Health-related quality of life among rural residents aged 45–69 years in Hua County, Henan Province, China: Results of ESECC Trial for esophageal cancer screening with endoscopy

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Abstract

Objective: There have been few population-based studies evaluating health related quality of life (HRQOL) in rural populations in China, and this study aimed to assess the current status of and risk factors for HRQOL in a general rural population in high risk region of esophageal cancer in China.

Methods: From November 2015 to September 2016, 12,085 permanent residents aged 45–69 years from 257 villages in the Endoscopic Screening for Esophageal Cancer in China (ESECC) trial (ClinicalTrials.gov: NCT01688908) randomly selected from Hua County, Henan Province, China were interviewed. The EQ-5D-3L, a generic measure of HRQOL, and a questionnaire were used to assess their HRQOL and potential risk factors.

Results: Among all the participants, 30.62% of the participants reported problems in at least one EQ-5D dimension. Pain/discomfort (25.52%) was the most frequently reported problem followed by anxiety/depression (7.97%), mobility (5.82%), usual activities (2.61%) and self-care (1%). These rural residents had a mean EQ-5D index score of 0.948, and lower EQ-5D index scores were associated with older age, female gender, lower levels of household annual per capita income, living alone, using shallow wells as main source of drinking water, exposure to family members smoking, testiness, unhealthy dietary habits, overweight or obesity, upper gastrointestinal cancer related symptoms and chronic diseases.

Conclusions: Rural residents in China have a relatively low quality of life. Health promotion programs in this population should focus on the elderly, especially elderly women and the elderly living alone. Improving basic living circumstances and primary medical care services should be priorities. Results of this study will also serve as the basis for the cost-utility evaluation in our ESECC screening trial.

Keywords: HRQOL; EQ-5D; rural population; China

Introduction

With the socio-economic development, the biomedical model has undergone change to a biopsychosocial model (1). Traditional health indicators, such as morbidity, mortality and survival do not fully reflect overall health

status (2). Health related quality of life (HRQOL) refers to the overall impact of physical, mental, and social well-being on an individual, and reflects mainly on the individual's life itself rather than on the length of survival (3). This has been increasingly recognized to be an endpoint which can serve to measure health needs (4).

China is an agricultural country with 1.3 billion people and 70% of Chinese people live in rural areas (5). There is an obvious gap between the levels of urban and rural health, and the health level of rural residents is still relatively low (5). In 2016 the Chinese central government proposed the "The Thirteenth Five-Year Plan" and improving life quality and eliminating poverty in rural areas is one of the major goals of this plan (6). There has been a growing acceptance of the need for understanding the current status of the life quality and risk factors in rural populations, which can help to establish and regulate relevant health policy and effectively eliminate factors which adversely impact health equity between rural and urban populations, and thus improve the overall level of health for rural Chinese people.

Unfortunately, there have been few population-based studies evaluating HRQOL in rural populations in China, and defects in study design of most previous studies such as inadequate sample size, flawed sampling sources and statistical analysis (7,8) have limited the reliability of the conclusions and the comparability among studies. Moreover, these studies focused predominantly on exploring the association of socio-economic status and HRQOL, which is insufficient for fully understanding the risk factors which may impact HRQOL.

In this study, we investigated current HRQOL findings in over 12,000 rural adults aged 45–69 years, and explored risk factors for low HRQOL on the basis of a large randomized trial in rural Hua County, Henan Province, China (9). The goal of this study was to identify the vulnerabilities and principal risk factors which impact life quality in this population, and to provide intervention targets for health promotion programs in rural China.

Materials and methods

Study subjects

Hua County of Henan Province, with a rural population of 1.1 million, is an agricultural region in northern part of China, and the per capita GDP was $2,430 in 2013 (10). The mortality for esophageal squamous cell carcinoma

(ESCC) in this area is among the highest in the world (9).

In January 2012, we initiated the Endoscopic Screening for Esophageal Cancer in China (ESECC) randomized controlled trial (ClinicalTrials.gov identifier: NCT 01688908) in Hua County to evaluate the efficacy and cost-effectiveness of population level endoscopic screening for ESCC. The inclusion criteria in the ESECC trial were: 1) permanent residency in a target village; 2) age 45–69 years (with >5 years of life expectancy) and no history of endoscopic examination within 5 years prior to the initial interview; 3) no history of cancer or mental disorder; 4) negative for hepatitis B virus, hepatitis C virus and human immunodeficiency virus; and 5) agreement to complete all phases of the trial (9).

Based on the ESECC trial, from November 2015 to September 2016, we interviewed 12,085 residents from 257 target villages with total population sizes ranging from 500 to 3,000 which were randomly selected from 18 towns in Hua county.

EQ-5D instrument

The EQ-5D-3L was developed as a standardized non-disease-specific measure of HRQOL by the EuroQoL Group, a voluntary multinational collaboration of European investigators (11). This instrument consists of five dimensions, mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has three levels of severity ranked as no problem, some/moderate problems, and severe/extreme problems (coded 1, 2 and 3 respectively). For example, state 11111 represents full health (no problems on any dimension), whereas state 33333 represents an extreme problem on all five dimensions. The EQ-5D-3L has 245 kinds of health conditions, including "unconscious" and "death" which are considered as health states.

In practical terms, the EQ-5D-3L has the advantage of being a simple instrument, which is easy to use with good response rates, so it has been one of the most commonly applied generic HRQOL instruments, particularly in less-educated elderly population (12). The validity and reliability of the EQ-5D-3L scale have been tested in China (13).

HRQOL results measured by the EQ-5D-3L were converted to index scores (health utility scores) using the China time trade-off value sets (ranging from –0.149 for the worst health status to 1.00 representing the best health rating) which were developed by Liu et al. in 2014 (14).

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Questionnaire investigation

A computer aided one-on-one questionnaire was also completed by all participants in the interview to investigate potential risk factors associated with low HRQOL, which included demographic factors (age, gender), socio-economic status (educational level, job type, household annual per capita income), household factors (living arrangement, source of drinking water, family members smoking), behavioral and mental factors (cigarette smoking, alcohol drinking, testiness), dietary habits (regularity of eating, eating speed, dietary pattern) and health status [body mass index (BMI), upper gastrointestinal cancer related symptoms, chronic diseases] (*Supplementary File S1*).

Statistical analysis

We transformed the continuous EQ-5D-3L index scores into binary variable and respondents who were below the tenth percentile of index scores were defined as having a poor quality of life (coded 1), others were good (coded 0). In addition, due to the ceiling effects of EQ-5D-3L (15), we regrouped the three response levels (no problem, some/moderate problems and extreme problems) into two categories, namely no problem and any problem (coded 0 and 1, respectively).

All variables were first evaluated with unconditional univariate logistic regression analysis. Age, gender and variables with P<0.05 were subjected to multivariate logistic regression model analysis and backward selection with P<0.05 was used to explore potential risk factors for low quality of life. Odds ratio (OR) and 95% confidence interval (95% CI) were estimated taking village cluster into account (16), and pairwise interactions were exhaustively tested in multivariate models. Due to rigorous logic checking of our computer-based investigation system, there were few missing data in this study. The living arrangement information and body mass index (BMI) were not available in 3 (0.02%) and 41 (0.34%) subjects respectively, and they were excluded from the regression analysis. There were 1,002 (8.29%) respondents who refused to declare their income, so we conducted sensitive analysis by including and not including the household annual per capita income variable in the multivariate logistic regression analysis. As the results were similar, only results from the analysis based on the models not including the household annual per capita income variable were presented.

