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Health-related quality of life among rural men and women with hypertension: assessment by the EQ-5D-5L in Jiangsu, China

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Abstract

Purpose Hypertension is a major global public health problem, including rural China. However, studies examining health-related quality of life (HRQoL) for patients with hypertension have been mostly conducted in urban populations. This study aimed to use the EuroQol five-dimensional-five-level (EQ-5D-5L) and its recently developed Chinese value set to analyze HRQoL and its influencing factors among hypertensive population in rural China.

Methods This is a cross-sectional population-based survey. Standard interview of participants was conducted from July to September 2016 in Donghai County's 334 villages of Jiangsu Province, China. Data collection included the EQ-5D-5L, along with sociodemographic characteristics and disease-related factors such as duration of hypertension, antihypertensive treatment and comorbid conditions. The Tobit regression model was employed to analyze potential influencing factors on HRQoL.

Results A total of 16,596 adults (18 years and older) with hypertension participated in this study. 62.4% were women. The mean utility score was 0.85 (standard deviation [SD] = 0.23). The proportion of participants reporting pain/discomfort problems was highest, while least patients reported problems in self-care dimension. Females, elderly, illiterate patients, ex-smokers and patients with longer duration of hypertension or comorbidities scored lower on HRQoL than others. Stroke, heart failure and coronary heart disease were associated with a larger negative impact on HRQoL among all comorbidities.

Conclusions The HRQoL was lower in this rural hypertensive population than previously reported urban counterparts. To improve the HRQoL of hypertensive patients in rural areas, it is important to control hypertension and prevent its associated co-morbidities. More attention needs to be directed to elderly female patients with less education who scored much lower HRQoL than their male counterparts.

Keywords Hypertension · EQ-5D-5L · HRQoL · Chinese rural area

Introduction

Hypertension is a major public health problem worldwide because it is one of the major risk factors for cardiovascular diseases including stroke, diabetes mellitus (DM) and

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chronic kidney diseases (CKD) [1, 2]. A global study estimated that up to 7.6 million premature deaths and 92 million disability-adjusted life years (DALYs) were attributable to hypertension, and about 80% of this disease burden occurred in people from low- and middle-income regions [3]. China, a developing country, carries a great disease burden of hypertension, and its prevalence has continued to climb in recent years [4–6]. According to recent national surveys, approximately 200 million adults in China have hypertension [7, 8]. The prevalence of hypertension in China's rural areas (composing over 50% of population in China) continues to rise and has surpassed that of urban areas [5, 9, 10].

Health-related quality of life (HRQoL) is a widely accepted measure to assess the effect of chronic disease conditions on one's health. It is a multidimensional concept that reflects a patient's physical, psychological, social and emotional well-being [11–13]. The EuroQol 5-Dimensions (EQ-5D) is one of the major self-reported instruments to evaluate HRQoL due to its simplicity, low respondent burden and high universal acceptance [14, 15]. EQ-5D, especially the 3-level version (EQ-5D-3L), has been widely used to measure the HRQoL of hypertensive patients in China [16, 17]. The 5 level version—EQ-5D-5L has gained popularity in recent studies because its ability to reduce the ceiling effect found in the EQ-5D-3L. It also has high convergent validity and is more sensitive to mild health changes [18, 19]. However, its application to evaluate HRQoL in China remains quite limited [20, 21]. The results of the EQ-5D can be converted to a health utility index score using a population-based preference time trade-off (TTO) model. Notably, a EQ-5D-5L value set on the basis of health preferences in a Chinese population was developed, which allows us to convert EQ-5D-5L health states to utility scores and use them in the data analyses [22].

At present, studies on HRQoL among hypertensive rural population have been conducted in China [17, 23], however, no research has focused on exploring the appropriate survey ways for rural population, most of whom are elder and illiterate people (the population over 65 years old accounts for 10% of the total population, and its illiteracy rate up to 44.4%) [24]. Suffering from the poor vision and illiteracy, these people are unable to read and finish the paper version by themselves. They are also hard to understand the whole questions during interview process due to their short-term memory load. For these reasons, it is imperative to find an appropriate interview process to accurately assess the quality of life of these patients accounting for great proportion among Chinese hypertensive patients.

The city of Lianyungang, located in eastern China, has the highest prevalence rate of hypertension of rural China [25]. Donghai County is its largest and most populous county with a largely rural population of more than one million. As a coastal city, seafood comprises much of the residents' diet, contributing to an excessive daily intake of salt and placing them at high risk of hypertension. In light of the high prevalence of hypertension in Donghai County, we sought to evaluate the HRQoL of this rural hypertensive population and identify major influencing factors on their HRQoL. To the best of our knowledge, this is the first study with the largest sample size to evaluate the HRQoL of Chinese rural hypertensive patients by using the Chinese value set for the EQ-5D-5L.

