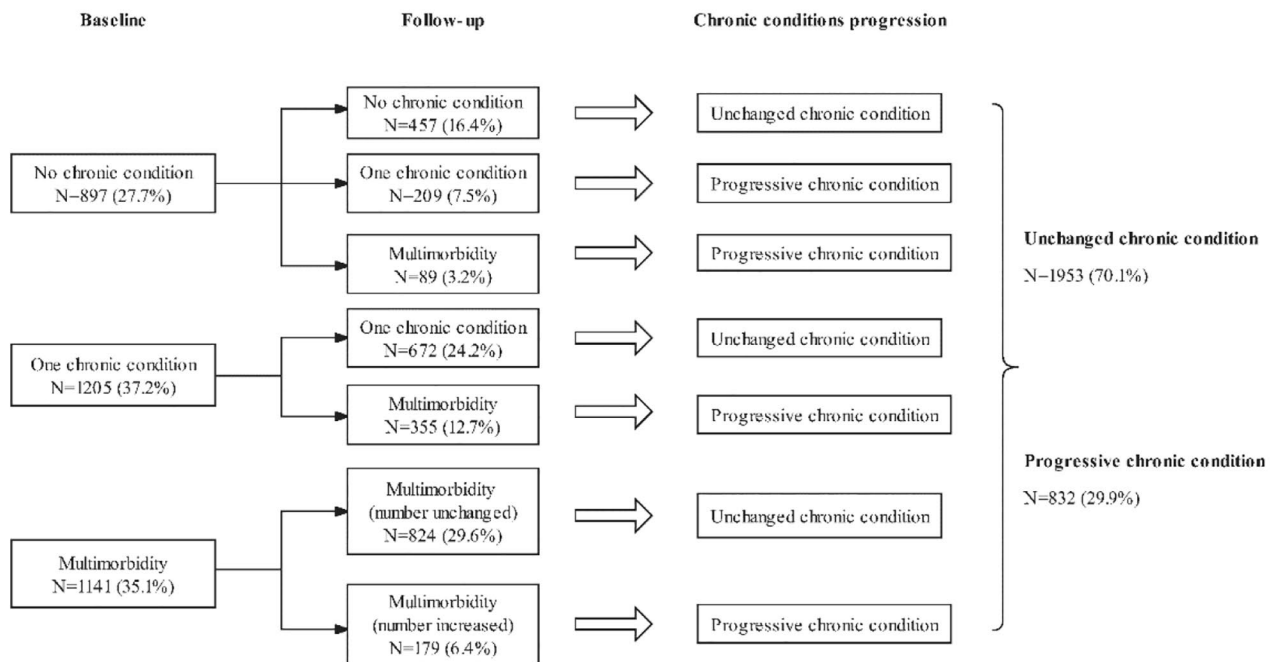
Fig. 1 Chronic condition progression from the baseline survey to the follow-up survey

conditions, older people with different chronic conditions progression have increased likelihood of unmet hospitalization (remained one chronic condition: OR=3.31; 95%CI=1.26, 8.73; *p*=0.016; unchanged multimorbidity: OR=5.17; 95%CI=2.04, 13.12; *p*=0.001; no chronic condition to one chronic condition: OR=3.22; 95%CI=1.02, 10.16; *p*=0.047; no chronic condition to emerging multimorbidity: OR=6.09; 95%CI=1.87, 19.86; *p*=0.003; one chronic condition to emerging multimorbidity: OR=6.69; 95%CI=2.52, 17.64; *p*<0.001; progressive multimorbidity: OR=9.75; 95%CI=3.57, 26.68; *p*=0.028). Outpatient (OR=0.732, *p*<0.001) and inpatient utilization (OR=0.780, *p*<0.001) in 2020 were less than in 2019, and unmet hospitalization needs in 2020 were 1.951 times (*p*<0.001) higher than in 2019.

Moderating role of intergenerational financial support

Table 3 shows that the intergenerational financial support moderated the association between chronic condition progression and outpatient during the last two years. Specifically, the significant interaction term (Unchanged multimorbidity × intergenerational financial support: OR=0.40; 95%CI=0.20, 0.83; *p*=0.013. Progressive multimorbidity × intergenerational financial support: OR=0.35; 95%CI=0.15, 0.84; *p*=0.019) suggested that intergenerational financial support alleviated the possibility of outpatient utilization among rural older adults with multimorbidity (no matter unchanged or progressive). It was apparent from Fig. 2 that intergenerational

financial support moderated the association between chronic condition progression and outpatient utilization.