All statistical analysis was performed using STATA (Version 13.1; StataCorp LLC, TX, USA). All tests were two-sided and had a significance level of 0.05.

Ethics statement

Research protocols were approved by the Institutional Review Board of Peking University Cancer Hospital, Beijing, China. All participants provided written informed consent before the survey.

Results

Proportion of full health by selected sociodemographic and health characteristics

From 2015 to 2016, a total of 12,085 permanent residents (median age 56 years; male-female ratio 0.96) from rural Hua County were interviewed. Selected demographic and behavioral characteristics of the participants are shown in *Table 1*. All respondents were of Han ethnicity and 91.28% of the respondents were farmers. The respondents had an average EQ-5D-3L index score of 0.948 (standard deviation=0.089), and 69.38% of the respondents reported full health status. The proportion of full health varied with the demographic and behavioral characteristics of the participants. Older age, female gender, lower educational level, farming as occupation, lower levels of household annual per capita income, living alone, using shallow wells as main source of drinking water, exposure to family members smoking, testiness, irregular eating, eating slowly, unhealthy dietary pattern, overweight or obesity, upper gastrointestinal cancer related symptoms and chronic diseases were associated with a lower proportion of full health (P<0.001). In addition, smokers and drinkers had a higher proportion of full health than who did not smoke or drink (P<0.001).

Health status distribution in five dimensions of EQ-5D

Among the five dimensions under evaluation, pain/discomfort was the most frequently reported problem (25.52%, 95% CI: 24.75%–26.30%), followed by anxiety/depression (7.98%, 95% CI: 7.51%–8.47%), mobility (5.82%, 95% CI: 5.41%–6.25%), usual activities (2.61%, 95% CI: 2.34%–2.91%) and self-care (1.00%, 95% CI: 0.84%–1.20%). The prevalence of severe problems in all dimensions was less than 0.50% (*Supplementary Table S1*).

HRQOL by age and gender

As shown in *Figure 1*, the total EQ-5D index score decreased with age in both males and females, and men had

Table 1 Selected demographic and behavioral characteristics and EQ-5D index scores among 12,085 residents from rural Hua County, China, ESECC trial, 2015–2016

Variables	n (%)	Mean (SD)	Full health (%)[a]	P[b]
Age (year)				
45–50	3,098 (25.64)	0.957 (0.079)	73.21	<0.001
51–55	2,793 (23.11)	0.951 (0.082)	69.53	
56–60	2,070 (17.13)	0.947 (0.089)	68.74	
61–65	2,730 (22.59)	0.943 (0.096)	68.17	
66–69	1,394 (11.53)	0.933 (0.105)	63.85	
Median (IQR)	56 (50–62)			
Gender				
Male	5,913 (48.93)	0.956 (0.082)	73.33	<0.001
Female	6,172 (51.07)	0.941 (0.094)	65.59	
Educational level				
High school or above (>10 year)	1,271 (10.52)	0.954 (0.082)	71.83	<0.001
Middle school (7–9 year)	4,339 (35.90)	0.954 (0.081)	71.74	
Primary school (1–6 year)	2,950 (24.41)	0.949 (0.088)	69.49	
Illiterate (<1 year)	3,525 (29.17)	0.938 (0.099)	65.48	
Job type				
Worker or other	1,054 (8.72)	0.965 (0.075)	79.13	<0.001
Farmer	11,031 (91.28)	0.946 (0.090)	68.44	
Household annual per capita income (RMB)				
>3,500	3,381 (27.98)	0.954 (0.079)	70.96	<0.001
1,500–3,500	4,385 (36.28)	0.949 (0.088)	70.06	
<1,500	3,317 (27.45)	0.939 (0.097)	65.51	
Unknown	1,002 (8.29)	0.953 (0.091)	73.85	
Living arrangement				
Living with offspring	8,276 (68.48)	0.951 (0.085)	70.54	<0.001
Living only with spouse	3,503 (28.99)	0.944 (0.095)	67.83	
Living alone	303 (2.51)	0.914 (0.116)	55.45	
Unknown	3 (0.02)	1[c]	100	
Source of drinking water				
Deep well (>100 meters)	11,141 (92.19)	0.950 (0.087)	70.26	<0.001
Shallow well (≤100 meters)	944 (7.81)	0.926 (0.106)	58.90	
Family members smoking				
No	7,777 (64.35)	0.954 (0.086)	72.62	<0.001
Yes	4,308 (35.65)	0.938 (0.093)	63.51	
Cigarette smoking				
Non-smoker	7,899 (65.36)	0.945 (0.092)	67.98	<0.001
Ex-smoker	1,265 (10.47)	0.947 (0.092)	68.54	
Smoker	2,921 (24.17)	0.957 (0.079)	73.74	
Alcohol drinking				
Non-drinker	9,495 (78.57)	0.945 (0.091)	68.11	<0.001
Ex-drinker	281 (2.33)	0.932 (0.105)	60.50	

Table 1 (*continued*)

Table 1 (*continued*)

Variables	n (%)	Mean (SD)	Full health (%)[a]	P[b]
Drinker	2,309 (19.11)	0.962 (0.073)	75.66	
Testiness				
No	9,680 (80.10)	0.955 (0.083)	73.18	<0.001
Yes	2,405 (19.90)	0.920 (0.104)	54.05	
Regularity of eating				
Yes	11,413 (94.44)	0.949 (0.089)	70.30	<0.001
No	672 (5.56)	0.916 (0.091)	53.72	
Eating speed				
Fast	10,023 (82.94)	0.950 (0.086)	70.30	<0.001
Slow	2,062 (17.06)	0.937 (0.100)	64.89	
Dietary pattern[d]				
Nothing unhealthy	2,755 (22.80)	0.963 (0.072)	75.50	<0.001
Mildly unhealthy	4,310 (35.66)	0.952 (0.080)	69.86	
Moderately unhealthy	4,173 (34.53)	0.939 (0.101)	66.98	
Severely unhealthy	847 (7.01)	0.923 (0.108)	58.80	
BMI (kg/m^2)				
<25	5,046 (41.75)	0.953 (0.083)	71.17	<0.001
≥25	6,998 (57.91)	0.945 (0.092)	68.07	
Unknown	41 (0.34)	0.946 (0.088)	68.29	
Upper gastrointestinal cancer related symptoms[e]				
0	6,665 (55.15)	0.966 (0.072)	78.48	<0.001
1	2,844 (23.53)	0.941 (0.089)	64.45	
≥2	2,576 (21.32)	0.910 (0.112)	51.24	
Chronic diseases[f]				
0	10,181 (84.24)	0.954 (0.083)	71.81	<0.001
1	1,734 (14.35)	0.922 (0.108)	57.96	
≥2	170 (1.41)	0.880 (0.141)	40.00	
Total	12,085 (100)	0.948 (0.089)	69.38	

ESECC, Endoscopic Screening for Esophageal Cancer in China; IQR, inter-quartile range; BMI, body mass index; SD, standard deviation; [a], proportion of respondents with no problem in any EQ-5D dimension; [b], P values were derived from the chi-square test; [c], the standard deviation could not be estimated; [d], unhealthy dietary pattern refers to low intake of vegetables, fruit and meat/egg/milk (*Supplementary File S1*); [e], the number of upper gastrointestinal cancer-related symptoms including dysphagia, chest pain, heartburn reflux, indigestion, black stool, upper abdominal pain and weight loss; [f], one "chronic disease" represents a system disease that may contain more than one kind of specific disease (*Supplementary File S1*).

a higher mean score than women in all age groups (0.956 *vs.* 0.941, P<0.001). The proportion of participants with EQ-5D identified problems increased with age in all dimensions except for the anxiety/depression dimension. Women tended to have more problems than men with mobility (P=0.01), pain/discomfort (P<0.001) and anxiety/depression (P<0.001). Although men and women had no differences in usual activities on the whole (P=0.185), we found that women had a significantly higher proportion of reported activity related problems than men

after 55 years old (P<0.001).