Methods

Study design and patients

This cross-sectional investigation was carried out in the rural areas of Donghai County, Lianyungang, Jiangsu province, from July to September 2016. The hypertensive population in our study were sampled from the Donghai National Health Service Survey, a county-wide survey that covered 21 townships with a total of 334 villages. One hundred households were surveyed according to the number of rural households obtained from the "Tabulation of the 2010 population census of the people's republic of China" and the prevalence rate of hypertension [24]. Households who had participated in the survey were randomly selected on the basis of site location in each village or community. If the location of a selected household was inaccessible, it was replaced by a neighboring household that was accessible. Participants with mental disorders or anyone unable to respond to interview questions were excluded. Informed consent was obtained from all participants before they were enrolled in the study. Adults (18 years or older) who were diagnosed with hypertension according to the "Hypertension Prevention and Treatment Guidelines of China (2010)" (mean systolic blood pressure $\geq$ 140 mm Hg and/ or mean diastolic blood pressure $\geq$ 90 mm Hg, or the use of antihypertensive drugs in the past 2 weeks) were invited for our health-related quality of life assessment [26]. In total, 36,401 residents in the survey were preliminary diagnosis of hypertension. Then, we used simple random sampling half of the hypertensive patients to conduct the EQ-5D-5L questionnaire. Participants without being invited for EQ-5D questionnaire ($n = 18{,}200$), or final diagnosed as non-hypertension, or missing EQ-5D-5L data ($n = 208$) and characteristic data ($n = 265$), or error in age data ($n = 17$), were excluded. In total, 16,596 eligible patients were included in this HRQoL study (see Appendix Fig. 4).

Data collection

Quality control measures were implemented during the process of data collection. All participants were interviewed

face-to-face in the nearest community hospital, and the whole interview processes were recorded for subsequent quality control. Data were collected through semi-structured standardized interviews by well-trained investigators. To ensure the accuracy and integrity of the collected data, each township was assigned 10 quality controllers to supervise interviewers (one quality controller to five interviewers) on site and routinely checked 100% questionnaires and 50% of the recordings after interview. Any missing information was recollected the following day. The information on sociodemographic characteristics included gender, age, body mass index (BMI), education background, smoking status, antihypertensive medication use, duration of hypertension and types of comorbidity (e.g., diabetes mellitus, stroke, coronary heart disease, heart failure, chronic kidney disease and cancer).

Since most of the respondents were illiterate or with poor vision, we adopted face-to-face interview instead of self-administered questionnaires. Questions were administered in a step-by-step process to reduce any short-term memory load. An example of the interview process is shown in Appendix Fig. 5.

Measurements of the EQ-5D utility score

HRQoL as measured by the EQ-5D-5L was considered the main health outcome of the hypertensive patients in this study. The five dimensions included in the EQ-5D-5L were mobility (MO), self-care (SC), usual activities (UA), pain/discomfort (PD) and anxiety/depression (AD). Each dimension had five levels of response (no problems, slight problems, moderate problems, severe problems and extreme problems), which theoretically resulted in 3125 unique health states in combination.

The EQ-5D utility scores were calculated based on the recently available Chinese value set for the EQ-5D-5L instrument (details in Appendix Table 4) [25]. Utility = $1 - \mathrm{MO} \times \mathrm{Ln} - \mathrm{SC} \times \mathrm{Ln} - \mathrm{UA} \times \mathrm{Ln} - \mathrm{PD} \times \mathrm{Ln} - \mathrm{AD} \times \mathrm{Ln}$ ($n = 1, 2, 3, 4, 5$) [22]. The score ranges from -0.391 to 1, where 1 represents full health, 0 represents death, and a score less than 0 represents a health status worse than death.

Statistical analysis

Descriptive statistics were applied to characterize the respondents. Frequencies and percentages were used for categorical variables, while means and standard deviations (SD) were calculated for continuous variables. Kruskal–Wallis tests or Wilcoxon rank-sum tests were conducted to test the differences in EQ-5D scores among the various subgroups. Chi-square tests were used to detect differences in categorical variables.

A multivariate Tobit regression model was employed to assess the association between EQ-5D utility scores and potential influencing factors. The Tobit model was chosen because the distribution of the EQ-5D utility was skewed and the utility score was censored at 1 [27–29]. When studying the factors associated with utility, we included all sociodemographic and disease characteristics of the patients as independent variables, including gender, age, BMI, education level, smoking status, duration of disease and types of comorbidity. Data were analyzed using STATA version 16. All p values were two-tailed, and statistical significance was set at $p < 0.05$.

Results

Patient characteristics

The participants' characteristics are shown in Table 1. A total of 16,596 questionnaire interviews were completed, and approximately half of the respondents were 65 years of age or older. Compared with men, women had lower education levels on average ($p < 0.001$). The illiteracy rate among females was two-thirds, while just a quarter of males were illiterate. Gender difference in smoking status was profound ($p < 0.001$), where a large proportion of ex-smokers or smokers were male (56.8%), compared to only 3.1% who were female. We found that only 55.0% of the hypertensive patients were on antihypertensive medication. Stroke was the most prevalent comorbidity in both females and males, followed by coronary heart disease (CHD) and DM.

Distribution of self-reported health states

Figure 1 summarizes the percentage of respondents with self-reported problems (no, slight, moderate, severe, or extreme problems) based on the EQ-5D questionnaire. The pain/discomfort dimension was the most prominent across the five dimensions in both genders. In contrast, the self-care dimension was the least reported as having any problems.

