

# Differences in Health-Related Quality of Life and Its Associated Factors Among Older Adults in Urban and Rural Areas

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**Purpose:** Urban-rural health disparity is one of the most prominent challenges in China today. The goal of this study is to find differences in health-related quality of life (HRQoL) and its associated factors among older people in urban and rural areas.

**Methods:** A multi-stage stratified sampling method was conducted in Shanxi Province, with a total of 3250 older adults participated in this cross-sectional survey. HRQoL was assessed using the Chinese version of the EQ-5D-5L. Tobit regression models were employed to identify associated factors for HRQoL.

**Results:** The mean EQ-5D utility score of the total sample was  $0.87 \pm 0.23$ , with a statistically significant difference observed between urban ( $0.89 \pm 0.22$ ) and rural areas ( $0.86 \pm 0.23$ ). Obesity ( $Coe = -0.10$ ,  $p = 0.021$ ) and nutrition awareness ( $Coe = -0.14$ ,  $p = 0.009$ ) were two unique associated factors to rural older adults' HRQoL. While, age (Urban:  $Coe = 0.13$ ,  $p = 0.001$ ; Rural:  $Coe = -0.019$ ,  $p < 0.001$ ), socioeconomic status (Urban:  $Coe = 0.13$ ,  $p < 0.001$ ; Rural:  $Coe = 0.14$ ,  $p < 0.001$ ), number of chronic non-communicable diseases (Urban:  $Coe = -0.20$ ,  $p < 0.001$ ; Rural:  $Coe = -0.15$ ,  $p < 0.001$ ), sleep quality (Urban:  $Coe = -0.22$ ,  $p < 0.001$ ; Rural:  $Coe = 0.15$ ,  $p < 0.001$ ) and daytime sleepiness (Urban:  $Coe = -0.13$ ,  $p < 0.001$ ; Rural:  $Coe = -0.13$ ,  $p < 0.001$ ) were found to be associated with HRQoL regardless of the residential area.

**Conclusion:** This study suggested that rural older adults are facing HRQoL disadvantages compared to those in urban area. Accordingly, more attention should be devoted to rural older adults' HRQoL, particularly to the unique factors like body weight and nutrition awareness. Targeted policies and interventions should be implemented to improve HRQoL and bridge the urban-rural HRQoL gap.

**Keywords:** health-related quality of life, HRQoL, older adults, urban and rural, health management

## Introduction

With the increasing trend of aging, China will have 264.02 million older adults over the age of 60 by the end of 2020.<sup>1</sup> Despite the fact that China's rapid economic growth has helped to improve populations' overall health and average life expectancy. However, one of the most prominent issues today is the health disparity between urban and rural areas. Chinese current urban-rural dichotomy probably in related to the household registration system since 1958, which has kept a large group of people, mostly farmers, in rural areas.<sup>2</sup> For a long time in the past, rural households did not have the same access to social resources such as education and social welfare comparing with the urbanities.<sup>3</sup> The dichotomy further exacerbated health disparity between urban and rural older adults. A number of academics have demonstrated the urban-rural health disparities. Zimmer et al discovered that urbanites older adults have substantial advantages in functional health status over those in rural areas.<sup>4</sup> Other localized studies have also described that mental health and activities of daily living problems are more pressing among rural older adults.<sup>3,5</sup>