Risk factors for HRQOL

As shown in *Table 2* and *Supplementary Table S2*, lower EQ-5D-3L index scores were associated with older age (P$_{trend}$<0.001), female gender (OR=1.29, 95% CI: 1.11–1.50), lower levels of household annual per capita income (P$_{trend}$<0.001), living alone (P$_{trend}$<0.001), using shallow wells as main source of drinking water (OR=1.53,
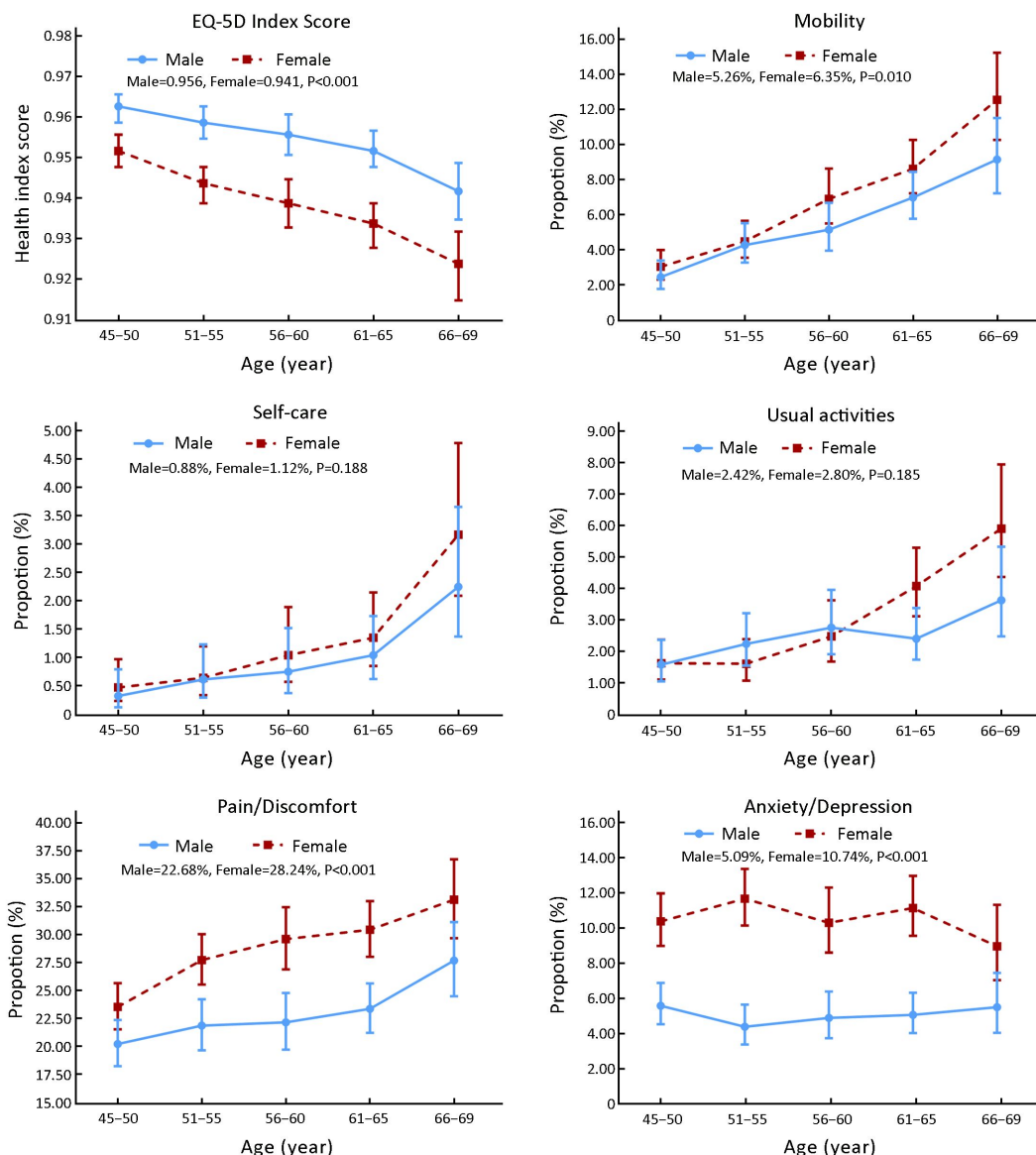
Figure 1 Mean EQ-5D index score and problem proportion in each EQ-5D dimension by age group and gender among 12,085 residents from rural Hua County, China, Endoscopic Screening for Esophageal Cancer in China (ESECC) trial, 2015–2016.

95% CI: 1.23–1.89), exposure to family members smoking (OR=1.28, 95% CI: 1.10–1.49), testiness (OR=1.56, 95% CI: 1.31–1.85), irregular eating (OR=1.48, 95% CI: 1.01–2.17), eating slowly (OR=1.28, 95% CI: 1.07–1.53), unhealthy dietary pattern ($P_{trend}<0.001$), overweight or obesity (OR=1.57, 95% CI: 1.38–1.80), upper gastro-intestinal cancer related symptoms ($P_{trend}<0.001$) and chronic diseases ($P_{trend}<0.001$). Among these factors, living alone, unhealthy dietary pattern, upper gastrointestinal cancer related symptoms and chronic diseases had a significantly negative impact on all of the five dimensions

which were evaluated. Although job type and alcohol drinking did not impact the overall HRQOL, respondents who engaged in farming reported more problems with pain/discomfort, and alcohol drinking had slight protective effects in mobility and self-care dimensions.

Interaction evaluation

As is shown in *Table 3*, we found the modification effect of age on the relationship between BMI and quality of life. Overweight or obese subjects had a significantly higher risk

Table 2 Multivariate logistic analysis of risk factors for low HRQOL among 12,085 residents from rural Hua County, China, ESECC trial, 2015–2016