Subgroups analysis

As shown in Supplementary Table 3, the population was divided into two subgroups, including those with and without intergenerational financial support. The outpatient and inpatient utilization differences between the subgroups mainly manifest in progressive chronic condition groups. In detail, compared to the group with intergenerational financial support, significant association between no chronic condition to one chronic condition and outpatient use (OR=2.582, *P*=0.030) was found among people without intergenerational financial support. The association between no chronic condition to emerging multimorbidity and inpatient use was significant (OR=3.302, *P*<0.001) among older people with intergenerational financial support. The association between remained no chronic condition and unmet hospitalization needs was significant (OR=3.446, *P*=0.012) among older people with intergenerational financial support.

Meanwhile, the interactions that were significant still reflected in unchanged multimorbidity and progressive multimorbidity groups. Specifically, the characteristic of subgroups with significant interactions including: female (Unchanged multimorbidity × Intergenerational financial support: OR=0.344, *P*=0.014), above 75 years age group (Progressive multimorbidity × Intergenerational financial

Table 2 Association between chronic conditions changes and health care utilization among older people in rural Shandong, China (*N*=2785) (adjusted model)

	Outpatient		Inpatient		Unmet hospitalization needs	
	OR [95% CI]	*P*	OR [95% CI]	*P*	OR [95% CI]	*P*
Chronic conditions						
Unchanged chronic conditions						
Remained no chronic condition	1.000		1.000		1.000	
Remained one chronic condition	1.717 [1.227, 2.404]	**0.002**	1.932 [1.429,2.612]	**<0.001**	3.309 [1.255, 8.726]	**0.016**
Unchanged multimorbidity (chronic conditions unchanged)	2.392 [1.741, 3.287]	**<0.001**	3.828 [2.877, 5.093]	**<0.001**	5.172 [2.038, 13.124]	**0.001**
Progressive chronic conditions						
No chronic condition→ One chronic condition	1.359 [0.841, 2.198]	0.210	1.485 [0.982, 2.246]	0.061	3.215 [1.018, 10.157]	**0.047**
No chronic condition→ Emerging multimorbidity	1.831 [1.069, 3.134]	**0.028**	2.761 [1.643, 4.640]	**<0.001**	6.088 [1.867, 19.857]	**0.003**
One chronic condition→ Emerging multimorbidity	2.166 [1.496, 3.137]	**<0.001**	3.395 [2.469, 4.669]	**<0.001**	6.668 [2.520, 17.648]	**<0.001**
Progressive multimorbidity (chronic conditions increased)	3.255 [2.176, 4.869]	**<0.001**	5.319 [3.685, 7.679]	**<0.001**	9.754 [3.566, 26.682]	**<0.001**
Covariates						
Gender						
Male	1.000		1.000		1.000	
Female	1.666 [1.338, 2.075]	**<0.001**	0.898 [0.755, 1.069]	0.225	1.081 [0.722, 1.616]	0.705
Age						
60–65	1.000		1.000		1.000	
65–70	0.887 [0.691, 1.138]	0.347	0.964 [0.772, 1.204]	0.747	1.042 [0.644, 1.685]	0.867
70–75	0.671 [0.511, 0.882]	**0.004**	1.210 [0.963, 1.521]	0.102	0.604 [0.353, 1.034]	0.066
>75	0.778 [0.575, 1.053]	0.104	1.262 [0.975, 1.634]	0.077	0.544 [0.295, 1.003]	0.051
Education						
Illiteracy	1.000		1.000		1.000	
Primary school	1.224 [0.987, 1.518]	0.065	1.073 [0.893, 1.289]	0.454	1.177 [0.766, 1.808]	0.458
Junior school or above	1.388 [1.052, 1.830]	**0.020**	1.191 [0.940, 1.508]	0.149	0.999 [0.575, 1.734]	0.997
Economic status						
Quartile 1 (Poorest)	1.000		1.000		1.000	
Quartile 2	1.042 [0.809, 1.342]	0.750	1.033 [0.840, 1.272]	0.756	1.078 [0.682, 1.702]	0.749
Quartile 3	1.133 [0.880, 1.459]	0.331	1.403 [1.142, 1.724]	**0.001**	0.808 [0.495, 1.321]	0.396
Quartile 4 (Richest)	1.158 [0.891, 1.505]	0.273	1.383 [1.117, 1.711]	**0.003**	0.672 [0.399, 1.135]	0.137
Intergenerational financial support						
No	1.000		1.000		1.000	
Yes	1.039 [0.843, 1.279]	0.720	0.902[0.761, 1.069]	0.233	0.992[0.634, 1.551]	0.970
Distance to the nearest medical clinic						
<1 km	1.000		1.000		1.000	
≥1 km	1.144 [0.854, 1.532]	0.368	1.336 [1.063, 1.678]	**0.013**	2.014 [1.222, 3.320]	**0.006**
ADL, M (P25, P75)	1.027 [1.010, 1.045]	**0.002**	1.043 [1.028,1.059]	**<0.001**	1.015 [0.989, 1.042]	0.252
Year						
2019	1.000		1.000		1.000	
2020	0.732 [0.615, 0.871]	**<0.001**	0.780 [0.680, 0.895]	**<0.001**	2.951 [1.956, 4.452]	**<0.001**

