Quality of Life Research (2019) 28:695–702
https://doi.org/10.1007/s11136-018-2038-6

Health-related quality of life among cancer survivors in rural China

Mingzhu Su[1,2] · Xingxing Hua[1,2] · Jialin Wang[3] · Nengliang Yao[1,2] · Deli Zhao[4] · Weidong Liu[5] · Yuewei Zou[6] · Roger Anderson[7] · Xiaojie Sun[1,2]

Accepted: 25 October 2018 / Published online: 29 October 2018

Abstract

Purpose The purpose of the study was to examine health-related quality of life (HRQoL) about the most common cancers survivors (lung, stomach, colorectal, breast, and esophageal cancer) in rural China.

Methods We administrated a cross-sectional study in three counties in Shandong province from August to September 2017. The five-level EuroQol-5-dimension (EQ-5D-5L) questionnaire was used to measure the HRQoL among cancer patients at least 8 months post-diagnosis. The Chinese population-based preference trade-off time (TTO) model and discrete choice experiment (DCE) were used to convert the EQ-5D-5L utility score. Tobit regression model was used to identify independent associations between socio-demographic, clinical variables with the HRQoL.

Results In total, 452 cancer survivors were included. The mean EQ-5D-5L utility scores and Visual Analog Scale (EQ-VAS) scores were 0.841 ($SD = 0.233$) and 70.35 ($SD = 18.80$) for cancer survivors, respectively. Among the five dimensions, 58.6% of survivors had at least slight levels of pain/discomfort, and 39.2% showed at least slight levels of anxiety/depression. The influencing factors of HRQoL included cancer stage at diagnosis, tumor site, comorbidities, annual household income, and migrant worker status (rural-to-urban migration). Compared to other cancer patients, lung cancer patients had the lowest HRQoL. Higher household income and being a migrant worker were associated with a higher HRQoL for cancer survivors.

Conclusions Cancer survivors in rural China have deteriorated HRQoL, and a substantial number of survivors have pain/discomfort problems. Our study provides detailed data on HRQoL of rural cancer survivors for future supportive and survivorship care in China.

Keywords Cancer survivors · Health-related quality of life · Rural · China

Background

Cancer is one of the leading causes of death worldwide [1]. It is the principal cause of death in China (126.9 per 100,000 persons), causing about one-fourth of all deaths and the burden of cancer in the population is increasing [2–4]. Five highly prevalent cancers (lung, stomach, colorectal, female breast, and esophageal cancers) account for 56% of the cancer burden in China, and the National Cancer Center of China reports that the estimated number of cancer survivors that lived for at least 5 years in China is 7.5 million, with roughly 39% of these cancer patients residing in rural areas [5]. In 2016, the Chinese government proposed "Healthy China 2030" as a national strategy, and one of the goals of "Healthy China 2030" is to increase the overall 5-year survival rate of cancer patients by 15% by 2030 [6]. Cancer survivorship has become one of the significant public health

✉ Xiaojie Sun
xiaojiesun@sdu.edu.cn

1 School of Health Care Management, Shandong University, Jinan, China

2 NHC Key Laboratory of Health Economics and Policy Research, Shandong University, Jinan, China

3 Shandong Provincial Cancer Hospital Affiliated to Shandong University, Shandong Academy of Medical Sciences, Jinan, China

4 Feicheng People's Hospital, Feicheng, Shandong, China

5 Health and Family Planning Commission of Linqu County, Linqu, Shandong, China

6 Rushan Center for Disease Control and Prevention, Rushan, Shandong, China

7 Department of Public Health Sciences, University of Virginia, Charlottesville, VA, USA

problems in China and requires new research to assist policy makers and health care reform.

Even after initial treatment has generally been completed, cancer survivors may experience a spectrum of late and long-term life changes due to the illness and its treatment, of which both impair quality of life [7, 8]. Notably, patients living in rural areas are more vulnerable to difficulties due to the poorer quality of care and limited medical treatment services [9]. A particular focus on health-related quality of life (HRQoL) among rural cancer survivors is warranted because of the large rural population in China, and because there are only limited data on cancer outcomes in this population. Understanding the quality of life among rural cancer survivors is essential in assessing their risk of post-treatment outcomes, in helping improve the well-being of potentially vulnerable people of survivors, in facilitating the better-targeted use of health resources, and in promoting the development of policies for post-cancer care. Therefore, the quality of life of cancer survivors in rural areas is of great concern.