EQ-5D-5L utility scores by patient characteristics

Figure 2 shows the utility scores of the EQ-5D and its distribution among the participants. Their mean utility score of the total sample was 0.85 ± 0.23, ranging from -0.39 to 1. It showed a left-skewed distribution (skewness = -2.24), with a state of 11111 (no problems in any dimensions) reported by 37.1% of the total interviewees (44.8% of male and 32.4% of female). Nevertheless, there were still 202 patients (58 males and 144 females) whose utility scores were less than 0, representing health states worse than death.

Table 1 Characteristics of the study participants

Subject characteristics	Total ($N=16,596$)		Male ($N=6240$)		Female ($N=10,356$)		p
	N	%	N	%	N	%	
Age years (mean ± SD)	62.96 ± 9.59		63.53 ± 9.90		62.61 ± 9.39		< 0.001
< 45	427	2.57	195	3.13	232	2.24	
45–54	2962	17.85	992	15.90	1970	19.02	
55–64	5612	33.82	2030	32.53	3582	34.59	
65–74	5622	33.88	2149	34.44	3473	33.54	
> 74	1973	11.89	874	14.01	1099	10.61	
BMI* kg/m^2 (mean ± SD)	25.98 ± 3.81		25.40 ± 3.63		26.32 ± 3.87		< 0.001
< 18.5	221	1.35	113	1.83	108	1.05	
18.5–23.9	4723	28.77	2042	33.07	2681	26.17	
24.0–27.9	6913	42.11	2604	42.17	4309	42.07	
> 28.0	4561	27.78	1416	22.93	3145	30.70	
Education level							< 0.001
Illiterate	8555	51.55	1656	26.54	6899	66.62	
Primary school	4058	24.45	1913	30.66	2145	20.71	
Middle or high school	3916	23.60	2623	42.04	1293	12.49	
College	67	0.40	48	0.77	19	0.18	
Smoking status							< 0.001
Non-smoker	12,728	76.69	2697	43.22	10,031	96.86	
Ex-smoker	1475	8.89	1314	21.06	161	1.55	
Smoker	2393	14.42	2229	35.72	164	1.58	
Duration of disease	5.82 ± 5.99		5.51 ± 6.15		6.01 ± 5.88		< 0.001
0 year	2917	17.58	1279	20.50	1638	15.82	
1–5 years	6463	38.94	2480	39.74	3983	38.46	
6–10 years	4965	29.92	1735	27.80	3230	31.19	
>10 years	2251	13.56	746	11.96	1505	14.53	
Anti-hypertension medication							0.027
No	7466	44.99	2876	46.09	4590	44.32	
Yes	9130	55.01	3364	53.91	5766	55.68	
With comorbidities							0.066
No	11,817	71.20	4495	72.04	7322	70.70	
Yes	4779	28.80	1745	27.96	3034	29,30	
Prevalence of comorbidities							< 0.001
Stroke	2598	15.65	1102	17.66	1496	14.45	
Coronary heart disease	1293	7.79	376	6.03	917	8.85	
Diabetes mellitus	1277	7.69	370	5.93	907	8.76	
Chronic kidney disease	242	1.46	108	1.73	134	1.29	
Cancer	219	1.32	25	0.40	194	1.87	
Heart failure	106	0.64	41	0.66	65	0.63	
Prevalence of hypertension with only one comorbidity							< 0.001
Stroke	1923	49.73	888	61.07	1035	42.89	
Coronary heart disease	789	20.40	225	15.47	564	23.37	
Diabetes mellitus	815	21.08	236	16.23	579	24.00	
Chronic kidney disease	137	3.54	68	4.68	69	2.86	
Cancer	155	4.01	18	1.24	137	5.68	
Heart failure	48	1.12	19	1.31	29	1.20	