Note: ADL, activities of daily living

M, Median; P$_{25}$, 25th percentile; P$_{75}$, 75th percentile.

support: OR=0.082, *P*=0.043), single (Unchanged multimorbidity × Intergenerational financial support: OR=0.087, *P*=0.025), Q1 (Progressive multimorbidity × Intergenerational financial support: OR=0.073, *P*=0.012) and Q2 economic status (Unchanged multimorbidity × Intergenerational financial support: OR=0.119, *P*=0.011), illiteracy (Unchanged multimorbidity × Intergenerational financial support: OR=0.328, *P*=0.049; Progressive multimorbidity × Intergenerational financial support: OR=0.155, *P*=0.008).

Discussion

The current study examined the link between chronic condition progression and health care utilization among Chinese rural older people. After adjusting for potential confounders, the results revealed that the change of

Table 3 The moderating effect of intergenerational financial support on the relationship between chronic condition changes and health care utilization among Chinese older people

Characteristic	Outpatient	
	OR [95% CI]	*P*
Chronic conditions		
Unchanged chronic conditions		
Remained no chronic condition	1.0	**0.012**
Remained one chronic condition	2.342 [1.204, 4.556]	**< 0.001**
Unchanged multimorbidity (chronic conditions unchanged)	4.583 [2.441, 8.606]	**< 0.001**
Progressive chronic conditions		
No chronic condition→ One chronic condition	2.366 [1.032, 5.421]	**0.042**
No chronic condition→ Emerging multimorbidity	2.210 [0.765, 6.387]	0.143
One chronic condition→ Emerging multimorbidity	3.309 [1.627, 6.730]	**0.001**
Progressive multimorbidity (chronic conditions increased)	7.019 [3.263, 15.098]	**< 0.001**
Intergenerational financial support		
No	1.0	
Yes	1.846 [0.965, 3.532]	0.064
Interaction term		
Chronic conditions × Intergenerational financial support		
Unchanged chronic conditions × Intergenerational financial support		
Remained no chronic condition × Intergenerational financial support	1.0	
Remained one chronic condition × Intergenerational financial support	0.639 [0.298, 1.369]	0.249
Unchanged multimorbidity (chronic conditions unchanged) × Intergenerational financial support	0.402 [0.195, 0.826]	**0.013**
Progressive chronic conditions × Intergenerational financial support		
No chronic condition→ One chronic condition × Intergenerational financial support	0.406 [0.145, 1.135]	0.086
No chronic condition→ Emerging multimorbidity × Intergenerational financial support	0.758 [0.217,2.651]	0.665
One chronic condition→ Emerging multimorbidity × Intergenerational financial support	0.544 [0.239, 1.243]	0.149
Progressive multimorbidity (chronic conditions increased) × Intergenerational financial support	0.349 [0.145, 0.841]	**0.019**
Covariates		
Gender		
Male	1.0	
Female	1.684 [1.363, 2.081]	**< 0.001**
Age		
60–65	1.0	
65–70	0.877 [0.686,1.121]	0.295
70–75	0.679 [0.524, 0.879]	**0.003**
>75	0.802 [0.611, 1.052]	0.112
Education		
Illiteracy	1.0	
Primary school	1.117 [0.911, 1.369]	0.287
Junior school or above	1.258 [0.973, 1.627]	0.080
ADL	1.029 [1.011, 1.046]	**0.001**
Year		
2019	1.0	
2020	0.731 [0.613, 0.870]	**< 0.001**

chronic conditions were closely associated with health care utilization. Our results also revealed that intergenerational financial support moderated the chronic conditions progression-outpatient utilization relationship. To our knowledge, the patterns of association between chronic condition changes and healthcare utilization have not been explored. This is the first study to investigate the changes of chronic condition and its influence on health care utilization from a dynamic perspective,

and revealed the role of intergenerational financial support in moderating this relationship.