At present, the majority of research focusing on rural cancer survivors has been conducted in the USA, Australia [10–15]. These studies have found that rural survivors were likely to report poorer health conditions and unemployment compared to urban survivors. In China, previous studies on quality of life among cancer survivors have focused almost exclusively on the acute treatment period in hospital rather than examining health status during post-treatment [16, 17]. Most studies have focused on a single cancer type (e.g., breast cancer) [18, 19] and few studies have focused on the post-treatment period among rural survivors [20]. Thus, little is known about the population characteristics and quality of life of cancer survivors in rural China.

In light of this lack of data, this study aimed to describe the HRQoL in cancer survivors who reside in the rural areas of China. The secondary objective was to examine the link between population-based characteristics and quality of life outcomes among cancer survivors in rural China.

Methods

Study design and data collection

Shandong, located on the eastern coast of China, is the third most economically developed province in China, and it has a population of more than 99 million people, of which 50.8% reside in rural areas [21]. Shandong is mostly a typical province in population structure, cultural features and social pattern in China. Multistage sampling framework was used for this study design involving three provincial counties, namely, Rushan, Linqu, and Feicheng to obtain a representative sample of cancer survivors in rural areas. These counties differ by geographical location and socioeconomic development status. In each county, about 150 cancer survivors were randomly selected, and all cancer cases were identified from the local cancer registry system. Three to four townships were randomly selected within each county, and then villages were randomly selected within each sampled township using the probability proportional to size.

Inclusion criteria of participants were as follows: (a) 18 years or older at the time of diagnosis; (b) at least 8 months post-diagnosis; (c) previously diagnosed with the most common cancers (lung, stomach, colorectal, female breast, and esophageal cancers). These criteria were selected mainly to ensure that the study sample reflected individuals diagnosed in adulthood and to locate individuals' representative of the most common cancers in China.

This study was conducted from August to September in 2017 by the local public health staff in the household survey. All investigators received questionnaire survey training a few days before the formal survey. The survey was conducted at the homes of cancer survivors. Public health staff from local township health centers interviewed all potential participants and then decided their eligibility for inclusion. About 800 cancer cases were randomly selected from the local cancer registry system. About 57% of cancer cases participated in the survey. Among non-participants, death was the main reason, and other reasons included refusal to participate and relocated or unreachable. Among 456 participants, 4 respondents (1%) did not complete the questionnaire; 452 respondents (99%) who completed the questionnaire were included in the final analysis. The questionnaire consisted of two sections. The first section included questions on demographics, socioeconomic status (age, sex, marital status, level of educational, household income and employment status), and clinical characteristics. Clinical information included the date of diagnosis, tumor site, cancer stage at diagnosis and type of primary treatment, and the existence of chronic diseases before diagnosis. The second section was the EuroQol-5 dimensions instrument (Chinese version EQ-5D-5L).

The Ethics Review Board of the School of Public Health, Shandong University approved this study (No. 20140201), and it adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants prior to entry into this study.

EQ-5D-5L

In China, studies of the health state utility of cancer survivors are still scarce; previous studies have shown the feasibility of cancer-related quality of life assessment and health utility evaluation could give priority to the scale of the Chinese-specific scoring algorithms (e.g., EQ-5D) [17, 18, 22]. EQ-5D-5L is a newer version of the EQ-5D, a brief, generic preference-based instrument developed by the EuroQol Group in

2011 [17, 23]. It was developed to reduce the ceiling effects and improve the sensitivity of the original version, i.e., the 3-level EQ-5D (EQ-5D-3L) [24]. And the first part comprises five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression), each with five levels corresponding to "no(t)/ slight/ moderate/ severe/ unable or extreme," resulting a total of 3125 (5^5) unique composite health states. A single EQ-5D-5L utility score was calculated using a specific Chinese value set developed by the time trade-off (TTO) and discrete choice experiment (DCE) by Luo et al. [25]. The Chinese utility value set (Table 1) was used to obtain utility scores for EQ-5D-5L health states. For example, the utility score for states "12345" was Utility = 1 − (0.000 + 0.048 + 0.107 + 0.252 + 0.258) = 0.335. The values for 11,111 (the best state) and 55,555 (the worst state) are 1 and − 0.391, respectively. The next part is the EQ-visual analog scale (EQ-VAS), in which the respondents describe their health status using a VAS scale from 0 (worst imaginable health status) to 100 (best imaginable health status). The respondents indicated the point on the scale that represents their current health state.