*Missing data for BMI: male/female: 65/113

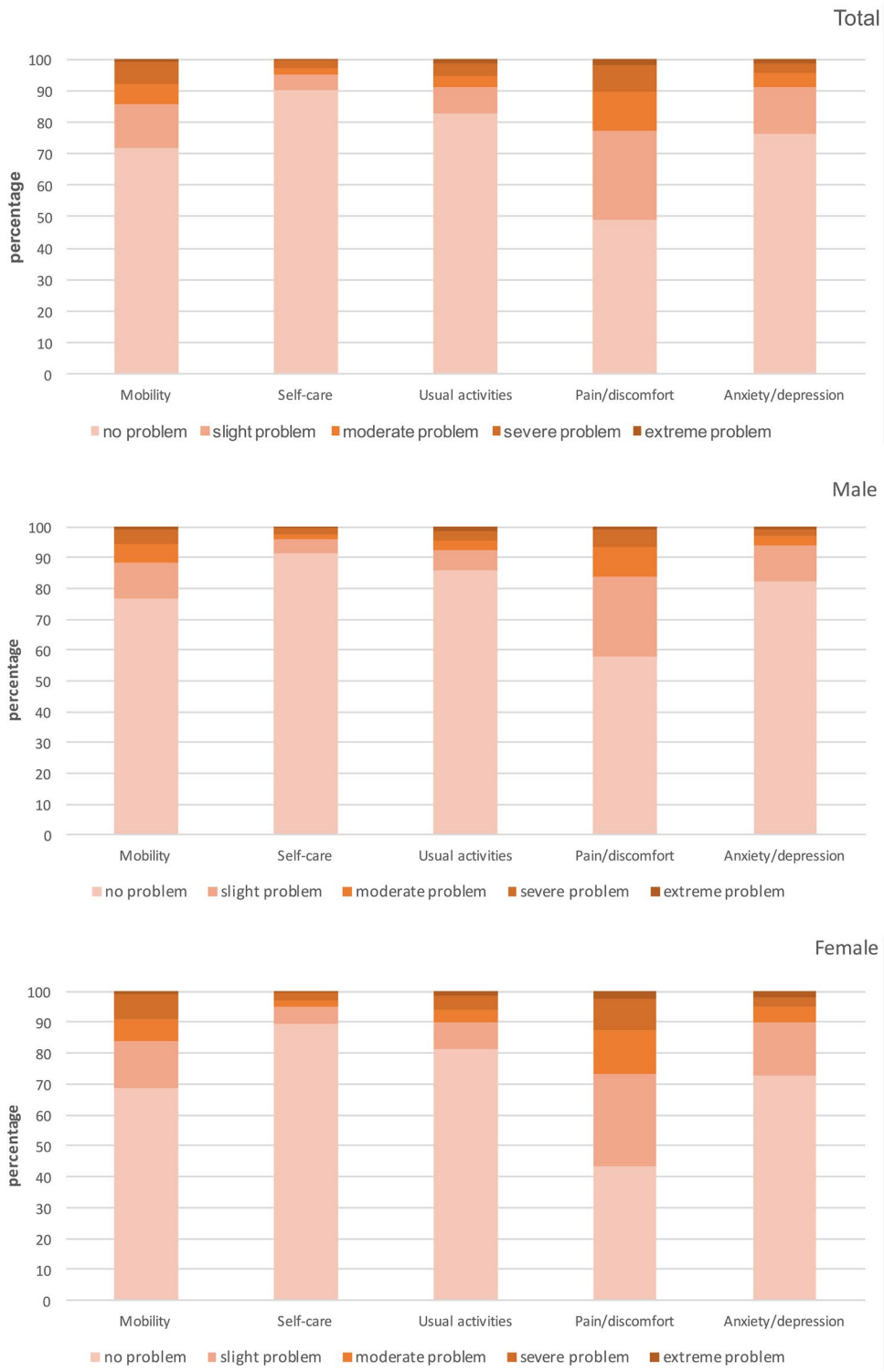

Fig. 1 Distribution of the EQ-5D-5L by self-classified health states in total sample and among males and females, respectively

The EQ-5D-5L scores by each sociodemographic variable are listed in Table 2. The differences in EQ-5D scores between different levels of these variables were all statistically significant. The average score of males (0.88) was significantly higher than that of females (0.83). Patients who were elderly, illiterate, with a longer duration of disease or comorbidities scored lower compared to other groups ($p < 0.001$). The results showed that both female and male smokers had lower scores, representing a worse HRQoL, than non-smokers, whereas former smokers had the lowest scores. Figure 3 displays the scores of hypertensive patients who only had one of the comorbidities, respectively. Among