Variables[a]	EQ-5D-3L Index[b]		Mobility		Self-care		Usual activities		Pain/discomfort		Anxiety/depression	
	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)
Age (year)												
45–50	2,878/220	Ref	3,011/87	Ref	3,085/13	Ref	3,047/51	Ref	2,414/684	Ref	2,846/252	Ref
51–55	2,553/240	1.10 (0.89–1.37)	2,669/124	1.42 (1.06–1.91)	2,775/18	1.31 (0.61–2.83)	2,739/54	1.02 (0.68–1.53)	2,090/703	1.13 (0.99–1.29)	2,559/234	0.97 (0.79–1.19)
56–60	1,867/203	1.28 (1.03–1.58)	1,944/126	1.87 (1.39–2.52)	2,051/19	1.52 (0.72–3.23)	2,015/55	1.34 (0.90–1.99)	1,532/538	1.20 (1.04–1.38)	1,912/158	0.93 (0.75–1.16)
61–65	2,413/317	1.48 (1.19–1.83)	2,516/214	2.22 (1.67–2.94)	2,697/33	1.74 (0.92–3.27)	2,641/89	1.53 (1.04–2.26)	1,996/734	1.23 (1.08–1.41)	2,511/219	1.01 (0.82–1.24)
65–69	1,189/205	1.73 (1.37–2.18)	1,242/152	2.84 (2.08–3.87)	1,356/38	3.28 (1.58–6.82)	1,327/67	2.02 (1.34–3.05)	969/425	1.39 (1.18–1.63)	1,293/101	0.81 (0.60–1.09)
P		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P=0.275
Gender												
Male	5,433/480	Ref	5,602/311	Ref	5,861/52	Ref	5,770/143	Ref	4,572/1,341	Ref	5,612/301	Ref
Female	5,467/705	1.29 (1.11–1.50)	5,780/392	1.08 (0.88–1.33)	6,103/69	1.02 (0.66–1.58)	5,999/173	1.12 (0.87–1.44)	4,429/1,743	1.18 (1.07–1.30)	5,509/663	1.88 (1.58–2.23)
Job type												
Worker or other	993/61	Ref	1,017/37	Ref	1,053/1	Ref	1,026/28	Ref	864/190	Ref	1,008/46	Ref
Farmer	9,907/1,124	–[c]	10,365/666	–	10,911/120	–	10,743/288	–	8,137/2,894	1.31 (1.10–1.56)	10,113/918	–
Household annual per capita income (RMB, yuan)												
>3,500	3,140/241	Ref	3,270/111	Ref	3,366/15	Ref	3,333/48	Ref	2,544/837	Ref	3,127/254	Ref
1,500–3,500	3,973/412	1.19 (0.97–1.45)	4,145/240	1.43 (1.13–1.81)	4,343/42	1.76 (0.93–3.34)	4,281/104	1.46 (1.04–2.05)	3,294/1,091	–	4,031/354	–
<1,500	2,892/425	1.53 (1.25–1.87)	3,041/276	1.96 (1.51–2.54)	3,267/50	2.12 (1.09–4.13)	3,180/137	2.28 (1.60–3.25)	2,363/954	–	3,023/294	–
P_trend		P<0.001		P<0.001		P<0.001		P<0.001				
Living arrangement[d]												
Living with offspring	7,544/732	Ref	7,883/393	Ref	8,214/62	Ref	8,088/188	Ref	6,262/2,014	Ref	7,600/676	Ref
Living only with spouse	3,111/392	1.15 (0.99–1.32)	3,232/271	1.24 (1.02–1.51)	3,458/45	1.18 (0.85–1.62)	3,394/109	1.07 (0.84–1.37)	2,548/955	1.14 (1.02–1.27)	3,253/250	0.95 (0.80–1.13)
Living alone	242/61	2.13 (1.55–2.91)	264/39	1.71 (1.18–2.48)	289/14	2.87 (1.46–5.62)	284/19	1.75 (1.03–2.99)	188/115	1.86 (1.44–2.40)	265/38	1.84 (1.23–2.76)

Table 2 (continued)

Table 2 (*continued*)

Variables[a]	EQ-5D-3L Index[b]		Mobility		Self-care		Usual activities		Pain/discomfort		Anxiety/depression	
	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)	No/Yes	Adjusted OR (95% CI)
P_trend		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		p<0.001
Source of drinking water												
Deep well (>100 meters)	10,099/1,042	Ref	10,536/605	Ref	11,045/96	Ref	10,879/262	Ref	8,369/2,772	Ref	10,271/870	Ref
Shallow well (≤100 meters)	801/143	1.53 (1.23–1.89)	846/98	1.96 (1.56–2.47)	919/25	2.90 (1.85–4.54)	890/54	2.27 (1.62–3.18)	632/312	1.32 (1.08–1.61)	850/94	–
Family members smoking												
No	7,103/674	Ref	7,347/430	Ref	7,700/77	Ref	7,585/192	Ref	5,997/1,780	Ref	7,285/492	Ref
Yes	3,797/511	1.28 (1.10–1.49)	4,035/273	–	4,264/44	–	4,184/124	–	3,004/1,304	1.34 (1.20–1.49)	3,836/472	1.23 (1.05–1.44)
Alcohol drinking												
Non-drinker	8,499/996	Ref	8,899/596	Ref	9,389/106	Ref	9,236/259	Ref	6,974/2,521	Ref	8,667/828	Ref
Ex-drinker	247/34	–	260/21	0.99 (0.60–1.64)	276/5	1.42 (0.54–3.75)	266/15	–	192/89	–	256/25	–
Drinker	2,154/155	–	2,223/86	0.69 (0.52–0.91)	2,299/10	0.50 (0.28–0.91)	2,267/42	–	1,835/474	–	2,198/111	–
Testiness												
No	8,879/801	Ref	9,148/532	Ref	9,598/82	Ref	9,447/233	Ref	7,457/2,223	Ref	9,172/508	Ref
Yes	2,021/384	1.56 (1.31–1.85)	2,234/171	–	2,366/39	–	2,322/83	–	1,544/861	1.43 (1.27–1.61)	1,949/456	2.92 (2.50–3.42)
Regularity of eating												
Yes	10,717/1,152	Ref	11,175/694	Ref	11,748/121	Ref	11,556/313	Ref	8,882/2,987	Ref	10,947/922	Ref
No	183/33	1.48 (1.01–2.17)	207/9	–	216/0	–	213/3	–	119/97	2.22 (1.67–2.95)	174/42	2.35 (1.62–3.42)
Eating speed												
Fast	9,102/921	Ref	9,486/537	Ref	9,941/82	Ref	9,785/238	Ref	7,537/2,486	Ref	9,256/767	Ref
Slow	1,798/264	1.28 (1.07–1.53)	1,896/166	1.37 (1.11–1.69)	2,023/39	1.70 (1.10–2.61)	1,984/78	1.37 (1.03–1.82)	1,464/598	1.13 (1.01–1.26)	1,865/197	–

Table 2 (*continued*)

Table 2 (*continued*)