Statistical analyses

Descriptive summary statistics were estimated for socio-demographic and clinical characteristics, the EQ-5D-5L dimensions, health utility score. Mean and standard deviations were calculated for continuous variables; and frequencies and percentages for categorical variables. Due to a skewed distribution, the non-parametric Kruskal–Wallis test was conducted to test the difference in EQ-5D-5L utility scores among the various subgroups. A number of the utility values clustered at the limiting value (e.g., 1 indicates full health). Therefore, Tobit regression model was employed to examine the influence of socio-demographic variables (age, sex, marital status, level of education, annual household income, and employment status) and clinical variables (tumor site, cancer stage at diagnosed, previous treatments, pre-existing chronic conditions, and duration of disease since diagnosis) on the utility scores of cancer survivors [26, 27]. All analyses were performed using R statistical package version 3.4.4 (R Development Core Team, Vienna, Austria). In this study, a *P* value of below 0.05 (two-sided test) was considered to be statistically significant.

Table 1 Chinese-specific scoring algorithm of EQ-5D-5L

Dimension	Level[a]				
	1	2	3	4	5
Mobility	0.000	0.066	0.158	0.287	0.345
Self-care	0.000	0.048	0.116	0.210	0.253
Usual activities	0.000	0.045	0.107	0.194	0.233
Pain/discomfort	0.000	0.058	0.138	0.252	0.302
Anxiety/depression	0.000	0.049	0.118	0.215	0.258

[a]1 = no problems, 2 = slight problems, 3 = moderate problems, 4 = severe problems, 5 = unable to do/extreme problems

Results

Characteristics of the participants

Table 2 below summarizes the characteristics of the cancer survivors. The average age of the participants was 63.67 (*SD* = 10.97) years old, and 56% of them were male. The annual household income of 10.2% (*n* = 46) of them was more than 50,000 Chinese Yuan (US$7495), while 58.4% reported an income of less than 20,000 Chinese Yuan (US$2998). Of the sample, 25.7% (*n* = 116) with stomach cancer, 23% (*n* = 104) with lung cancer, 19.7% (*n* = 89) with female breast cancer, 17.5% (*n* = 79) with colorectal cancer, 14.2% (*n* = 63) had been diagnosed with esophageal cancer. The time interval between cancer diagnosis and study participation was 2.0 years on average (*SD* = 0.66).

EQ-5D-5L dimensions

The frequency of item response for each EQ-5D-5L dimension is shown in Table 3, and the distribution of the five levels is shown in Fig. 1. 129 participants (28.5%) reported no problems on any of the five dimensions. The proportion of participants reporting pain/discomfort problems was highest (58.6%), followed by anxiety/depression (39.2%). In contrast, only 19% of respondents, the lowest proportion, reported problems with self-care.

EQ-5D-5L utility scores and EQ-VAS scores

The mean EQ-5D-5L utility score for rural survivors was 0.841 (*SD* = 0.233), and the mean EQ-VAS score was 70.35 (*SD* = 18.80). The mean EQ-5D-5L utility scores for localized, regional and distant were 0.893 (*SD* = 0.184), 0.828 (*SD* = 0.214), and 0.739 (*SD* = 0.324), respectively. Table 4 shows the EQ-5D-5L utility scores of each categorical variable.

The EQ-5D utility scores of females were significantly lower than those of males (*P* = 0.039). With respect to age, younger populations had significantly higher utility scores than older populations (*P* = 0.002). Patients with an education level lower than middle school (*P* = 0.001) and non-migrant workers (*P* < 0.001) had the lowest utility scores under their respective categories. Patients with a lower household income reported lower utility scores than those patients with a household income of more than 50,000 Chinese Yuan (US$7495) per year (*P* = 0.002). The difference

Table 2 Characteristics of the participants ($N=452$)

Characteristics	*N* (%)
Sex	
Male	253 (56.0)
Female	199 (44.0)
Age (years)	
< 45	27 (6.0)
45–59	153 (33.8)
60–74	222 (49.1)
≥ 75	50 (11.1)
Marital status	
Married	403 (89.2)
Unmarried	49 (10.8)
Education level	
Primary school or lower	254 (56.2)
Middle school	159 (35.2)
High school and above	39 (8.6)
County of residence	
Rushan	156 (34.5)
Linqu	146 (32.3)
Feicheng	150 (33.2)
Household income in 2017, Chinese Yuan[a]	
< 5000	76 (16.8)
5000–20,000	188 (41.6)
20,000–50,000	142 (31.4)
≥ 50,000	46 (10.2)
Migrant workers	
Yes	92 (20.4)
No	360 (79.6)
Cancer site	
Esophagus	64 (14.1)
Stomach	116 (25.7)
Colorectal	79 (17.5)
Lung	104 (23.0)
Breast	89 (19.7)
Cancer stage	
Localized	190 (42.0)
Regional	192 (42.5)
Distant	70 (15.5)
Previous treatment[b]	
Surgery	355 (78.5)
Chemotherapy	279 (61.7)
Radiotherapy	63 (13.9)
Pre-existing chronic conditions	
None	291 (64.4)
One	105 (23.2)
Two	37 (8.2)
Three or more	19 (4.2)
Duration of disease since diagnosis	
8 months to 1 year	100 (22.1)
1 to less than 2 years	253 (56.0)
2 years or more	99 (21.9)