“Health-related quality of life” (HRQoL) is a multidimensional concept captures the overall health and well-being of people, reflecting health status of individuals or groups with wide range of socio-economic characteristics at different stages of life.<sup>6</sup> It is also a valuable addition to traditional health indicators for its comprehensiveness.<sup>7</sup> HRQoL could be measured with a variety of questionnaire-based methods, and the European Quality of Life Five Dimension Five Level Scale (EQ-5D-5L) is one of the most recent and widely used self-reported instruments for HRQoL evaluation.<sup>8</sup> With a lowered ceiling effect and increased sensitivity, EQ-5D-5L is a suitable extension of the prior three-level system,<sup>9</sup> and has been applied to compelling research of older adults.<sup>10</sup> In terms of HRQoL influencing factors, literature have identified that age, gender, marital and educational status, income, chronic disease, and self-rated health have a major influence on HRQoL measured by EQ-5D.<sup>11,12</sup> A mediation analysis also revealed the mediation role of socioeconomic status in the relationship between residential area and HRQoL.<sup>13</sup> Despite many local studies have explored HRQoL associated factors, most of them either concentrated on Chinese rural or urban area separately,<sup>14,15</sup> or people with certain chronic diseases such as hypertension<sup>16</sup> or special groups such as empty nesters.<sup>17</sup> Furthermore, living in rural areas have been identified as a risk factor for HRQoL in several local studies of older adults. A study using the SF-36 to measure HRQoL indicated that rural older population had the lowest HRQoL.<sup>18</sup> Other localized studies reached similar conclusions with the quality of life in these studies been measured by a single item rather than a validated scale.<sup>19,20</sup> Similar rural-urban HRQoL inequalities have also been observed in a longitudinal study tracking US veterans.<sup>21</sup> Although the urban-rural HRQoL difference have been compared, few research have went a closer looking at the differentials in urban-rural HRQoL influencing factors.

Based on the aforementioned findings, the goal of this study is twofold: (1) evaluate HRQoL using the EQ-5D-5L among older adults from Shanxi province, China by residential area; (2) explore the influencing factors of HRQoL among urban and rural Chinese older adults, respectively. This study could bring a deeper understanding of the current status of urban-rural HRQoL and help to find out their differentials in HRQoL associated factors. The government or local communities could follow the guidance of the study, formulating evidence-based interventions to enhancing older adults’ HRQoL.

## Measures

### Study Design and Participants

Shanxi province is located in central China with a total land area of 156,700 square kilometers.<sup>22</sup> The number of urban population in Shanxi was 21,827,800 and accounted for 62.53% of the total population, which was slightly lower than the national average of 63.89%.<sup>23</sup> A questionnaire-based cross-sectional study was undertaken in all 11 cities Shanxi province (Taiyuan, Datong, Yangquan, Changzhi, Jincheng, Shuozhou, Jinzhong, Yuncheng, Xinzhou, Linfen, and Lvliang).

We used a multistage stratified sampling method to select the participants aged 60 years old and above. Firstly, according to the order of districts (counties) on the government’s website, each district (county) in every city was numbered. Secondly, two (districts) counties in each city were selected using the random number table, and then two communities (administrative villages) were drawn from each district (county) in the same way. Thirdly, considering the different scales of each community (administrative village), once again, we select 1 to 2 residential communities (natural villages) from each community (administrative village) by the random number table. Finally, we obtained older people’s name list and numbered in each community or natural villages, and the random number table was also applied to select old adults who meet the criteria in this study.

The inclusion criteria for this study were: (1) being aged 60 and above and (2) having clear awareness and barrier-free communication skills. Those who had difficulty communicating were excluded.

Before our formal survey, a pre-study had been conducted to ensure the accuracy, validity, and understandability of the questionnaires. The pre-study was conducted in Taiyuan, Shanxi Province, with 137 questionnaires distributed and 135 returned. The pre-study data was not included in the formal study. And the results demonstrated the questionnaire had a good reliability and validity and could be well-understood by older adults.

All participants were interviewed face-to-face using a structured questionnaire by trained interviewers with medical knowledge in Shanxi Province, China. We used face-to-face interviews instead of self-complete questionnaires because

some of the older adults were illiterate, and some of them could not read or write due to poor vision, hand tremors or other reasons. The study was conducted from June to August 2019 and involved 3266 older adults, of whom 3250 completed the questionnaire effectively, with an effective response rate of 99.51%.

## Measurement of HRQoL

In this study, HRQoL was estimated by the EQ-5D-5L, which was translated into Chinese in 2002 by Luo et al.<sup>24</sup> EQ-5D-5L is a generic measure of health status that descriptive system consists of five dimensions covering mobility (MO), self-care (SC), usual activities (UA), pain/discomfort (PD) and anxiety/depression (AD), and a Visual Analogue Scale (EQ-VAS). Each dimension had five levels of response: 1, no problems; 2, slight problems; 3, moderate problems; 4, severe problems; and 5, extreme problems. As a result, a total of 3125 ( $5^5$ ) unique health states statements can be combined in this system. The EQ-5D utility scores were calculated based on the recently available Chinese value set.<sup>25</sup> The score ranges from -0.391 to 1, where 1 represents full health (1,1,1,1,1), and the lowest is -0.391 represents a health status worse than death (5,5,5,5,5).