Variables[a]	EQ-5D-3L Index[b] No/Yes	EQ-5D-3L Index[b] Adjusted OR (95% CI)	Mobility No/Yes	Mobility Adjusted OR (95% CI)	Self-care No/Yes	Self-care Adjusted OR (95% CI)	Usual activities No/Yes	Usual activities Adjusted OR (95% CI)	Pain/discomfort No/Yes	Pain/discomfort Adjusted OR (95% CI)	Anxiety/depression No/Yes	Anxiety/depression Adjusted OR (95% CI)
Dietary pattern												
Nothing unhealthy	2,620/135	Ref	2,689/66	Ref	2,750/5	Ref	2,727/28	Ref	2,157/598	Ref	2,629/126	Ref
Mildly unhealthy	3,973/337	1.41 (1.16–1.70)	4,151/159	1.37 (1.00–1.89)	4,293/17	1.80 (0.72–4.47)	4,244/66	1.30 (0.82–2.08)	3,237/1,073	1.06 (0.91–1.23)	3,954/356	1.63 (1.32–2.00)
Moderately unhealthy	3,610/563	2.49 (2.01–3.07)	3,794/379	3.38 (2.55–4.48)	4,099/74	7.12 (2.83–17.89)	3,991/182	3.55 (2.35–5.39)	3,038/1,135	1.12 (0.97–1.29)	3,806/367	1.66 (1.30–2.13)
Severely unhealthy	697/150	2.92 (2.21–3.87)	748/99	4.05 (2.84–5.78)	822/25	9.28 (3.46–24.86)	807/40	3.38 (2.04–5.60)	569/278	1.27 (1.03–1.57)	732/115	2.23 (1.65–3.01)
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
BMI (kg/m²)[e]												
<25	4,641/405	Ref	4,848/198	Ref	5,001/45	Ref	4,945/101	Ref	3,833/1,213	Ref	4,654/392	Ref
≥25	6,222/776	1.57 (1.38–1.80)	6,495/503	2.14 (1.81–2.53)	6,922/76	–	6,785/213	1.64 (1.27–2.14)	5,139/1,859	1.20 (1.10–1.32)	6,429/569	–
Upper gastrointestinal cancer related symptoms												
0	6,277/388	Ref	6,392/273	Ref	6,632/33	Ref	6,564/101	Ref	5,492/1,173	Ref	6,380/285	Ref
1	2,540/304	1.74 (1.49–2.04)	2,665/179	1.48 (1.21–1.81)	2,815/29	1.84 (1.11–3.06)	2,762/82	1.82 (1.31–2.52)	1,992/852	1.86 (1.68–2.05)	2,608/236	1.73 (1.45–2.06)
≥2	2,083/493	2.88 (2.43–3.41)	2,325/251	2.02 (1.66–2.45)	2,517/59	3.09 (1.94–4.91)	2,443/133	2.74 (2.00–3.74)	1,517/1,059	2.72 (2.42–3.05)	2,133/443	3.19 (2.60–3.91)
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
Chronic diseases												
0	9,352/829	Ref	9,709/472	Ref	10,112/69	Ref	9,978/203	Ref	7,772/2,409	Ref	9,452/729	Ref
1	1,419/315	1.99 (1.69–2.35)	1,528/206	2.08 (1.71–2.53)	1,692/42	2.45 (1.71–3.52)	1,633/101	2.33 (1.82–2.99)	1,149/585	1.40 (1.23–1.59)	1,528/206	1.50 (1.24–1.80)
≥2	129/41	2.34 (1.61–3.40)	145/25	2.08 (1.26–3.45)	160/10	4.90 (2.12–11.32)	158/12	2.17 (1.08–4.35)	80/90	2.80 (1.97–3.98)	141/29	2.01 (1.30–3.13)
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001

OR and 95% CI were derived after accounting for village cluster; HRQOL, health related quality of life; ESECC, Endoscopic Screening for Esophageal Cancer in China; BMI, body mass index; OR, odds ratio; 95% CI, 95% confidence interval; [a], educational level and cigarette smoking were not in this table, as a two-step variable selection method was used in this study. Age and gender were forced to all models, other variables in *Table 1* were firstly evaluated in univariate logistic regression models and variables with P<0.05 were retained and subjected to multivariate logistic regressions; [b], EQ-5D index scores were divided into binary variable, and respondents who were below the tenth percentile of index scores were defined as having a poor quality of life; [c], variables which were not significant in the multivariate logistic models were excluded from the models and showed using "–"; [d], living arrangement was not available in 3 (0.02%) subjects who were excluded from the models containing the living arrangement variable; [e], BMI was not available in 41 (0.34%) subjects who were excluded from the models containing the BMI variable.

Table 3 Interaction analysis between age and BMI for HRQOL among 12,085 residents from rural Hua County, China, ESECC trial, 2015–2016

Dimension*	45–55 years		56–69 years		P for interaction
	BMI<25/BMI≥25 (kg/m^2)	Adjusted OR (95% CI)**	BMI<25/BMI≥25 (kg/m^2)	Adjusted OR (95% CI)**	
Mobility					
No problem	2,188/3,471	Ref	2,660/3,024	Ref	0.170
Some problems	60/150	1.73 (1.27–2.35)	138/353	2.23 (1.80–2.77)	
Self-care					
No problem	2,235/3,603	Ref	2,766/3,319	Ref	0.243
Some problems	13/18	1.03 (0.51–2.09)	32/58	1.49 (0.93–2.39)	
Usual activities					
No problem	2,211/3,554	Ref	2,734/3,231	Ref	0.028
Some problems	37/67	1.18 (0.78–1.79)	64/146	2.20 (1.59–3.06)	
Pain/Discomfort					
No problem	1,749/2,741	Ref	2,084/2,398	Ref	0.862
Some problems	499/880	1.17 (1.03–1.33)	714/979	1.22 (1.08–1.38)	
Anxiety/Depression					
No problem	2,058/3,326	Ref	2,596/3,103	Ref	0.541
Some problems	190/295	1.08 (0.87–1.34)	202/274	1.18 (0.95–1.47)	
EQ-5D index scores***					
Good	2,087/3,324	Ref	2,554/2,898	Ref	0.006
Poor	161/297	1.27 (1.03–1.56)	244/479	1.80 (1.52–2.13)	

BMI, body mass index; HRQOL, health related quality of life; ESECC, Endoscopic Screening for Esophageal Cancer in China; OR, odds ratio; 95% CI, 95% confidence interval; *, each dimension adopts the same multivariate models as EQ-5D index scores, including variable age, gender, household annual per capita income, living arrangement, source of drinking water, family members smoking, testiness, regularity of eating, eating speed, dietary pattern, BMI, upper gastrointestinal cancer related symptoms, and chronic diseases; **, OR and 95% CI were derived after accounting for village cluster; ***, EQ-5D index scores were divided into binary variable, and respondents who were below the tenth percentile of index scores were defined as having a poor quality of life.

of low quality of life in the 56–69 year group than in the 45–55 year group (OR$_{56-69y}$=1.80, OR$_{45-55y}$=1.27, P$_{interaction}$=0.006), which was mainly resulted from the usual activities dimension (OR$_{56-69y}$=2.20, OR$_{45-55y}$=1.18, P$_{interaction}$=0.028).

Discussion

In this cross-sectional study, we investigated 12,085 rural residents aged 45–69 years from Hua County and found that up to 30.62% reported problems in at least one EQ-5D dimension. A series of risk factors for low quality of life in this rural population were also evaluated. This is the first population-based study using random sampling to evaluate the HRQOL status and risk factors which impact HRQOL in a rural population in China.

Pain/discomfort and anxiety/depression were the most commonly reported dimensions with moderate or severe health problems, which is consistent with previous studies from other regions of China (5,7,17). International studies among general populations aged 60 years and older from Asia (18) and Europe (19,20) also identified pain/discomfort as the most common problem with a prevalence ranging of 29.4%–61.3%. Thus, relieving of physical discomfort should be a global priority in prevention of HRQOL deterioration in community level health care programs.

The mean EQ-5D index score in this population was 0.948, which is lower than the scores reported in two previous studies of urban populations in China using the same health utility weights for calculating health index scores. A community based study in Suzhou, which is an urban metropolis in East China, investigated 5,557 inhabitants aged 60 years and older and reported a mean

EQ-5D index score of 0.959 (17). For purposes of comparison, we also calculated the health index score in our rural population of individuals aged 60–69 years, and the mean score was 0.941. Another cross-sectional survey in 13 provinces across China from 2013 to 2014 which was a part of the Cancer Screening Program in Urban China (CanSPUC) reported that the mean EQ-5D index score was 0.96 for 11,699 participants with an age range similar to participants in our study (21). The urban-rural health inequality in China has been reported to be associated not only with natural conditions and socio-economic development, but also with allocation of health care resources and health services (5). The quality and accessibility of primary health care services play an important role in the health of the population in rural Chinese areas, and these factors should be targets of the health promotion programs to eliminate the urban-rural disparities in the overall quality of life.