[a]10,000 Chinese Yuan ≈ 1499 US dollar in 2017; and per capita disposable income of Chinese rural residents in 2017 was 12,363 Chinese Yuan

Table 2 (continued)

[b]Categories are not mutually exclusive because most patients received a combination of treatments

in utility scores was statistically significant among different cancer site groups ($P=0.002$). Patients with an advanced cancer stage at diagnosis ($P<0.001$) and pre-existing chronic diseases ($P=0.004$) had lower utility scores than those without them.

Factors influencing health utility

Table 5 shows the independent effect of variables on the utility scores by Tobit regression model. Lower utility scores were associated with a more advanced cancer stage at diagnosis ($P=0.004$), lung cancer ($P=0.030$), and three or more pre-existing chronic conditions ($P=0.041$); household incomes of 50,000 Chinese Yuan (US$7495) and above ($P=0.005$) and migrant worker status ($P=0.017$) were independent, statistically significant factors of higher utility scores.

Discussion

As far as we know, this is the first study to use the EQ-5D-5L to evaluate HRQoL among cancer survivors in rural China. These results provide significant insight into the quality of life of rural Chinese cancer survivors. Prior studies indicated that EQ-5D-5L is an acceptable instrument of the health status of cancer survivors [28–31]. As we all know, use of non-Chinese preference weights could lead to biased estimates when conducting Chinese cost-utility analysis, possibly due to cultural differences [32]. And the availability of Chinese preferences makes the EQ-5D-5L especially suited to this study. In previous Chinese studies, the values were generated using a Japan-, or a UK-, rather than a Chinese-based algorithm, and it may underestimate the HRQoL of Chinese [27, 33], or the values were estimated using the EQ-5D-3L which may be more the ceiling effects and less sensitive than the EQ-5D-5L version [34]. The valid health utility value of cancer survivors can provide essential baseline data for the cost-utility analysis of post-treatment care of cancer in rural China.

The mean utility scores for cancer survivors in our study was estimated at 0.841 ($SD=0.233$), which was nearly the same as the utility score of cancer survivors from Canadian study [35]. Before our study, a multicenter study in 13 provinces across China evaluated the health utility scores for common cancer patients in hospitals was 0.77, which had 0.07 lower than the utility score of our cancer survivors [36]. The study by Guan et al. showed that EQ-5D utility

Table 3 Frequency of item response in each EQ-5D-5L dimension

Level	Mobility *N* (%)	Self-care *N* (%)	Usual activities *N* (%)	Pain/discomfort *N* (%)	Anxiety/depression *N* (%)
1	337 (74.6)	366 (81.0)	299 (66.2)	187 (41.4)	275 (60.8)
2	74 (16.4)	51 (11.3)	88 (19.5)	193 (42.7)	141 (31.2)
3	25 (5.5)	19 (4.2)	42 (9.3)	51 (11.3)	27 (6.0)
4	10 (2.2)	6 (1.3)	13 (2.9)	12 (2.7)	5 (1.1)
5	6 (1.3)	10 (2.2)	10 (2.2)	9 (2.0)	4 (0.9)