## Explanatory Variables

### Socio-Demographic Variables

The socio-demographic background characteristics including gender, age, marital status and socioeconomic status (SES). SES is an index comprehensively evaluates people's general living standard, which is a combination of economic, social, and work status, commonly measured by income, educational level and occupation. In our study, personal monthly income, educational level and occupation before retirement were selected to access older adults' SES.<sup>26</sup> As a general method, principal components analysis (PCA) was employed to generated SES index.<sup>27</sup> Then we classified the continuous index of SES by quartiles into four levels: 0=low, 1=middle low, 2=middle high, 3=high.

### Health Condition Variables

The health condition variables were characterized by number of chronic non-communicable diseases (NCDs) and obesity ( $\text{BMI} \geq 30.0 \text{ kg/m}^2$  based on measured weight and height).<sup>28</sup> Information on chronic diseases was collected through self-reporting, supported by diagnostic evidence from medical records or physicians' prescriptions.

### Health Behavior Variables

Health behaviors are defined as actions people do to stay in good health or improve their health.<sup>29</sup> In our study, smoking status, alcohol intake status, tea drinking, sleep quality, excessive daytime sleepiness, and nutrition awareness are included. Participants rated the quality of their sleep during the past 30 days using the validated Pittsburgh Sleep Quality Index (PSQI).<sup>30</sup> The 19 items (ranged from 0–3) generate a total score and seven different domains or subscales. The PSQI score ranges from 0 to 21, with PSQI score  $> 5$  classified as poor sleep quality and  $\leq 5$  as good sleep quality.<sup>31</sup> In the study, the Cronbach's  $\alpha$  for PSQI was 0.758. Epworth Sleepiness Scale (ESS) is the most used self-reported instrument for the assessment of daytime sleepiness. Participants are asked to rate their usual chances of dozing off or falling asleep while engaged in eight occasions on a four-point scale (0–3). Scores on the ESS range from 0–24, with ESS score  $> 10$  as the cut point.<sup>32</sup> Internal consistency as measured by Cronbach's alpha was 0.871. In line with previous research, "nutritional awareness" in our study aimed at capturing the "participant self-perception of the importance of balanced meals".<sup>33</sup> The variable "nutrition awareness" was accessed by the question of: "how much attention do you attached to your balanced meals in order to feel in a good health?" The response was measured on a 5-point Likert scale (from 1=never to 5 =always) and was treated as a dichotomous variable.

## Statistical Analysis

Participants' characteristics by residential area are summarized using descriptive statistics. As the EQ-5D utility scores followed a non-normal distribution, Wilcoxon rank-sum tests and Kruskal–Wallis test were conducted to test the differences in EQ-5D scores among the various sub-groups, with the test statistics expressed as  $H$  and  $Z$ , respectively. A multivariate Tobit regression model was employed to assess the association between EQ-5D utility scores and its

potential influencing factors. The Tobit model was chosen because of a common ceiling effect in the EQ-5D instruments, as a large number of patients report the highest health state, leading to some utility scores being censored at 1.0.<sup>34,35</sup> Therefore, when it comes to censored data, the use of Tobit regression model is advised.<sup>36</sup> Data were analyzed using STATA version 15. All *p* values were two-tailed, and statistical significance was set at *p* < 0.05.

## Ethics Declarations

The study complied with the Declaration of Helsinki. All study procedures were approved by the Ethics Committee of Shanxi Medical University. The survey's goals and contents have been fully disclosed to all potential participants. Only the participants who were willing to participate voluntarily and signed the informed consent form were considered final respondents in the survey.

## Results

### Participants' Characteristics

The participants' characteristics by residential area were shown in Table 1. In a total of 3250 older adults participated in this research, 1453 (44.70%) of them lived in urban residents and 1797 (55.30%) in rural area. The mean age of urban and rural group was  $69.39 \pm 6.81$  and  $69.87 \pm 6.73$ , respectively.