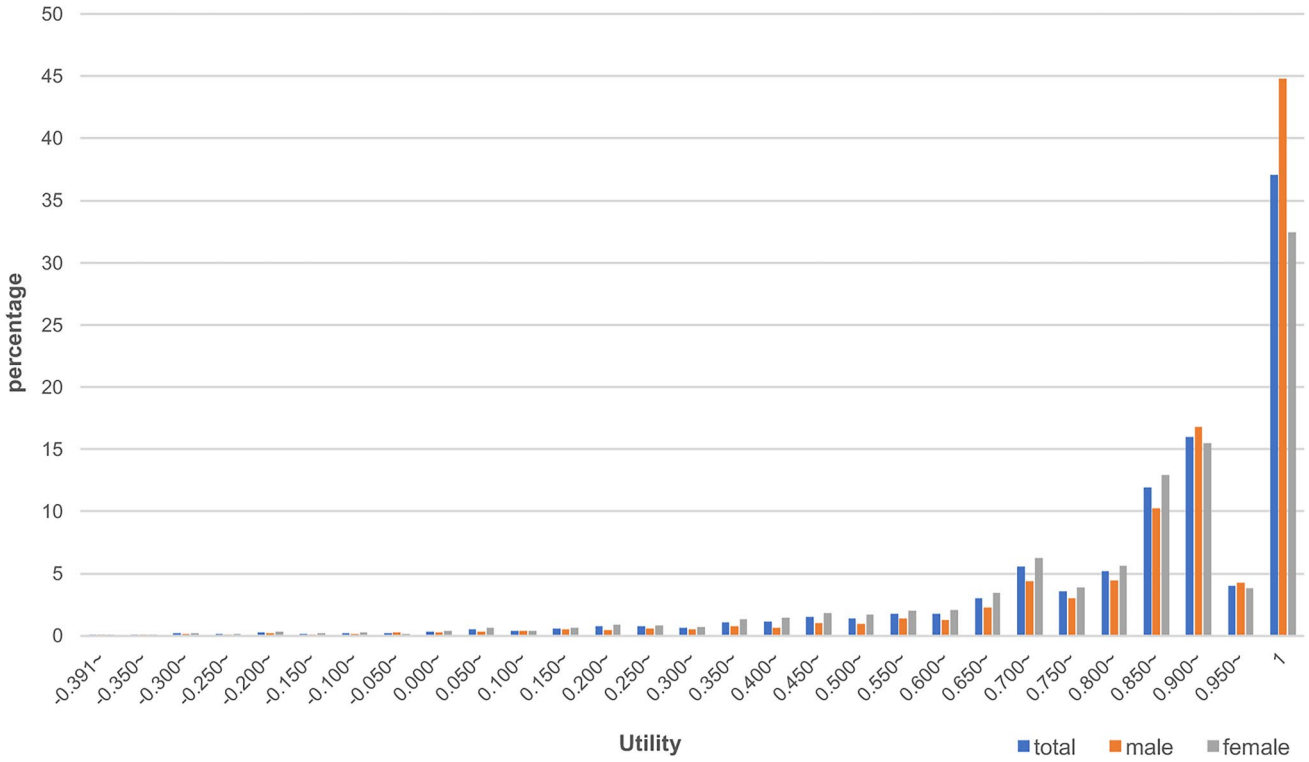

Fig. 2 Distribution of utility scores based on the EQ-5D-5L values set for China

them, patients with stroke had the lowest utility score of 0.77 on average, followed by, in progressive order, those with heart failure, CKD, cancer and CHD. DM scored the highest with 0.82 on average.

Influencing factors of HRQoL

The regression coefficients obtained by the Tobit regression model are summarized in Table 3. The EQ-5D utility scores of females were lower than those of males ($p < 0.001$) and decreased with age. In general, patients with higher education levels had significantly higher utility scores (e.g., college education was 0.064 higher compared to illiteracy in total sample, $p < 0.001$). Smoking had a negative influence on HRQoL, where ex-smokers had lower utility scores than non-smokers (-0.022, $p < 0.001$); this difference was significant in males (-0.019, $p < 0.001$) but not in females ($p = 0.092$). In terms of disease-related factors, the duration of hypertension was adversely associated with the utility scores, where patients with a hypertension history of more than 10 years had a lower utility score than newly diagnosed patients (-0.015, $p = 0.001$ in total sample; -0.020, $p = 0.006$ in females). However, there was no significant association between utility and duration of hypertension in males. We also observed that hypertensive patients with comorbidities had lower scores compared to those without comorbidities ($p < 0.001$). This trend was also observed in both males and females ($p < 0.001$).

Discussion

In this large sample of rural Chinese hypertensive population, we evaluated their HRQoL using the latest EQ-5D-5L. Our study also identified influencing sociodemographic factors on the HRQoL: female, elders, lower education levels, or ex-smokers had lower HRQoL utility score. In addition, a longer duration of hypertension and comorbidities had a negative impact on HRQoL, especially such comorbidities as stroke, heart failure, or chronic kidney disease.

In this rural Chinese hypertensive population, the average HRQoL utility score was 0.85 (SD ± 0.23, with a range of −0.391 to 1), which was slightly lower than that reported by other studies [17, 20]. This may be due to the fact that most of our respondents were elderly and more than half were illiterate. Previous study showed that HRQoL utility score of non-hypertensive patients was 0.9787. This study found that hypertensive patients had lower utility scores than the normotensive population [16]. While compared with urban areas, rural hypertensive patients had significantly lower utility scores both in EQ-5D and in all five dimensions [17].

Table 2 Univariate analysis of mean utility scores in total sample and by gender

Subject characteristics	Total		Male		Female	
	Mean (SD)	*p*	Mean (SD)	*p*	Mean (SD)	*p*
Total	0.85 (0.23)		0.88 (0.21)		0.83 (0.24)	
Age years		< 0.001		< 0.001		< 0.001
< 45	0.94 (0.10)		0.94 (0.10)		0.94 (0.09)	
45–54	0.89 (0.17)		0.92 (0.15)		0.88 (0.17)	
55–64	0.85 (0.22)		0.89 (0.20)		0.83 (0.24)	
65–74	0.83 (0.24)		0.87 (0.22)		0.80 (0.26)	
> 74	0.79 (0.27)		0.83 (0.25)		0.76 (0.28)	
BMI kg/m^2		< 0.001		0.021		< 0.001
< 18.5	0.83 (0.26)		0.84 (0.27)		0.82 (0.25)	
18.5–23.9	0.86 (0.22)		0.87 (0.21)		0.84 (0.22)	
24.0–27.9	0.85 (0.22)		0.88 (0.20)		0.83 (0.23)	
> 28.0	0.83 (0.24)		0.89 (0.19)		0.80 (0.25)	
Education level		< 0.001		< 0.001		< 0.001
Illiterate	0.81 (0.25)		0.85 (0.24)		0.81 (0.26)	
Primary school	0.86 (0.20)		0.87 (0.21)		0.86 (0.20)	
Middle or high school	0.90 (0.18)		0.90 (0.17)		0.88 (0.18)	
College	0.94 (0.15)		0.95 (0.10)		0.89 (0.22)	
Smoking status		< 0.001		< 0.001		< 0.001
Non-smoker	0.84 (0.23)		0.89 (0.19)		0.83 (0.24)	
Ex-smoker	0.83 (0.25)		0.84 (0.24)		0.75 (0.31)	
Smoker	0.88 (020)		0.88 (0.20)		0.79 (0.25)	
Duration of disease		< 0.001		< 0.001		< 0.001
0 year	0.88 (0.20)		0.90 (0.18)		0.86 (0.21)	
1–5 years	0.85 (0.22)		0.88 (0.20)		0.83 (0.23)	
6–10 years	0.83 (0.24)		0.87 (0.22)		0.82 (0.24)	
> 10 years	0.81 (0.25)		0.85 (0.22)		0.79 (0.26)	
Anti-hypertension medication		< 0.001		< 0.001		< 0.001
No	0.86 (0.21)		0.89 (0.19)		0.84 (0.23)	
Yes	0.83 (0.24)		0.87 (0.22)		0.81 (0.25)	
With comorbidities		< 0.001		< 0.001		< 0.001
No	0.87 (0.20)		0.91 (0.17)		0.85 (0.21)	
Yes	0.78 (0.28)		0.81 (0.27)		0.76 (0.28)	