In this study, we found that once the older people had suffered from chronic condition, they would use more health care services than those without chronic conditions, which was consistent with previous studies [1, 5, 6, 12]. Literature in different regions demonstrated that older adults with chronic condition, especially with multimorbidity, were 2 times and above more likely to use
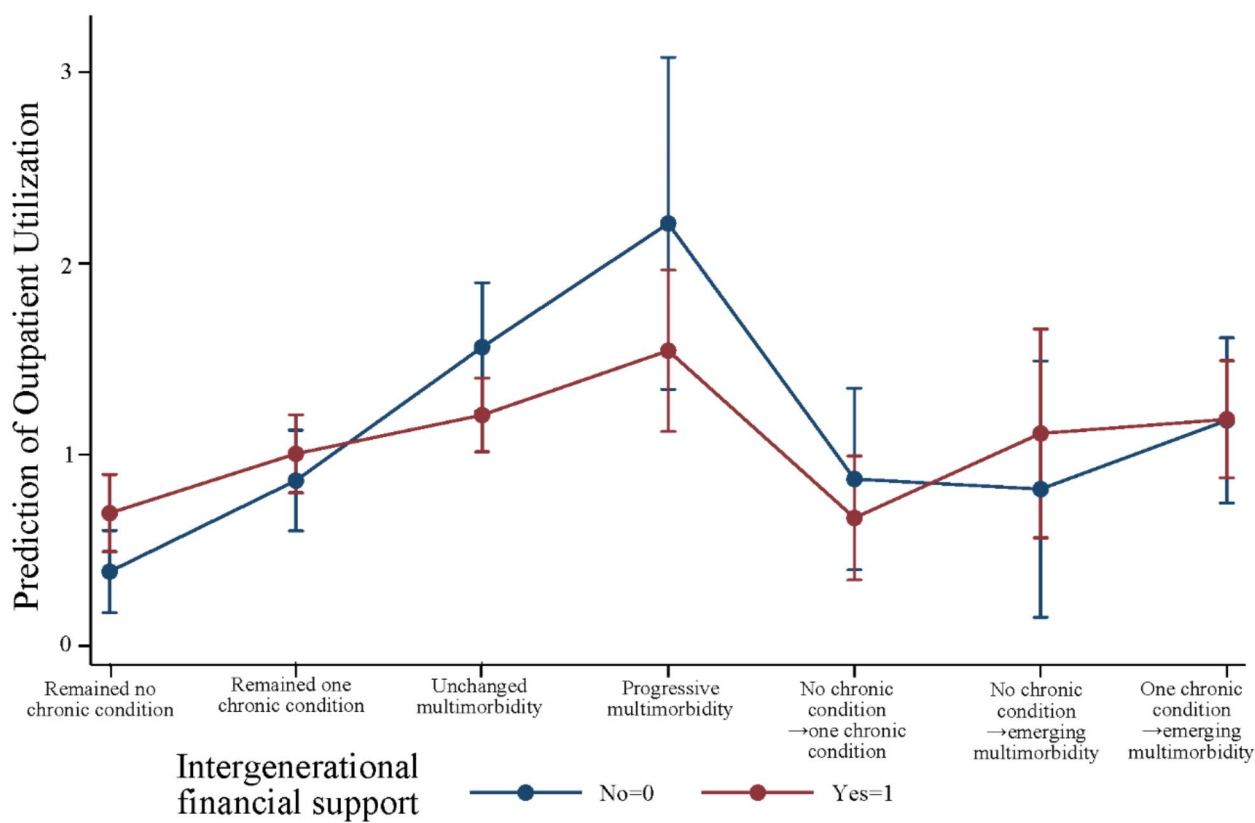
Fig. 2 The moderating role of intergenerational financial support in the association between chronic conditions progression and outpatient utilization

health care services than those without chronic conditions, which had lower risks than our findings [2, 6, 12, 31, 32]. The reason for the research difference might be that this study focused on the rural rather than the national population, thereby the impact of chronic conditions on healthcare utilization could be more significant [2]. Since the chronic condition progression is irreversible and has a long duration, older adults with poor health status might exhibit regularity of health care seeking behaviors [33–35]. According to the dynamic and recursive health behavior model, the health outcomes have multiple influences on health service utilization, including subsequent predisposing factors and perceived health care needs, which could further reduce disease severity and improve health status [36]. For older people with chronic conditions, especially those with multimorbidity, their health care utilization would be maintained at a certain level, and obviously higher than those who were in a relatively healthy status. These findings emphasized that rural older people with one or more chronic conditions should be regarded as the key group of health care service provision. Regular health assessments and personalized care plans should be developed by family doctors or community health workers.