We found that the EQ-5D index scores decreased with age, and women reported lower quality of life than men. This was also consistent with previous studies both from China (7,17) and other countries (18-20). Older people were more likely to experience problems in the physical domains of EQ-5D than their younger counterparts in this study. This finding may further serve to explain that more severe disabilities in activity, cognitive impairment and poor physical functioning may be the main causes of poor quality of life among the elderly (17,22). Lower quality of life among women was mainly due to problems with pain/discomfort and anxiety/depression in this study. Possible explanations for this gender difference are as follows. First, women may be more sensitive to pain and other physical discomfort than men (23). Second, women in Asia-pacific countries are more vulnerable to the conditions of lower socio-economic status including fewer job opportunities, lower wages and discriminatory attitudes and so on (24), which may lead to negative psychologic pressure.

People living alone had the poorest quality of life than those living with their offspring or spouse in this rural population. Studies from Japan (25), the UK (26) and the US (27) also reported that living alone was significantly and negatively correlated with mental health, life satisfaction and self-rated health among the elderly. Similarly, China's 4th National Household Health Survey in 2008 reported that Chinese urban elders who lived with their offspring or spouse had better HRQOL than those living alone (28). Lack of financial and social support, companionship and

daily care from family members may be principal reasons. In addition, we found that the elderly living only with spouse reported more physical problems than those living with their offspring. The explanation for this finding may be economic independence. The majority of rural residents in China do not have unemployment insurance or retirement pension, and their social and health security is dependent largely on their family, particularly their offspring. There has been an increasing trend of migration among the young labor force from rural to urban areas because of urbanization in China (29), which may leave more and more elderly people living on their own with less physical and emotional support. Strengthening the social support system and basic medical services among the rural elderly is likely to be measures for improving their quality of life.

Water source has not been a commonly reported factor which impacts HRQOL, especially in developed countries. Since the 1980's, the Chinese government has committed significant resources to an extensive water improvement project, and deep groundwater (>100 meters) has become the main water source for most of the inhabitants of rural Hua county (30). We found that 7.81% of the residents who still used shallow wells as main water source had a lower quality of life and more problems in physical health than those who did not. A previous cross-sectional survey in mid-east rural China also reported that the quality of a water source (deep groundwater or public water system *vs.* surface or shallow well water) was positively associated with the HRQOL score (31). The shallow ground water source was more likely to result in exposure to chemical and biological pollution (32), which may be potential risk factors to physical health, and thus lead to a decline in quality of life. From a more macroscopic perspective, the quality of a water source may reflect the individual's level of socio-economic status, which is also a crucial determinant of life quality (33).

Obesity, which is a clear risk factor for physical health, also leads to a decrease in the physical domain of HRQOL in our study, especially in individuals of 55 years or older. The obesity epidemic in low-income and middle-income countries is mainly a result of unhealthy dietary habits and physical inactivity (34). This low-income, less-educated population tended to use low-protein high-energy pasta as main dietary staple, and at the same time poor social resources limited their chances of physical activity. Comprehensive life style intervention for weight control and improvement

of physical fitness such as dietary education and establishment of physical exercise facilities would likely play an important role for improvement of quality of life in this rural population, especially for older people.

Cancer has become a major public health problem in China since 2010 (35). The ESCC incidence and mortality vary by economic level and geographic location, which have brought about extremely heavy burden to the "high-risk" regions (36,37). We found that esophageal cancer related symptoms had a stable negative impact on life quality in this high prevalence population for ESCC, which suggested that physical symptoms due to the high-prevalence disease might lead to the decline of general quality of life. We found that chronic diseases, which are worldwide risk factors for quality of life in the elderly (38), were also strongly associated with low HRQOL in this population, and this further demonstrated that primary health care services and chronic disease management are crucial for improving the overall health status in this rural population.

This study has two limitations that should be acknowledged. First, we could not conclude a causal relationship between these factors and HRQOL due to the nature of cross-sectional investigation. Second, although high-grade sampling method was adopted, respondents of this study were restricted to those from Hua County, Henan Province, which might limit the generalizability of our findings to other rural population in China.

Conclusions

This large population-based survey reports the current HRQOL status and describes a series of risk factors which impact HRQOL in this rural population in China using random sampling methodology. The overall quality of life among Chinese rural residents was relatively low by objective measurement. Health intervention and promotion programs in rural China are needed, and more attention should be given to the elderly, especially to elderly women and the elderly living alone. Alleviation of poverty, improvement of basic living conditions and primary medical care should be priorities for improvement of the overall HRQOL in rural China. Results of this study are crucial for generating health promotion strategy in rural population in China, and will also serve as the fundamental basis for the cost-utility evaluation in our ESECC screening trial in the future.

Acknowledgements

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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Information regarding definitions and coding forms of potential risk factors investigated in this study

Age

Age at enrollment was calculated as $Round\left(\dfrac{Date\,(interview) - Date\,(birthday)}{365.25}\right)$. The age of each individual was treated as a continuous variable and directly applied to the variable selection procedure.

Cigarette smoking and alcohol drinking

Participants were asked about their life-time smoking and alcohol drinking history. Cigarette smoking was defined as a smoking history of at least 18 packs over 1 year, and alcohol drinking was defined as drinking Chinese liquor (containing >40% alcohol) at least twice a week for ≥12 months (consumption of other kinds of alcoholic beverages such as beer and wine is very rare in the study area). In this study, the smoking and drinking status (coded as 0 or 1) of each participant was used in the analysis.

Testiness

Participants were asked about whether they are prone to be testy? This question had two options: 1) no; and 2) yes. Subjects selecting 1) were coded as 0 and those selecting 2) were coded as 1.

Family members smoking

Participants were asked about whether they live with any family members who smoke. This question had two options: 1) no; and 2) yes. Subjects selecting 1) were coded as 0 and those selecting 2) were coded as 1.

Source of drinking water

This question had two options: 1) deep well; and 2) shallow well. Subjects selecting 1) were coded as 0 and those selecting 2) were coded as 1. Deep well water was defined as motor-pumped groundwater from a depth of ≥100 meters.

Dietary habits

Five questions about dietary habits were asked as follows:
1. Regularity of eating
This question had three options: 1) habitually eating regularly; 2) sometimes eating regularly; and 3) eating irregularly. Subjects selecting 1) and 2) were coded as 0 and those selecting 3) were coded as 1.
2. Eating speed
This question had three options: 1) slow; 2) sometimes fast; and 3) always fast. Subjects selecting 2) and 3) were coded as 0 and those selecting 1) were coded as 1.
3. Unhealthy dietary pattern
Participants were asked with three questions about their intake of vegetable, fruit and meat/egg/milk. Each question had three options: 1) no (<1 times per week); 2) sometimes (1–3 times per week); and 3) frequently (≥4 times per week). Subjects selecting 3) in three, two, one and none of all the questions were defined as nothing, mildly, moderately, and severely unhealthy dietary pattern, which were coded as 0, 1, 2 and 3 respectively in this study.

Body mass index (BMI)

BMI was calculated as body weight in kilograms divided by the square of body height in meters (kg/m^2). Subjects were

categorized into two groups as BMI <25 (coded as 0) and BMI ≥25 (coded as 1) according to the overweight standard of World Health Organization (WHO).

Upper gastrointestinal cancer related symptoms

Seven questions regarding upper gastrointestinal cancer related symptoms were asked as follows: unexplained dyspepsia, chest pain, heartburn reflux, indigestion, black stool, upper abdominal pain and weight loss. Each question had three options: 1) no (<1 times per week); 2) sometimes (1–3 times per week); and 3) frequently (≥4 times per week). Subjects selecting 1) were coded as 0 and those selecting 2) and 3) were coded as 1. The number of these symptoms was counted for each participant and was evaluated in the logistic regression models.