As to the influencing factors on HRQoL, this was the first study to identify that different set of problems came up more frequently for ex-smokers than smokers. One possible explanation is that smokers believe that smoking can ease their nerves, relieve pain and help them deal with stress to some extent [30]. Another possible explanation is the "healthy smoker" phenomenon, while ex-smokers were likely forced to quit smoking due to illness.

Comorbidity of hypertension is one of the important influencing factors in HRQoL for people diagnosed with hypertension, but few previous studies have quantified this using the EQ-5D-5L [31, 32]. In our study, we included six common comorbidities of hypertension to examine their impact on utility. Our results are the first to show that stroke had the greatest impact on decreasing HRQoL in a Chinese rural population [33]. Other comorbidities with great adverse effects on HRQoL included heart failure, CKD and cancer.

Four previous similar studies explored the HRQoL of Chinese rural hypertensive patients and were conducted in Shandong, Shanxi and Chongqing, respectively [16, 17, 23, 34]. These studies did not use the EQ-5D-5L, although they showed the following findings comparable with ours. Pain/discomfort was the most common problem, and self-care was the least reported. Sex, age, education status and duration of disease were significant influencing factors on HRQoL in hypertensive patients. However, studies carried out in Chongqing indicated that a long-term physician-patient relationship, self-management efficacy and health literacy can improve HRQoL in rural hypertensive patients [23, 34].

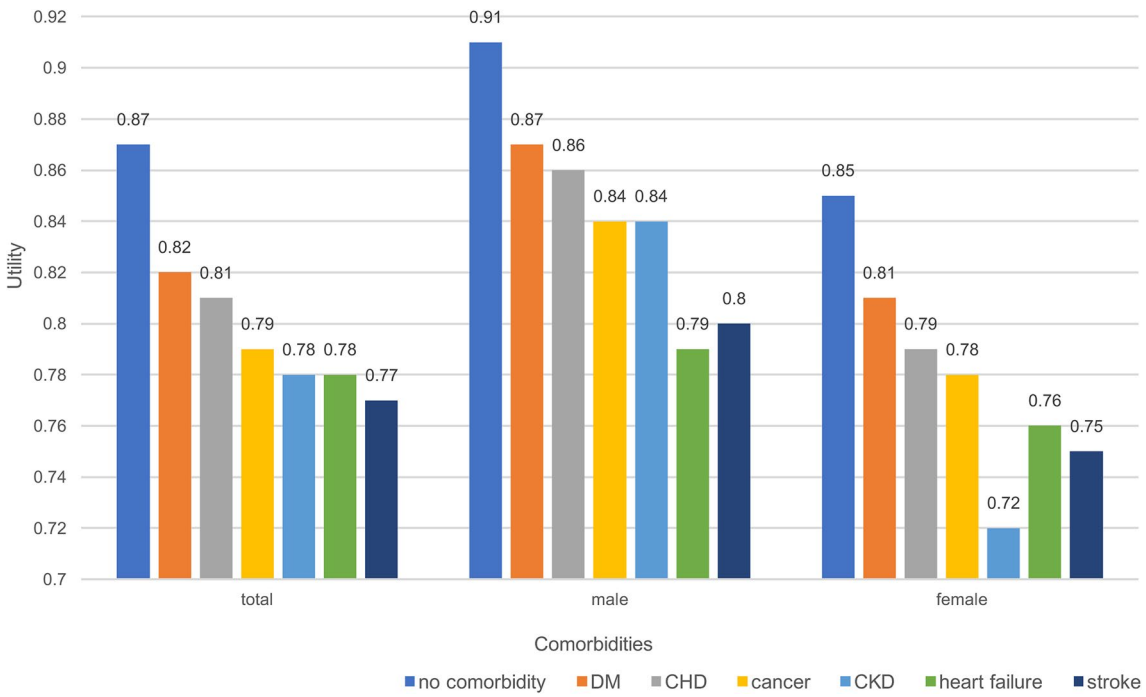

Fig. 3 EQ-5D-5L scores among hypertensive patients with only one of the comorbidities

We also found that the treatment rates of hypertension in the city of Lianyungang have increased from 44% in 2011 to 55% in 2016. This increase in treatment rate was largely attributable to the China Stroke Primary Prevention Trial conducted in partial townships within the city of Lianyungang during 2008–2015 [35]. However, compared to the 75% average treatment rates in developed countries [36, 37], such rates in rural China remain to be improved [38].