### Description of the EQ-5D Utility Scores and Health Problem Dimensions

The HRQoL utility scores were a left-skewed distribution (skewness = -2.68), with a state of full health (no problems in any dimension) reported by 50.0% of the total interviewees (883, 51.30% of urban and 792, 48.70% of rural). Nevertheless, there were still 44 older adults (23 from urban and 21 from rural) whose utility scores were less than 0, representing health states worse than death. Figure 1 showed participants who reported having any problems (slight problems; moderate problems; severe problems; extreme problems) in five health problem dimensions of EQ-5D by residential area. There was a significant difference in HRQoL between urban and rural participants ( $Z = -5.78, -4.24, -3.62, -7.00$  and  $-5.18$  respectively,  $p < 0.001$ ), with rural participants reported more health problems. In both rural and urban areas, pain/discomfort dimension was the most prominent across the five dimensions (Urban: 522 out of 1453, 35.92%; Rural: 865 out of 1797, 48.14%). While the self-care dimension was the least reported dimension to have any problems in both residential areas (Urban: 227 out of 1453, 15.62%; Rural: 386 out of 1797, 21.48%).

### Regression Results by Area

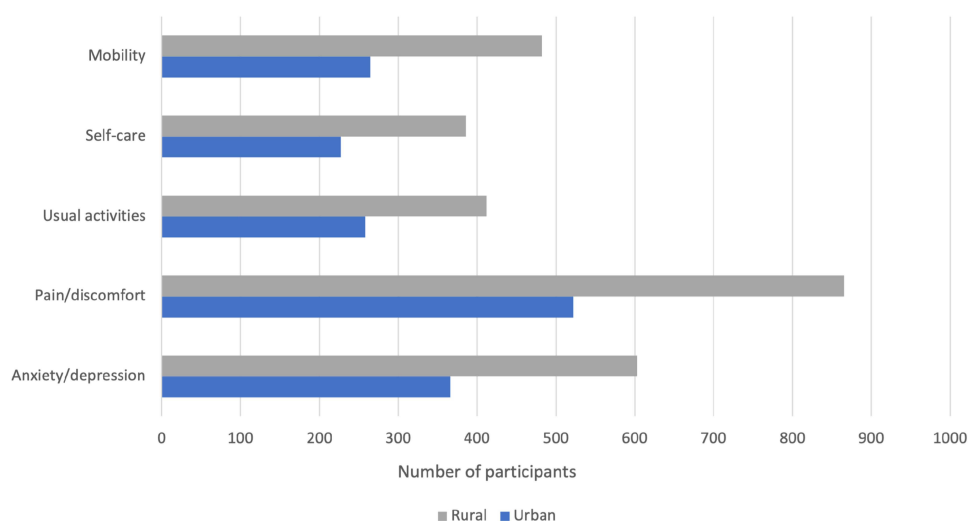
The mean EQ-5D utility score of the total sample was  $0.87 \pm 0.23$ , with a statistically significant difference observed in urban ( $0.89 \pm 0.22$ ) and rural ( $0.86 \pm 0.23$ ) participants ( $Z = -7.30, p < 0.001$ ). The EQ-5D utility scores by participant characteristics and residential area were shown in Table 2. Kruskal–Wallis tests or Wilcoxon rank-sum tests presented the correlation between EQ-5D utility scores and the explanatory variables, revealing that smoking status and tea drinking were not associated with the EQ-5D utility scores of the respondents ( $p > 0.05$ ).

Table 3 summarized the regression coefficients derived by the Tobit regression model. Regardless of urban–rural location, gender and marital status showed no significant impact on HRQoL. People' HRQoL decreased considerably with age (eg, in both urban and rural areas, participants aged over 80 had 0.12 and 0.19 lower EQ-5D utility score than those aged 60 to 69, respectively,  $p < 0.01$ ). For both residential areas, a high SES was a protective factor. Rural older adults who have a middle-high and high level of SES tend to have higher utility score ( $Coe = 0.01$  and  $0.14$ , respectively, all  $p < 0.001$ ). In urban area, the protective effect of high SES was significant, but not in middle-high SES ( $p = 0.061$ ). In terms of health conditions, the number of chronic non-communicable diseases (NCDs) was found to be adversely associated with HRQoL in both areas. There was no significant association between utility scores and obesity in urban areas, but obese people in rural areas were found to have considerably poorer HRQoL ( $Coe = -0.01, p < 0.05$ ). Poor sleep quality ( $PSQI > 5$ ) and excessive daytime sleepiness ( $ESS \geq 10$ ) were both negatively correlated with HRQoL regardless of residential region. Rural older adults with highest level nutrition awareness appeared to have better HRQoL ( $Coe = 0.11, p < 0.01$ ). However, in urban areas, nutrition awareness had no significant impact on HRQoL.