According to the disease progression network, some older people may remain in the current state, while others may progress to the next state with aging and physical function decline [13]. That is to say, chronic condition might change from the status without chronic condition to having one or more chronic conditions, or the number of chronic conditions increased [1, 4]. No significant changes in health care utilization were observed among older adults when they progressed from a healthy state to with one chronic condition. The possible reason was that chronic condition was in its initial stage, and the symptoms were not so severe to draw older adults' attention [31]. Therefore, their health care utilization might not be influenced because of habit strength [37]. However, health care utilization increased when the health status of older people progressed from without chronic condition to emerging multimorbidity, or the number of chronic conditions increased. According to the stress process theory, when the relatively healthy status progressed to with multimorbidity, the sudden deterioration of health status would impact older adults a lot, which became the stressor of them and their caregiver, thus causing the older adults to pay more attention to their physical conditions [10]. In order to slow disease progression and control the deterioration of health status, health care needs

of those older people would increase [2, 31], and might be more than those with unchanged chronic conditions [38]. Therefore, older people who progress to multimorbidity status should be the focus of health management. It was effective for family doctors to regularly monitor the progression of chronic conditions by using hospital information systems, and intervene the older people with progressive chronic conditions promptly. Establishing a protocol for regular check-ins with older adults showing signs of disease progression, either through home visits or telemedicine, could ensure timely intervention and management.

Although older adults with pre-existing or emerging chronic conditions use more outpatient and inpatient services than those who stay healthy, higher unmet hospitalization needs still existed among them. Previous study has demonstrated that multimorbidity was associated with more likelihood of experiencing ADL limitation [39], which could become a barrier to access regular health care services. Further, older adults who suffered from multimorbidity, especially those in rural areas, were more likely to refuse the hospitalized advices due to the heavy economic burden, traffic inconvenience, and limited knowledge of diseases [3, 29]. These findings implied that the accessibility (including economic and geographical) of health care services among rural older adults needs to be further improved. Policymakers should expand the proportion of medical insurance reimbursement for rural older people with multiple diseases or disabilities, or provide appropriate economic subsidies to promote economic accessibility [22]. For rural older people with limited mobility, the family doctor teams should promptly include them in the key groups of management, and provide scheduled on-site follow-up and basic examination services to improve geographical accessibility.

Compared with the health care utilization in 2019, older people's outpatient and inpatient use in 2020 were decreased, and unmet hospitalization needs were increased. After the outbreak of COVID-19, older adults with multimorbidity were found to miss scheduled medical appointments for chronic conditions care, decrease the admission rate, and reduce the number of procedures [40, 41]. Generally, chronic conditions were mild and persistent, which would not deteriorate rapidly during a short time. Considering the infection risk when accessing health services, older adults could be less urgent for health care utilization to control chronic conditions, thus causing the delay or miss in accessing health care services. Digital healthcare tools that are suitable for rural older adults should be further developed to address the issue of delayed health services utilization in the context of normalized epidemic situations.

Among those older people without intergenerational financial support, no matter whether they were suffering from unchanged or progressive chronic conditions, they were more likely to use outpatient service. While others with intergenerational financial support would have more inpatient utilization regardless of the changes in chronic conditions. It could be explained that hospitalization costs were generally higher than outpatient expenses [22, 42]. The economic status would be improved if older adults received financial support, and thereby they were more likely to choose inpatient services, which with higher cost but were more effective and comprehensive than outpatient services [22, 42, 43]. Although intergenerational financial support was not related to outpatient utilization, the moderating effect of intergenerational financial support became significant among those with multimorbidity (no matter unchanged or increased). These findings could be supported by Convoy Model of Social Relations, which emphasized the importance of social ties in the relationship between health problems and healthcare utilization, especially the offsetting effect on redundant healthcare utilization [18]. Lower levels of self-rated health status were reported among older people who were dissatisfied with the quantity and quality of their social relationships. Those older adults would consult health service provider and seek medical assistance more frequently to satisfy unmet need for interpersonal interaction and relieve the feeling of isolation [20]. That was, poor relationships of older adults might lead to inappropriate consultations with health professionals, which indicated that avoidable health care utilization could be prevented by strengthening social relationships [20, 44]. In the Chinese filial piety context, intergenerational support was a vital social relationship for the older adults, which possibly played an important role in avoiding unnecessary health care utilization. Moreover, older adults who received intergenerational financial support were more likely to purchase long-term care services, which would meet basic health-related needs and promote the management of chronic conditions, thereby reducing the use of outpatient services [45]. For older adults with multimorbidity, their health care demand and burden were more than those without multimorbidity. Therefore, the moderating effect of intergenerational financial support on health care utilization reflected in older adults with multimorbidity. Children should be encouraged to provide appropriate financial support to their older parents, which could reduce unnecessary healthcare utilization and alleviate the pressure on healthcare systems. Tax incentives or subsidies should be provided for families who offer regular financial assistance to their older members. It was beneficial for alleviating the economic burden on older adults, and reducing their reliance on healthcare services. Additionally, health education could be launched to raise awareness about the importance of intergenerational support, not just for

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economic reasons, but also for maintaining strong social ties that contribute to better health outcomes.