Chronic diseases

All reported chronic diseases were classified as digestive, respiratory, cardiocerebral, vascular, endocrine, motor and urinary system diseases according to the international Classification of diseases (ICD-10). One "chronic disease" in the statistical analysis represents a system disease that may contain more than one kind of specific disease. The number of system diseases was counted for each participant and was evaluated in the logistic regression models.

Table S1 Distribution of health status findings for 12,085 residents from rural Hua County, China, ESECC trial, 2015–2016

Health dimension	n (%)				
	Mobility	Self-care	Usual activities	Pain/discomfort	Anxiety/depression
No problem	11,382 (94.18)	11,964 (99.00)	11,769 (97.39)	9,001 (74.48)	11,121 (92.02)
Moderate problems	703 (5.82)	114 (0.94)	305 (2.52)	3,045 (25.20)	948 (7.84)
Severe problems	0 (0)	7 (0.06)	11 (0.09)	39 (0.32)	16 (0.13)
Total (with problem)	703 (5.82)	121 (1.00)	316 (2.61)	3,084 (25.52)	964 (7.98)

ESECC, Endoscopic Screening for Esophageal Cancer in China.

Table S2 Univariate logistic analysis of risk factors for low HRQOL among 12,085 residents from rural Hua County, China, ESECC trial, 2015–2016

Variables[a]	EQ-5D-3L index[b]		Mobility		Self-care		Usual activities		Pain/discomfort		Anxiety/depression	
	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)
Age (year)												
45–50	2,878/220	Ref	3,011/87	Ref	3,085/13	Ref	3,047/51	Ref	2,414/684	Ref	2,846/252	Ref
51–55	2,553/240	1.23§ (1.00–1.51)	2,669/124	1.61 (1.21–2.14)	2,775/18	1.54 (0.71–3.32)	2,739/54	1.18 (0.80–1.74)	2,090/703	1.19 (1.04–1.35)	2,559/234	1.03 (0.86–1.24)
56–60	1,867/203	1.42 (1.16–1.74)	1,944/126	2.24 (1.70–2.96)	2,051/19	2.20 (1.05–4.60)	2,015/55	1.63 (1.11–2.39)	1,532/538	1.24 (1.09–1.41)	1,912/158	0.93 (0.76–1.15)
61–65	2,413/317	1.72 (1.41–2.10)	2,516/214	2.94 (2.26–3.83)	2,697/33	2.90 (1.57–5.37)	2,641/89	2.01 (1.41–2.87)	1,996/734	1.30 (1.14–1.48)	2,511/219	0.98 (0.81–1.19)
65–69	1,189/205	2.26 (1.82–2.79)	1,242/152	4.24 (3.20–5.61)	1,356/38	6.65 (3.32–13.31)	1,327/67	3.02 (2.09–4.34)	969/425	1.55 (1.33–1.80)	1,293/101	0.88 (0.67–1.17)
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P=0.275
Gender												
Male	5,433/480	Ref	5,602/311	Ref	5,861/52	Ref	5,770/143	Ref	4,572/1,341	Ref	5,612/301	Ref
Female	5,467/705	1.46 (1.28–1.67)	5,780/392	1.22 (1.03–1.44)	6,103/69	1.27 (0.89–1.82)	5,999/173	1.16 (0.92–1.47)	4,429/1,743	1.34 (1.23–1.46)	5,509/663	2.24 (1.93–2.61)
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
Educational level												
High School or Above (>10 year)	1,170/101	Ref	1,216/55	Ref	1,262/9	Ref	1,243/28	Ref	971/300	Ref	1,190/81	Ref
Middle School (7–9 year)	3,996/343	0.99 (0.81–1.23)	4,153/186	0.99 (0.74–1.32)	4,307/32	1.04 (0.49–2.23)	4,241/98	1.03 (0.69–1.53)	3,320/1,019	0.99 (0.85–1.16)	4,035/304	1.11 (0.88–1.39)
Primary School (1–6 year)	2,672/278	1.21 (0.93–1.56)	2,788/162	1.28 (0.92–1.79)	2,926/24	1.15 (0.51–2.59)	2,886/64	0.98 (0.63–1.54)	2,213/737	1.08 (0.89–1.30)	2,693/257	1.40 (1.12–1.76)
Illiterate (<1 year)	3,062/463	1.75 (1.40–2.19)	3,225/300	2.06 (1.53–2.76)	3,469/56	2.26 (1.05–4.88)	3,399/126	1.65 (1.08–2.51)	2,497/1,028	1.33 (1.14–1.56)	3,203/322	1.48 (1.16–1.87)
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
Job type												
Worker or other	993/61	Ref	1,017/37	Ref	1,053/1	Ref	1,026/28	Ref	864/190	Ref	1,008/46	Ref
Farmer	9,907/1,124	1.85 (1.38–2.47)	10,365/666	1.77 (1.22–2.55)	10,911/120	11.58 (1.56–85.76)	10,743/288	–c	8,137/2,894	1.62 (1.36–1.92)	10,113/918	1.99 (1.38–2.87)
Household annual per capita income (RMB, yuan)[d]												
>3,500	3,140/241	Ref	3,270/111	Ref	3,366/15	Ref	3,333/48	Ref	2,544/837	Ref	3,127/254	Ref
1,500–3,500	3,973/412	1.35 (1.11–1.64)	4,145/240	1.71 (1.35–2.16)	4,343/42	2.17 (1.20–3.93)	4,281/104	1.69 (1.21–2.35)	3,294/1,091	1.01 (0.90–1.13)	4,031/354	–
<1,500	2,892/425	1.91 (1.59–2.31)	3,041/276	2.67 (2.08–3.44)	3,267/50	3.43 (1.95–6.06)	3,180/137	2.99 (2.12–4.22)	2,363/954	1.23 (1.09–1.38)	3,023/294	–
P_{trend}		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		–

Table S2 (*continued*)

Table S2 (*continued*)