**Table I** Participants' Characteristics by Residential Area (N = 3250)

Variables	Total	Urban	Rural
	3250	1453	1797
<b>Socio-demographic characteristics</b>			
<b>Gender</b>			
Male	1515	702	813
Female	1735	751	984
<b>Age group</b>			
60–69	1769	822	947
70–79	1164	487	677
80 and above	317	144	173
<b>Marital status</b>			
With spouse	2482	1157	1325
Without spouse	768	296	472
<b>Socioeconomic status</b>			
Low	562	158	404
Middle low	1063	214	849
Middle high	752	409	343
High	873	672	201
<b>Health conditions</b>			
<b>Number of NCDs</b>			
No NCDs	1349	651	698
Single NCDs	916	414	502
Two and more NCDs	985	388	597
<b>Obesity</b>			
Obesity	100	35	65
Non-obesity	3150	1418	1732
<b>Health behaviors</b>			
<b>Smoking status</b>			
Never	2264	1036	1228
Smoking	986	417	569
<b>Alcohol intake status</b>			
Never	2389	1053	1336
Drinking	861	400	461
<b>Tea drinking</b>			
Never	2524	1136	1388
Drinking	726	317	409
<b>Sleep quality (PSQI)</b>			
PSQI>5	676	284	392
PSQI≤5	2574	1169	1405
<b>Excessive daytime sleepiness (ESS)</b>			
ESS>10	1275	545	730
ESSI≤10	1975	908	1067
<b>Nutrition awareness</b>			
Never	121	40	81
Sometimes	785	230	555
Often	749	297	452
Usually	1359	742	617
Always	236	144	92

**Abbreviations:** NCDs, chronic non-communicable diseases; PSQI, Pittsburgh Sleep Quality Index; ESS, Epworth Sleepiness Scale.



**Figure I** Participants' distribution of EQ-5D health problem dimensions by residential area.

## Discussion

In this study of Chinese urban and rural older populations, we evaluated their HRQoL using the latest EQ-5D-5L and Chinese general population-based value set. Obesity and nutrition awareness were revealed as unique contributing factors for rural older persons' HRQoL. Age, SES, number of NCDs, sleep quality and daytime sleepiness were associated with older people's HRQoL, regardless of residential area.

The overall sample of our study had an average EQ-5D utility score of  $0.87 \pm 0.22$ , which was lower than older adults Singapore.<sup>11</sup> In our study, EQ-5D utility score of urban samples was  $0.89 \pm 0.22$ , higher than urban older adults from the 4th National Household Health Survey.<sup>37</sup> Among rural older adults, the mean score was  $0.86 \pm 0.23$ , which was higher than rural older individuals from China Health and Retirement Longitudinal Study.<sup>36</sup> Our study showed that the HRQoL of older adults in rural areas was poorer than urbanities. This phenomenon was in parallel with earlier research, highlighted the importance of residential area in terms of health outcomes. For instance, Burnette et al used the WHOQoL scale and founded that HRQoL of older adults in cities was significantly higher than those in rural areas.<sup>38</sup> Hou et al used the SF-36 scale to explore HRQoL of urban and rural older hypertensive patients in Suzhou and obtained similar conclusions.<sup>16</sup> These findings were in accordance with the materialism and structuralism theory, economic and associated socio-structural factors may alter the distribution of health outcomes.<sup>39</sup> The urban-rural HRQoL disparity may also be attributed to the implementation of a dual system of social welfare in urban and rural areas.<sup>3</sup> Our findings in EQ-5D health problem dimensions were consistent with the above study that rural older adults tend to have more health problems, which further highlighted the vulnerability of this population.