Existing research about the chronic condition progression mainly focused on the specific type of chronic diseases [46]. Others explored the association between chronic conditions and health care utilization at a single point of time [6, 12]. Chronic condition progression and its association with health care utilization in this study highlighted the importance of monitoring chronic condition progression regularly among rural older adults. Meanwhile, the role of intergenerational financial support in the relationship between chronic condition progression and health care utilization has been further confirmed. Despite the contributions, there were several limitations. First, key variables were self-reported, which might exist recall bias. Even though we had confirmed the information accuracy of chronic conditions and health care utilization, there might still be unavoidable record omissions. And intergenerational financial support could not be validated by other objective measure. Second, there might be selection bias associated with the attrition, because we only included older adults who completed both baseline and follow-up research. Third, the number of chronic conditions was one of the dimensions. The duration, severity, and patterns of multimorbidity should be further considered [47]. And the intergenerational financial support information about healthcare-cost and non-direct costs has not been collected. The specific dimensions of chronic condition and intergenerational financial support would be collected and explored in our future research. Fourth, the COVID-19 pandemic might influence health care utilization of older people. Although we have included time points (year) as one of the covariates, the COVID-19 pandemic as a stressful event, was possibly associated with the changes in health care utilization [48]. And the change in the main characteristics of older people might not be significant because of the short follow-up period. We would continue to monitor the changes in the subsequent follow-up survey. Finally, the generalizability of the results was limited based on the rural sample in one province.

Conclusion

In this prospective study, we found that the change of chronic conditions was closely associated with more health care utilization and higher unmet hospitalization needs among Chinese rural older adults. Intergenerational financial support moderated the relationship between chronic condition progression and outpatient utilization. The discovery provided the dynamic perspective of chronic condition, and clarified the differences in health service utilization related to various progressions, while recognizing the importance of intergenerational support in alleviating health system burden. These findings provided several implications for policy and practice. First, it was indicated that older people's chronic condition progression need continuously monitoring and timely intervention by family doctors of primary health institutions, especially for those with progressive chronic condition. Second, efforts should be taken to control the prevalence of multimorbidity and improve the health care services accessibility of rural older adults. Promoting information synchronization among medical institutions at all levels is one of the effective management modes. Different medical institutions should use family doctors as the hub to timely synchronize the chronic diseases progression and the utilization of health services among older adults by using health management system, in order to provide prompt intervention. Third, appropriate intergenerational financial support was beneficial to ease the medical system burden. Promoting intergenerational support such as strengthening policy publicity and providing subsidies were considerable measurements for policymakers to fill the gap between the large health care needs of older adults and the limited medical resources.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-024-05299-1.

Supplementary Material 1

Data availability
The datasets used and / or analyzed during the current study are available from the corresponding author (Prof. Chengchao Zhou) on reasonable request.

Declarations

Ethics approval and consent to participate
The Ethical Committee of the School of Public Health at Shandong University approved the study protocol. The investigation was conducted after written informed consent was obtained from all participants. All methods were carried out in accordance with relevant guidelines and regulations.