Variables[a]	EQ-5D-3L index[b] No/Yes	Crude OR (95% CI)	Mobility No/Yes	Crude OR (95% CI)	Self-care No/Yes	Crude OR (95% CI)	Usual activities No/Yes	Crude OR (95% CI)	Pain/discomfort No/Yes	Crude OR (95% CI)	Anxiety/depression No/Yes	Crude OR (95% CI)
Living arrangement[e]												
Living with offspring	7,544/732	Ref	7,883/393	Ref	8,214/62	Ref	8,088/188	Ref	6,262/2,014	Ref	7,600/676	Ref
Living only with spouse	3,111/392	1.30 (1.13–1.49)	3,232/271	1.68 (1.41–2.01)	3,458/45	1.72 (1.24–2.41)	3,394/109	1.38 (1.09–1.74)	2,548/955	1.17 (1.06–1.28)	3,253/250	0.86 (0.74–1.02)
Living alone	242/61	2.60 (1.97–3.42)	264/39	2.96 (2.15–4.09)	289/14	6.42 (3.43–12.01)	284/19	2.88 (1.78–4.66)	188/115	1.90 (1.51–2.40)	265/38	1.61 (1.12–2.31)
P$_{trend}$		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
Source of drinking water												
Deep well (>100 meters)	10,099/1,042	Ref	10,536/605	Ref	11,045/96	Ref	10,879/262	Ref	8,369/2,772	Ref	10,271/870	Ref
Shallow well (≤100 meters)	801/143	1.73 (1.38–2.17)	846/98	2.02 (1.57–2.59)	919/25	3.13 (1.93–5.09)	890/54	2.52 (1.83–3.46)	632/312	1.49 (1.22–1.83)	850/94	–
Family members smoking												
No	7,103/674	Ref	7,347/430	Ref	7,700/77	Ref	7,585/192	Ref	5,997/1,780	Ref	7,285/492	Ref
Yes	3,797/511	1.42 (1.24–1.63)	4,035/273	–	4,264/44	–	4,184/124	–	3,004/1,304	1.46 (1.33–1.61)	3,836/472	1.82 (1.57–2.11)
Cigarette smoking												
Non-smoker	7,055/844	Ref	7,416/483	Ref	7,818/81	Ref	7,688/211	Ref	5,803/2,096	Ref	7,151/748	Ref
Ex-smoker	1,150/115	0.84 (0.68–1.02)	1,181/84	1.09 (0.87–1.37)	1,247/18	–	1,227/38	–	937/328	0.97 (0.85–1.11)	1,184/81	0.65 (0.52–0.82)
Smoker	2,695/226	0.70 (0.59–0.83)	2,785/136	0.75 (0.62–0.91)	2,899/22	–	2,854/67	–	2,261/660	0.81 (0.73–0.89)	2,786/135	0.46 (0.38–0.57)
Alcohol drinking												
Non-drinker	8,499/996	Ref	8,899/596	Ref	9,389/106	Ref	9,236/259	Ref	6,974/2,521	Ref	8,667/828	Ref
Ex-drinker	247/34	1.17 (0.79–1.74)	260/21	1.21 (0.76–1.91)	276/5	1.60 (0.65–3.97)	266/15	2.01 (1.14–3.54)	192/89	1.28 (0.98–1.68)	256/25	1.02 (0.65–1.61)
Drinker	2,154/155	0.61 (0.51–0.73)	2,223/86	0.58 (0.46–0.73)	2,299/10	0.39 (0.22–0.68)	2,267/42	0.66 (0.48–0.91)	1,835/474	0.71 (0.64–0.80)	2,198/111	0.53 (0.43–0.65)
Testiness												
No	8,879/801	Ref	9,148/532	Ref	9,598/82	Ref	9,447/233	Ref	7,457/2,223	Ref	9,172/508	Ref
Yes	2,021/384	2.11 (1.80–2.46)	2,234/171	1.32 (1.09–1.59)	2,366/39	1.93 (1.23–3.03)	2,322/83	1.45 (1.11–1.89)	1,544/861	1.87 (1.69–2.07)	1,949/456	4.22 (3.62–4.93)
Regularity of eating												
Yes	10,717/1,152	Ref	11,175/694	Ref	11,748/121	Ref	11,556/313	Ref	8,882/2,987	Ref	10,947/922	Ref
No	183/33	1.68 (1.16–2.42)	207/9	–	216/0	–	213/3	–	119/97	2.42 (1.87–3.14)	174/42	2.87 (2.05–4.01)

Table S2 (*continued*)

Table S2 (*continued*)

Variables[a]	EQ-5D-3L index[b]		Mobility		Self-care		Usual activities		Pain/discomfort		Anxiety/depression	
	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)	No/Yes	Crude OR (95% CI)
Eating speed												
Fast	9,102/921	Ref	9,486/537	Ref	9,941/82	Ref	9,785/238	Ref	7,537/2,486	Ref	9,256/767	Ref
Slow	1,798/264	1.45 (1.23–1.71)	1,896/166	1.55 (1.27–1.89)	2,023/39	2.34 (1.56–3.51)	1,984/78	1.62 (1.22–2.13)	1,464/598	1.24 (1.12–1.37)	1,865/197	1.27 (1.08–1.50)
Dietary pattern												
Nothing unhealthy	2,620/135	Ref	2,689/66	Ref	2,750/5	Ref	2,727/28	Ref	2,157/598	Ref	2,629/126	Ref
Mildly unhealthy	3,973/337	1.65 (1.35–2.00)	4,151/159	1.56 (1.14–2.15)	4,293/17	2.18 (0.88–5.39)	4,244/66	1.51 (0.95–2.43)	3,237/1,073	1.20 (1.04–1.38)	3,954/356	1.88 (1.52–2.32)
Moderately unhealthy	3,610/563	3.03 (2.42–3.78)	3,794/379	4.07 (3.06–5.42)	4,099/74	9.93 (4.02–24.55)	3,991/182	4.44 (2.92–6.76)	3,038/1,135	1.35 (1.16–1.57)	3,806/367	2.01 (1.56–2.59)
Severely unhealthy	697/150	4.18 (3.21–5.43)	748/99	5.39 (3.79–7.68)	822/25	16.73 (6.39–43.78)	807/40	4.83 (2.89–8.05)	569/278	1.76 (1.44–2.15)	732/115	3.28 (2.46–4.38)
P$_{trend}$		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
BMI (kg/m2)[f]												
<25	4,641/405	Ref	4,848/198	Ref	5,001/45	Ref	4,945/101	Ref	3,833/1,213	Ref	4,654/392	Ref
≥25	6,222/776	1.43 (1.26–1.63)	6,495/503	1.90 (1.60–2.25)	6,922/76	–	6,785/213	1.54 (1.18–2.00)	5,139/1,859	1.14 (1.05–1.25)	6,429/569	–
Upper gastrointestinal cancer related symptoms												
0	6,277/388	Ref	6,392/273	Ref	6,632/33	Ref	6,564/101	Ref	5,492/1,173	Ref	6,380/285	Ref
1	2,540/304	1.94 (1.67–2.24)	2,665/179	1.57 (1.30–1.91)	2,815/29	2.07 (1.26–3.40)	2,762/82	1.93 (1.40–2.66)	1,992/852	2.00 (1.82–2.20)	2,608/236	2.03 (1.70–2.41)
≥2	2,083/493	3.83 (3.30–4.44)	2,325/251	2.53 (2.11–3.02)	2,517/59	4.71 (3.06–7.25)	2,443/133	3.54 (2.64–4.74)	1,517/1,059	3.27 (2.94–3.64)	2,133/443	4.65 (3.84–5.63)
P$_{trend}$		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001
Chronic diseases												
0	9,352/829	Ref	9,709/472	Ref	10,112/69	Ref	9,978/203	Ref	7,772/2,409	Ref	9,452/729	Ref
1	1,419/315	2.50 (2.16–2.90)	1,528/206	2.77 (2.32–3.32)	1,692/42	3.64 (2.54–5.22)	1,633/101	3.04 (2.41–3.84)	1,149/585	1.64 (1.46–1.85)	1,528/206	1.75 (1.46–2.09)
≥2	129/41	3.59 (2.54–5.05)	145/25	3.55 (2.25–5.60)	160/10	9.16 (4.52–18.57)	158/12	3.73 (1.98–7.03)	80/90	3.63 (2.59–5.08)	141/29	2.67 (1.77–4.02)
P$_{trend}$		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001		P<0.001

OR and 95% CI were derived after accounting for village cluster; HRQOL, health related quality of life; ESECC, Endoscopic Screening for Esophageal Cancer in China; BMI, body mass index; OR, odds ratio; 95% CI, 95% confidence interval; [a], all variables were evaluated in univariate logistic regression analysis with P<0.05; [b], EQ-5D index scores were divided into binary variable, and respondents who were below the tenth percentile of index scores were defined as having a poor quality of life; [c], these variables were not significant in univariate analysis; [d], household annual per capita income was not available in 1,002 (8.29%) subjects who were excluded from all univariate logistic regression analysis; [e], living arrangement was not available in 3 (0.02%) subjects who were excluded from all univariate logistic regression analysis; [f], BMI was not available in 41 (0.34%) subjects who were excluded from all univariate logistic regression analysis.