Our study has some political implications. First, compared to previous studies using EQ-5D-3L [16, 17], we are the first to adopt the EQ-5D-5L questionnaire to evaluate HRQoL in a large sample of Chinese rural hypertensive patients, bringing less ceiling effect [18, 39]. Compared to previous studies using Medical Outcomes Study 36-item Short Form Health Survey (SF-36) [23, 34], EQ-5D-5L was proven to be more friendly to less-educated interviewees, especially in Chinese rural areas. We modified our questionnaire interview process to overcome the challenges encountered in studying rural Chinese, such as being elderly and less educated, having poor hearing and comprehension capability, and routinely utilizing local dialects for communication. These characteristics typically hamper the measurement for HRQoL of Chinese rural patients. However, it is not clear whether such modifications had a positive or negative impact on the data collected compared to the stand inquiry. Second, we are the first to apply the newly developed Chinese population-based value set of the EQ-5D-5L on hypertensive patients in rural China. Previous studies using the EQ-5D-5L for hypertension in Chinese populations were based on value sets from other countries (e.g., Japanese or British) [39], potentially introducing bias due to cultural and population discrepancies. Third, ours has the largest sample size on Chinese rural hypertensive patients and included those with a range of comorbidities. Fourth, Lianyungang is one of the cities in China with the highest hypertensive prevalence [25]. Our study findings could bear significant policy implications for hypertension control in this region. In addition, our findings and methodology may serve as a model to inform hypertension control domestically and globally.

Our study had some limitations. First, the study participants were recruited locally from Donghai County, Lianyungang, Jiangsu province, and may not represent other rural areas in China. The distribution of patient characteristics was slightly skewed toward female and older age groups. Second, we may have missed characteristics that would have made a significant impact on HRQoL, such as disease staging and severity of comorbidities, which may have potentially biased our estimates. Third, our research sample involved only rural residents; however, the EQ-5D-5L value set for China was developed from urban areas rather than rural areas, it may introduce bias to our study.

Table 3 Influencing factors of EQ-5D utility scores using the Tobit regression model in total samples, males, and females, respectively

Variables	Total sample			Males			Females		
	Coe	SE	*p*	Coe	SE	*p*	Coe	SE	*p*
Gender (ref. = male)									
Female	−0.038	0.003	< 0.001	–	–	–	–	–	–
Age years (ref. < 45)									
45–54	−0.022	0.005	< 0.001	−0.011	0.008	0.174	−0.032	0.006	< 0.001
55–64	−0.037	0.005	< 0.001	−0.017	0.008	0.022	−0.052	0.007	< 0.001
65–74	−0.043	0.005	< 0.001	−0.016	0.008	0.042	−0.061	0.007	< 0.001
> 74	−0.069	0.006	< 0.001	−0.038	0.009	< 0.001	−0.090	0.008	< 0.001
BMI kg/m^2 (ref. < 18.5)									
18.5–23.9	0.007	0.011	0.531	0.013	0.015	0.385	−0.002	0.014	0.914
24.0–27.9	0.002	0.011	0.817	0.016	0.015	0.284	−0.011	0.014	0.459
> 28.0	−0.011	0.011	0.287	0.012	0.015	0.413	−0.030	0.014	0.041
Education level (ref.=illiterate)									
Primary school	0.009	0.003	0.002	0.007	0.005	0.118	0.008	0.004	0.027
Middle or high school	0.022	0.003	< 0.001	0.024	0.004	< 0.001	0.019	0.004	< 0.001
College	0.064	0.015	< 0.001	0.077	0.015	< 0.001	0.020	0.036	0.586
Smoking status (ref. = non-smokers)									
Smokers	−0.009	0.004	0.024	−0.006	0.004	0.113	−0.011	0.012	0.352
Ex-smokers	−0.022	0.005	< 0.001	−0.019	0.004	< 0.001	−0.024	0.014	0.092
Duration of disease (ref. = 0 year)									
1–5 years	−0.005	0.003	0.112	0.002	0.004	0.710	−0.010	0.004	0.014
6–10 years	−0.005	0.004	0.135	−0.002	0.005	0.764	−0.009	0.005	0.051
> 10 years	−0.015	0.004	0.001	−0.010	0.006	0.124	−0.020	0.006	0.001
Antihypertension medication (ref. = no)									
Yes	−0.005	0.002	0.039	−0.004	0.004	0.249	−0.005	0.003	0.105
Comorbidity (ref. = no)									
Yes	−0.048	0.003	< 0.001	−0.049	0.004	< 0.001	−0.048	0.003	< 0.001

Conclusion

In summary, by applying the latest EQ-5D-5L in a large sample of hypertensive patients in rural China, this study showed that the HRQoL in this sample was lower compared to that of previous reports and was significantly associated with one's gender, age, education background, smoking status, duration of disease and comorbidity. To improve the HRQoL of hypertensive patients in rural China, medical and health services and policy makers need to pay more attention to females, the elderly and the illiterate, especially those patients with comorbidity of stroke, heart failure and coronary heart disease. Additionally, more attention is needed to educate hypertensive patients to improve the treatment rate of hypertension.