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References

1. Beard JR, Officer A, de Carvalho IA, Sadana R, Pot AM, Michel JP, Lloyd-Sherlock P, Epping-Jordan JE, Peeters G, Mahanani WR, et al. The World report on ageing and health: a policy framework for healthy ageing. Lancet (London England). 2016;387(10033):2145–54.
2. Zhao Y, Atun R, Oldenburg B, McPake B, Tang S, Mercer SW, Cowling TE, Sum G, Qin VM, Lee JT. Physical multimorbidity, health service use, and catastrophic health expenditure by socioeconomic groups in China: an analysis of population-based panel data. Lancet Global Health. 2020;8(6):e840–9.
3. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet (London England). 2012;380(9836):37–43.
4. Zhang R, Lu Y, Shi L, Zhang S, Chang F. Prevalence and patterns of multimorbidity among the elderly in China: a cross-sectional study using national survey data. BMJ open. 2019;9(8):e024268.
5. Chen H, Chen Y, Cui B. The association of multimorbidity with healthcare expenditure among the elderly patients in Beijing, China. Arch Gerontol Geriatr. 2018;79:32–8.
6. von Berenberg P, Dräger D, Zahn T, Neuwirth J, Kuhlmey A, Gellert P. Chronic conditions and use of health care service among German centenarians. Age Ageing. 2017;46(6):939–45.
7. Aarts S, den Akker M, Bosma H, Tan F, Verhey F, Metsemakers J, van Boxtel M. The effect of multimorbidity on health related functioning: temporary or persistent? Results from a longitudinal cohort study. J Psychosom Res. 2012;73(3):211–7.
8. Grunau GL, Sheps S, Goldner EM, Ratner PA. Specific comorbidity risk adjustment was a better predictor of 5-year acute myocardial infarction mortality than general methods. J Clin Epidemiol. 2006;59(3):274–80.
9. Wang CY, Baldwin LM, Saver BG, Dobie SA, Green PK, Cai Y, Klabunde CN. The contribution of longitudinal comorbidity measurements to survival analysis. Med Care. 2009;47(7):813–21.
10. Yu Y, Liu ZW, Li TX, Li YL, Xiao SY, Tebes JK. Test of the stress process model of family caregivers of people living with schizophrenia in China. *Social science & medicine (1982)* 2020, 259:113113.
11. Strauss VY, Jones PW, Kadam UT, Jordan KP. Distinct trajectories of multimorbidity in primary care were identified using latent class growth analysis. J Clin Epidemiol. 2014;67(10):1163–71.
12. Marengoni A, Angleman S, Melis R, Mangialasche F, Karp A, Garmen A, Meinow B, Fratiglioni L. Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev. 2011;10(4):430–9.
13. Zhu Z, Heng BH, Teow KL. Lifetime trajectory simulation of chronic disease progression and comorbidity development. J Biomed Inform. 2018;88:29–36.
14. König HH, Leicht H, Bickel H, Fuchs A, Gensichen J, Maier W, Mergenthal K, Riedel-Heller S, Schäfer I, Schön G, et al. Effects of multiple chronic conditions on health care costs: an analysis based on an advanced tree-based regression model. BMC Health Serv Res. 2013;13:219.
15. Lai DWL, Lee VWP, Li J, Dong X. The Impact of Intergenerational Relationship on Health and Well-Being of older Chinese americans. J Am Geriatr Soc. 2019;67(S3):S557–63.
16. Anning H, Huayan G. The diversification of children's support for their parents in the context of an aging society: concepts and behavior. Social Sci China. 2018;39(04):114–36.
17. Sun Q, Wang Y, Lu N, Lyu S. Intergenerational support and depressive symptoms among older adults in rural China: the moderating roles of age, living alone, and chronic diseases. BMC Geriatr. 2022;22(1):83.
18. Antonucci TC, Ajrouch KJ, Birditt KS. The convoy model: explaining social relations from a multidisciplinary perspective. Gerontologist. 2014;54(1):82–92.
19. Aiai Z, Chengjian C, Jianhui Z, Qingmin L, Xin X. Evaluation of health-related quality of life of the empty-nest elderly in Hangzhou. Prev Med. 2017;29(9):883–7.
20. Valtorta NK, Moore DC, Barron L, Stow D, Hanratty B. Older adults' Social relationships and Health Care utilization: a systematic review. Am J Public Health. 2018;108(4):e1–10.
21. Quashie NT, Pothisiri W. Rural-urban gaps in health care utilization among older Thais: the role of family support. Arch Gerontol Geriatr. 2019;81:201–8.
22. Li C, Zhou R, Yao N, Cornwell T, Wang S. Health Care utilization and unmet needs in Chinese older adults with multimorbidity and functional impairment. J Am Med Dir Assoc. 2020;21(6):806–10.
23. Shao S, Wang M, Jin G, Zhao Y, Lu X, Du J. Analysis of health service utilization of migrants in Beijing using Anderson health service utilization model. BMC Health Serv Res. 2018;18(1):462.
24. Wang Y, Fu P, Li J, Jing Z, Wang Q, Zhao D, Zhou C. Changes in psychological distress before and during the COVID-19 pandemic among older adults: the contribution of frailty transitions and multimorbidity. Age Ageing. 2021;50(4):1011–8.
25. Chronic non-communicable diseases. [http://www.chinacdc.cn/jkzt/mxfcrjbhsh/]
26. Wu Y, Dong K, Bai R, Dong W. The relationship between intergenerational financial support and depressive symptoms among older adults: evidence from China Health and Retirement Longitudinal Study, 2011–2018. J Affect Disord. 2023;339:767–75.
27. He H, Xu L, Fields N. Pensions and depressive symptoms of older adults in China: the mediating role of intergenerational support. Int J Environ Res Public Health 2021, 18(7).
28. Griffith LE, Gruneir A, Fisher KA, Upshur R, Patterson C, Perez R, Favotto L, Markle-Reid M, Ploeg J. Measuring multimorbidity series-an overlooked complexity comparison of self-report vs. administrative data in community-living adults: paper 2. Prevalence estimates depend on the data source. J Clin Epidemiol. 2020;124:163–72.
29. Cassell A, Edwards D, Harshfield A, Rhodes K, Brimicombe J, Payne R, Griffin S. The epidemiology of multimorbidity in primary care: a retrospective cohort study. Br J Gen Practice: J Royal Coll Gen Practitioners. 2018;68(669):e245–51.
30. Zhai Y. Study on the influence of family intergenerational support on medical consumption of the elderly. Shandong University; 2019.
31. Hopman P, Heins MJ, Korevaar JC, Rijken M, Schellevis FG. Health care utilization of patients with multiple chronic diseases in the Netherlands: differences and underlying factors. Eur J Intern Med. 2016;35:44–50.
32. Wallace E, Salisbury C, Guthrie B, Lewis C, Fahey T, Smith SM. Managing patients with multimorbidity in primary care. BMJ (Clinical Res ed). 2015;350:h176.
33. Gao Q, Peng L, Min W, Nie J, Wang A, Shi Y, Shi H, Teuwen DE, Yi H. Regularity of clinical visits and medication adherence of patients with hypertension or diabetes in Rural Yunnan Province of China. Int J Environ Res Public Health 2020, 17(24).
34. Feng D, Serrano R, Ye T, Tang S, Duan L, Xu Y, Yang J, Liang Y, Chen S, Feng Z et al. What contributes to the regularity of patients with hypertension or diabetes seeking Health services? A pilot Follow-Up, Observational Study in two sites in Hubei Province, China. Int J Environ Res Public Health 2016, 13(12).
35. Suesse B, Lago L, Westley-Wise V, Cuenca J, Pai N. Predisposing, enabling and need factors associated with increased use and ongoing increased use of inpatient mental health care: a population-based longitudinal study. Aust N Z J Psychiatry. 2021;55(4):409–21.
36. Evans RG, Stoddart GL. Producing health, consuming health care. Soc Sci Med. 1990;31(12):1347–63.
37. Badawy SM, Shah R, Beg U, Heneghan MB. Habit strength, Medication Adherence, and habit-based Mobile Health interventions Across Chronic Medical conditions: systematic review. J Med Internet Res. 2020;22(4):e17883.
38. Fraysse SCG, Li J, Ozbay S, Wong AB. Disease Severity is Associated with Higher Healthcare utilization in nonalcoholic Steatohepatitis Medicare patients. Am J Gastroenterol. 2020;115(4):562–74.
39. Zhao YW, Haregu TN, He L, Lu S, Katar A, Wang H, Yao Z, Zhang L. The effect of multimorbidity on functional limitations and depression amongst middle-aged and older population in China: a nationwide longitudinal study. Age Ageing. 2021;50(1):190–7.
40. Kiss P, Carcel C, Hockham C, Peters SAE. The impact of the COVID-19 pandemic on the care and management of patients with acute cardiovascular disease: a systematic review. Eur Heart J Qual care Clin Outcomes. 2021;7(1):18–27.
41. Wong SYS, Zhang D, Sit RWS, Yip BHK, Chung RY, Wong CKM, Chan DCC, Sun W, Kwok KO, Mercer SW. Impact of COVID-19 on loneliness, mental health, and health service utilisation: a prospective cohort study of older adults with