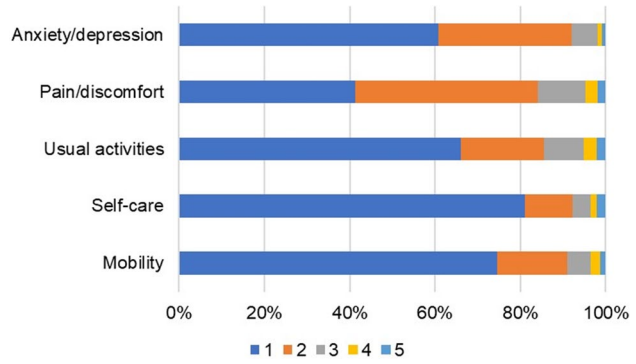

Fig. 1 The distribution of five levels in EQ-5D among respondents

scores and VAS scores of the general Chinese population were 0.951 and 88, respectively [37]. This study found that the rural cancer survivors had both lower utility scores and VAS scores than the general population. Furthermore, compared with the general Chinese population, rural cancer survivors reported more problem in all five dimensions, especially in pain/discomfort dimensions (30.4% vs. 58.6%) [6]. Therefore, the quality of life of cancer survivors can neither be regarded as cancer patients nor the general population. Approximately 39% of cancer survivors reported at least a slight level of anxiety/ depression in this sample, similar to a prior study in southeast Asia [28], but higher than another study which conducted in the USA (19%) [38]. This indicates that the experiences of rural Chinese survivors following cancer are much worse than those of American survivors. The anxiety/depression of rural cancer survivors should not be overlooked and need to be taken interventions.

The primary results indicate that survivors with advanced cancer stages at diagnosis, lung cancer, more than two chronic diseases and those in a poor socioeconomic position had impaired the health-related quality of life, which highlights the need for cancer survivorship care in rural China. The Chinese government has adopted the strategy of super-centers for cancer care that have concentrations of cancer medical resource in urban areas than rural areas [39]. So, the village clinic or clinics in towns cannot provide post-treatment care, and many rural residents need to travel long distances to get health care [40]. These may be significant barriers for rural cancer survivors to obtain cancer care information that is helpful in managing side effects or complications, and quality of life should be an important indicator of the effectiveness of cancer treatment and rehabilitation.

As we all know, the prognosis for patients with lung cancer is poor, and our results also demonstrate that lung cancer survivors had significantly lower HRQoL than survivors with other cancers. Other studies have found similar results. Grutters et al. [41] found the mean utility score was 0.74 for 260 patients with lung cancer. The ACTION Study Group [28] concluded that lung cancer heavily influences the HRQoL of survivors more so than other cancer types in eight low-and-middle income countries.

Cancer stage at diagnosis is widely recognized as an important factor of health utility in cancer survivors. Approximately 80–90% of cancer cases were diagnosed with advanced stages in China [42, 43]. One of the main reasons is the delay in seeking medical care in patients with acute symptoms, particularly in rural residents [44]. To reduce the delay in cancer care, the Chinese government has implemented a national cancer screening programme since 2006 as the main strategy for early diagnosis and treatment to improve prognosis in some rural areas [45]. Despite all efforts, the delay in cancer presentation remains considerable.

The influence of employment status on EQ-5D-5L utility scores showed that those who were migrant workers perceived better HRQoL than those who were homemakers or farmers in villages. Migrants are defined as a specific population under the *hukou* system, living in different places for work and life for more than 6 months of the year. Their *hukous*, a document permitting the holder to live in a particular place, typically belong to a countryside region [46]. However, residents in the countryside may find it more difficult to find jobs and thus are forced to migrate to urban areas, where production and service occupations are more common. This rural-to-urban migration offers migrant workers access to improved health care and necessary infrastructure to improve in population health in China [47]. We also found that higher income was significantly associated with a lower rate of problems in self-care and anxiety/depression and related to higher health utility scores. There are

Table 4 Univariate analysis of utility scores for rural cancer survivor

Variables	Mean	*SD*	χ^2
Sex			
Male	0.852	0.222	4.262*
Female	0.828	0.237	
Age (years)			
< 45	0.906	0.154	15.239**
45–59	0.885	0.168	
60–74	0.836	0.246	
≥ 75	0.764	0.257	
Marital status			
Married	0.843	0.231	1.373
Unmarried	0.829	0.214	
Education level			
Primary school or lower	0.805	0.261	13.813**
Middle school	0.886	0.171	
High school and above	0.896	0.162	
Household income in 2017, Chinese Yuan			
< 5000	0.780	0.304	15.025**
5000–20,000	0.818	0.238	
20,000–50,000	0.879	0.182	
≥ 50,000	0.923	0.110	
Migrant worker			
No	0.820	0.247	18.644**
Yes	0.926	0.104	
Cancer site			
Esophagus	0.900	0.133	16.838**
Stomach	0.870	0.199	
Colorectal	0.840	0.265	
Lung	0.754	0.288	
Breast	0.864	0.177	
Cancer stage			
Localized	0.893	0.184	22.498**
Regional	0.828	0.214	
Distant	0.739	0.324	
Previous treatment			
No surgery	0.847	0.211	0.025
Surgery	0.840	0.234	
No radiotherapy	0.843	0.224	0.004
Radiotherapy	0.831	0.261	
No chemotherapy	0.841	0.226	0.691
Chemotherapy	0.823	0.180	
Pre-existing chronic conditions			
None	0.856	0.213	8.124*
One	0.830	0.212	
Two	0.812	0.284	
Three or more	0.633	0.429	
Duration of disease since diagnosis			
8 months to 1 year	0.822	0.254	1.583
1 to less than 2 years	0.836	0.237	
2 years or more	0.872	0.175	