Univariate analysis and Tobit regression models further demonstrated that residential area exerted a significant effect on the HRQoL and identified the associated factors in urban and rural area. Regardless of urban or rural areas, HRQoL was correlated with older age, lower SES, more NCDs, poor sleep quality and excessive daytime sleepiness. Older age was significantly associated with HRQoL, which showed consistency with an earlier study.<sup>40</sup> The function of an older adult's organism would decline with age, resulting in weakened immune function and poor health. SES can have an impact on HRQoL, according to the social causation theory. Recent research has also observed the positive effects of SES on HRQoL among Chinese and Korean people.<sup>41,42</sup> In terms of the number of NCDs, our finding echoes with Pan et al's, who suggested chronic conditions would contribute to HRQoL declining among older Chinese populations.<sup>43</sup> Discomforts are more common in older adults with more chronic diseases, which can lead to decreased self-care abilities, limited mobility, and a slew of psychological distress issues. For sleep quality, its impact on HRQoL probably can be explained by its association with EQ-5D health problems. Former studies have shown that poor sleep quality was associated with mobility,<sup>44</sup> mental health<sup>45</sup> and pain<sup>46</sup> among older adults. Another common sleep complaint is daytime sleepiness, which was linked to a variety of negative health outcomes.<sup>47</sup> In our study, daytime



**Table 2** Univariate Analysis of EQ-5D Utility Scores by Residential Area (n = 3250)

Participants' Characteristics	Urban				Rural			
	Mean	SD	Z/H	p-value	Mean	SD	Z/H	p-value
Total	0.89	0.22			0.86	0.23		
<b>Socio-demographic characteristics</b>								
<b>Gender</b>								
Male	0.89	0.24	−1.85	0.065	0.86	0.24	−3.35	<b>0.001</b>
Female	0.89	0.20			0.85	0.21		
<b>Age group</b>			76.93	<b>&lt;0.001</b>			97.4	<b>&lt;0.001</b>
60–69	0.92	0.19			0.89	0.19		
70–79	0.86	0.23			0.85	0.23		
80 and above	0.79	0.28			0.71	0.30		
<b>Marital status</b>			−5.17	<b>&lt;0.001</b>			−6.25	<b>&lt;0.001</b>
With spouse	0.90	0.21			0.87	0.21		
Without spouse	0.84	0.26			0.81	0.25		
<b>Socioeconomic status</b>			54.50	<b>&lt;0.001</b>			64.86	<b>&lt;0.001</b>
Low	0.81	0.26			0.80	0.27		
Middle low	0.84	0.28			0.86	0.22		
Middle high	0.89	0.22			0.89	0.18		
High	0.92	0.17			0.91	0.19		
<b>Health conditions</b>								
<b>Number of NCDs</b>			123.34	<b>&lt;0.001</b>			147.53	<b>&lt;0.001</b>
No NCDs	0.93	0.20			0.90	0.19		
Single NCDs	0.90	0.18			0.86	0.23		
Two and more NCDs	0.82	0.27			0.80	0.25		
<b>Obesity</b>			−1.47	0.142			−4.17	<b>&lt;0.001</b>
Obesity	0.84	0.24			0.77	0.25		
Non-obesity	0.89	0.22			0.86	0.22		
<b>Health behaviors</b>								
<b>Smoking status</b>			−0.53	0.599			−1.51	0.132
Never	0.89	0.22			0.85	0.22		
Smoking	0.89	0.22			0.86	0.23		
<b>Alcohol intake status</b>			−0.65	0.515			−2.47	<b>0.013</b>
Never	0.89	0.22			0.85	0.23		
Drinking	0.89	0.22			0.87	0.22		
<b>Tea drinking</b>			−0.69	0.492			−0.73	0.463
Never	0.89	0.21			0.85	0.23		
Drinking	0.88	0.25			0.87	0.21		
<b>Sleep quality (PSQI)</b>			−12.53	<b>&lt;0.001</b>			−11.3	<b>&lt;0.001</b>
PSQI>5	0.92	0.17			0.23	0.20		
PSQI≤5	0.75	0.33			0.75	0.28		
<b>Excessive daytime sleepiness (ESS)</b>			−8.03	<b>&lt;0.001</b>			−11.33	<b>&lt;0.001</b>
ESS>10	0.84	0.27			0.80	0.26		
ESSI≤10	0.92	0.17			0.90	0.19		
<b>Nutrition awareness</b>			45.85	<b>&lt;0.001</b>			50.92	<b>&lt;0.001</b>
Never	0.86	0.27			0.80	0.23		
Sometimes	0.83	0.27			0.83	0.25		
Often	0.84	0.27			0.86	0.22		
Usually	0.92	0.17			0.88	0.21		
Always	0.94	0.13			0.92	0.17		