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Compliance with ethical standards

Conflict to interest The authors declare that they have no conflict of interest.

Informed consent Informed consent was obtained from all individual participants included in the study.

Ethical approval This study made use of clinical trial data (NCT00794885). The trial was approved by the ethics committee of the Institute of Biomedicine, Anhui Medical University, Hefei, China (FWA assurance number FWA00001263). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Appendix

See Table 4 and Figs. 4, 5.

Table 4 The Chinese utility value set for the EQ-5D-5L health states

MO	SC	UA	PD	AD	L1	L2	L3	L4	L5
0.345	0.253	0.233	0.302	0.258	0	0.191	0.458	0.832	1

MO mobility, *SC* self-care, *UA* usual activities, *PD* pain/discomfort, *AD* anxiety/depression

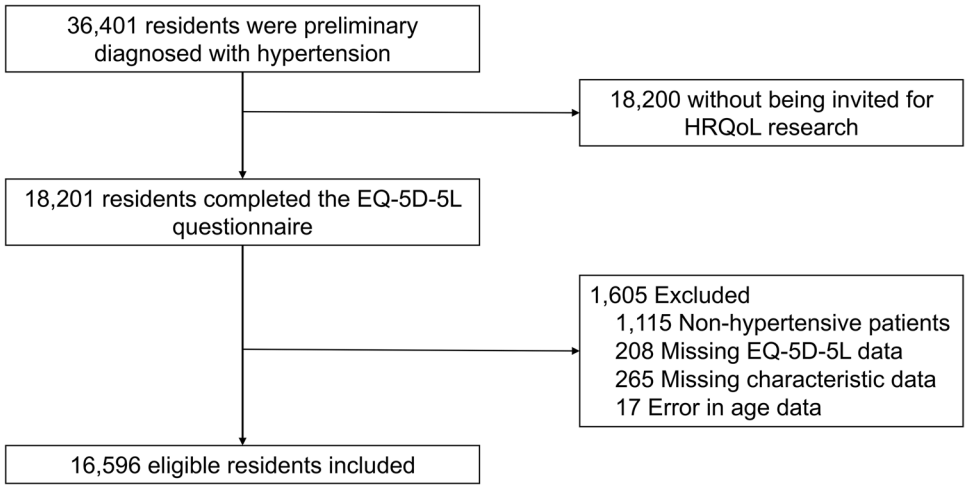

Fig. 4 Flow chart of the eligible residents' selection

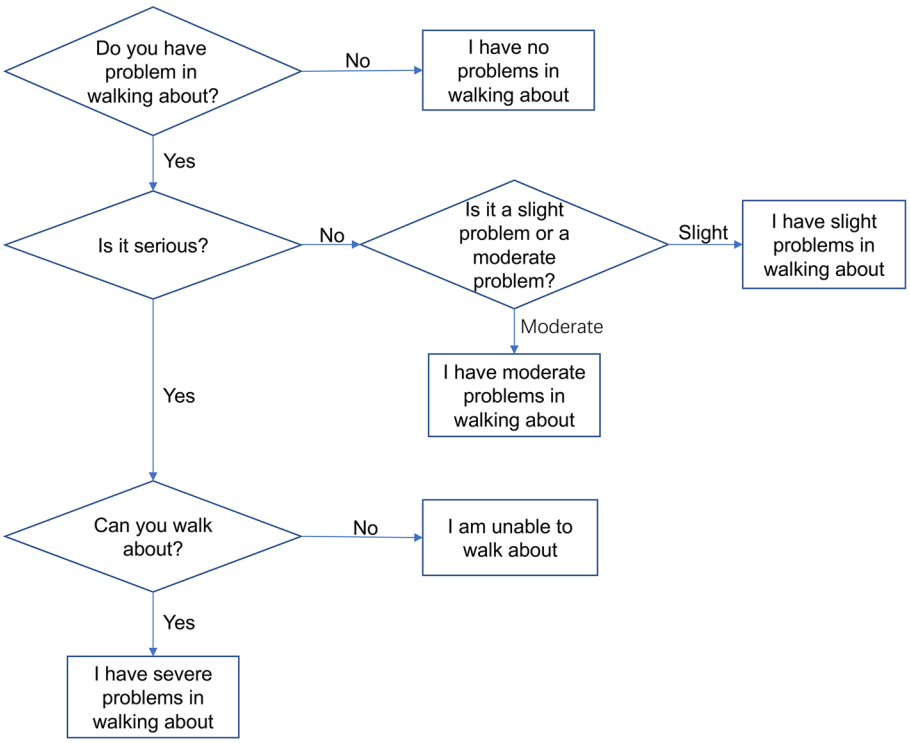

Fig. 5 Example of the interview process of the EQ-5D-5L questionnaire using (mobility)

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