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multimorbidity in primary care. Br J Gen Practice: J Royal Coll Gen Practitioners. 2020;70(700):e817–24.

42. Yue H. Study on medical expenditure and influencing factors of the elderly. Guizhou University of Finance and Economics; 2019.

43. Ying B. Health Effect of intergenerational support on the Elderly and their medical consumption. East China Normal University; 2017.

44. Cornwell EY, Waite LJ. Social disconnectedness, perceived isolation, and health among older adults. J Health Soc Behav. 2009;50(1):31–48.

45. Feng J, Wang Z, Yu Y. Does long-term care insurance reduce hospital utilization and medical expenditures? Evidence from China. *Social science & medicine (1982)* 2020, 258:113081.

46. Rizi RR, Hamedani H, Cereda M. In chronic obstructive Pulmonary Disease Progression, is it airway narrowing or Airway loss? Am J Respir Crit Care Med. 2021;203(2):154–5.

47. Kim J, Keshavjee S, Atun R. Trends, patterns and health consequences of multimorbidity among South Korea adults: analysis of nationally representative survey data 2007–2016. J Global Health. 2020;10(2):020426.

48. Bonavita S, Sparaco M, Russo A, Borriello G, Lavorgna L. Perceived stress and social support in a large population of people with multiple sclerosis recruited online through the COVID-19 pandemic. Eur J Neurol. 2021;28(10):3396–402.

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