**Note:** Bold fonts indicated p-value <0.05.

**Abbreviations:** NCDs, chronic non-communicable diseases; PSQI, Pittsburgh Sleep Quality Index; ESS, Epworth Sleepiness Scale.

**Table 3** Influencing Factors of EQ-5D Utility Scores Using the Tobit Regression Model by Residential Area (N =3250)

Participants' Characteristics	Urban			Rural		
	Coe	SE	p-value	Coe	SE	p-value
<b>Socio-demographic background characteristics</b>						
<b>Gender [ref = (With male)]</b>						
Female	0.04	0.03	0.158	0.04	0.02	0.083
<b>Age group [ref = (60–69)]</b>						
70–79	–0.06	0.02	<b>0.009</b>	–0.05	0.02	<b>0.004</b>
80 and above	–0.12	0.04	<b>0.001</b>	–0.19	0.03	<b>&lt;0.001</b>
<b>Marital status [ref = (With spouse)]</b>						
Without spouse	–0.05	0.03	0.073	–0.02	0.02	0.359
<b>Socioeconomic status [ref = (Low)]</b>						
Middle low	0.02	0.04	0.573	0.03	0.02	0.131
Middle high	0.07	0.04	0.061	0.1	0.03	<b>&lt;0.001</b>
High	0.13	0.04	<b>&lt;0.001</b>	0.14	0.03	<b>&lt;0.001</b>
<b>Health conditions</b>						
<b>Number of NCDs [ref = (No NCDs)]</b>						
Single NCDs	–0.10	0.03	<b>&lt;0.001</b>	–0.08	0.02	<b>&lt;0.001</b>
Two and more NCDs	–0.20	0.03	<b>&lt;0.001</b>	–0.15	0.02	<b>&lt;0.001</b>
<b>Obesity [ref = (Non-obesity)]</b>						
Obesity	–0.03	0.07	0.618	–0.1	0.04	<b>0.021</b>
<b>Health behaviors</b>						
<b>Alcohol intake status [ref = (Never)]</b>						
Drinking	0.03	0.03	0.333	0.02	0.02	0.348
<b>Sleep quality (PSQI) [ref = (PSQI≤5)]</b>						
PSQI>5	–0.22	0.03	<b>&lt;0.001</b>	–0.15	0.02	<b>&lt;0.001</b>
<b>Excessive daytime sleepiness (ESS) [ref = (ESS≤10)]</b>						
ESS>10	–0.13	0.02	<b>&lt;0.001</b>	–0.13	0.02	<b>&lt;0.001</b>
<b>Nutrition awareness [ref = (Never)]</b>						
Sometimes	–0.04	0.07	0.581	0.01	0.04	0.865
Often	0.01	0.07	0.989	0.04	0.04	0.285
Usually	0.06	0.07	0.356	0.05	0.04	0.179
Always	0.11	0.07	0.143	0.14	0.05	<b>0.009</b>

**Note:** Bold fonts indicated  $p$ -value  $<0.05$ .

**Abbreviations:** NCDs, chronic non-communicable diseases; PSQI, Pittsburgh Sleep Quality Index; ESS, Epworth Sleepiness Scale.

sleepiness was associated with the impairment of HRQoL in both urban and rural settings. And our results were in line with a population-based study in China.<sup>48</sup>

On the other hand, HRQoL was associated with more factors in rural older adults. Obesity and nutrition awareness were two unique factors associated with HRQoL of older adults in rural areas. Obesity might hasten the deterioration of physical function that comes with age. Excessive body weight may bring increased mobility limitation, possibly due to obesity-related health conditions such as joint wear and tear.<sup>49</sup> Meanwhile, rural older adults are more likely to engage in back-breaking labor in fields either because of their past lifestyles or it is required by living, which may exacerbate the strain on the body and lead to HRQoL impairment.<sup>50</sup> Another possibility is that rural residents would confront greater barriers to adequate physical activity due to insufficient exercise facilities, which may aggravate obesity.<sup>51</sup> Furthermore, our findings contradicted the “jolly fat hypothesis”. Several studies supported the hypothesis, suggested that there is a positive relationship between body weight and health.<sup>52,53</sup> However, our finding that obese people are more likely to have poor HRQoL did not support this notion. So is another recent study revealed that obesity exhibited no positive correlation with HRQoL among Chinese older adults.<sup>54</sup> The results showed that the traditional Chinese proverb “laugh while get fat” does not appear to be applicable in the context of modern health concepts.

Our findings also underscored the beneficial role of nutrition awareness to HRQoL, particularly given the current disparity in nutrition intake between urban and rural areas. Chinese rural residents consume fewer dairy products, fish and shrimp, dark



vegetables than urbanities, resulting in a prominent deficiencies of vitamin A, calcium, n-3 fatty acids and other nutrients, according to the Report on Dietary Guidelines for Chinese Residents 2021.<sup>55</sup> High nutrition awareness allows people to make better dietary choices based on their health status and nutritional needs, further boosting nutrient sufficiency and HRQoL.<sup>56,57</sup> Nutritional awareness, as an indicator of willingness and intention to eat to stay healthy, can influence people's nutrition-related behaviors through intricate mechanisms and eventually resulted in a significant impact on HRQoL in older adults.<sup>33,58</sup> As a modifiable factor, understanding the role of nutrition awareness can help in the formulation of cost-effective dietary intervention approaches for healthy aging.<sup>59</sup> For example, interventions can be designed and implemented to prompted older adults' nutrition awareness, and thus amplifying its positive effect on HRQoL.

There were three limitations in our study. To begin with, it was a cross-sectional study, and we reported associations instead of causal links. Longitudinal studies will be required to clarify these findings. Second, the study participants were recruited locally from Shanxi province, which does not represent other areas in China. To address the problem, we are currently organizing a national-level investigations for the purpose of achieving more generalizable results in future studies. Finally, the information about the explanatory variables was mainly gathered by self-report rather than by medical testing (except for chronic diseases, which was collected through self-reporting, supported by diagnostic evidence from medical records or physicians' prescriptions), which may have influenced the accuracy of the results. However, several variables were accessed by questionnaires like PSQI and ESS, which have been identified to have good psychometric properties and be applicable in population-based studies.

Our findings have important implications for both public policy and planning. Firstly, rural older individuals are facing HRQoL disadvantages due to the imbalanced development and urban-rural dichotomy. In this way, both the government and the local rural community should pay more attention to rural populations, through appropriate resource allocation or more policy support. Secondly, because local health resources in rural areas are limited, targeted health promotion must maximize the potential of the current three-tiered rural healthcare network. For instance, health education can be conducted to increase personal understanding of the obesity problem and nutrition awareness among older adults, motivating them to take positive action. Meanwhile, in collaboration with the county level medical institutions, the township clinics and village doctors should shoulder the responsibility of recording and tracking older adults' body weight and nutrition status, as well as screening for related chronic diseases. Macro-control and surveillance at the government level should also be improved to ensure the quality, continuity, and accessibility of healthcare services.

## Conclusion

In summary, this study used the EQ-5D-5L to assess Chinese older adults' HRQoL and investigated differences in HRQoL associated factors among older individuals in urban and rural areas. The HRQoL disadvantages were observed in rural older adults when comparing with urbanities. Obesity and nutrition awareness are two unique factors associated with HRQoL in rural older adults. Regardless of residential area, HRQoL was found to be associated age, SES, number of NCDs, sleep quality, and daytime sleepiness. Our findings have implications for policymaking aimed at improving HRQoL and bridging the urban-rural HRQoL gap, emphasizing the importance of a better plan and resource allocation. This study would help to improve HRQoL and contribute to healthy aging among Chinese older adults.

## Sponsor's Role

The sponsor had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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## Disclosure

The authors declared no conflict of interests.

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