SD standard deviation

*$P < 0.05$ and **$P < 0.01$, respectively

Table 5 Influencing factors of EQ-5D-5L utility scores from Tobit regression model

Variables	Coefficients	*SE*	*t*
Sex			
Male	Ref.		
Female	−0.034	0.034	−1.017
Age (years)			
< 45	Ref.		
45–59	0.038	0.071	0.538
60–74	0.001	0.072	0.019
≥ 75	−0.083	0.080	−1.044
Marital status			
Married	Ref.		
Unmarried	−0.055	0.046	−1.181
Education level			
Below primary and primary	Ref.		
Middle school	0.041	0.032	1.282
High school and above	0.035	0.053	0.658
Household income in 2017, Chinese Yuan			
< 5000	Ref.		
5000–20,000	0.014	0.039	0.363
20,000–50,000	0.066	0.042	1.577
≥ 50,000	0.155***	0.056	2.783
Migrant worker			
No	Ref.		
Yes	0.086**	0.036	2.384
Cancer site			
Esophagus	Ref.		
Stomach	−0.004	0.045	−0.086
Colorectal	−0.002	0.050	−0.038
Lung	−0.106**	0.049	−2.176
Breast	−0.006	0.056	−0.116
Cancer stage			
Localized	Ref.		
Regional	−0.051*	0.030	−1.709
Distant	−0.119***	0.042	−2.859
Previous treatment			
No surgery	Ref.		
Surgery	0.003	0.033	0.084
No radiotherapy	Ref.		
Radiotherapy	0.012	0.040	0.299
No chemotherapy	Ref.		
Chemotherapy	−0.010	0.028	−0.372
Pre-existing chronic conditions			
None	Ref.		
One	−0.011	0.032	−0.333
Two	−0.015	0.051	−0.295
Three or more	−0.160***	0.078	−2.050
Duration of disease since diagnosis			
8 months to 1 year	Ref.		
1 to less than 2 years	0.015	0.034	0.455
2 years or more	0.039	0.041	0.933

SE standard error

*$P < 0.1$; **$P < 0.05$ and ***$P < 0.01$, respectively

several similar reports on the relationship between household income and HRQoL [18, 28, 32].

Limitations

Our study is not without limitations. First, this study has a relatively small sample size. All of the subjects were selected from three counties in Shandong province in China. The results of this study may therefore not representative of the entire population of Chinese rural cancer survivors. However, Shandong Province does exemplify characteristics of the broader Chinese population and socioeconomic development in recent decades. A larger sample size may be needed in the future, but the results of this study may still provide a useful baseline for other rural areas in China. Second, this is a cross-sectional study, which can only draw conclusions about associations but not about causations. The causal association between quality of life and influencing factors needs to be examined in the future longitudinal study. Our study sample involved only rural patients, so this study cannot make causal inferences or a direct comparison between rural and urban cancer survivors. A longitudinal design including both urban and rural sample will be needed in the future.

Conclusions

Little is known about HRQoL of rural cancer survivors in China. Current study findings indicated that a substantial number of rural cancer survivors have pain/discomfort problems; in particular, rural to urban migration as a population characteristic that may be associated with HRQoL disparity among cancer survivals. The results of this study provide detailed data on HRQoL of rural cancer survivors for future supportive and survivorship care in China.

Acknowledgements The authors thank all the local participants for their support and hard work in launching and implementing this ongoing study.

Funding This study was funded by the China Medical Board (CMB 13-160).

Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to disclose.

Ethical approval All procedures performed in this study are in accordance with ethical standards of the Institutional Review Board at School of Public Health of Shandong University (No. 20140201), and with the Declaration of Helsinki.

Informed consent Written informed consent was obtained from all participants before data collection.

References

1. Torre, L. A., Siegel, R. L., Ward, E. M., & Jemal, A. (2016). Global cancer incidence and mortality rates and trends—An update. *Cancer Epidemiology Biomarkers & Prevention, 25*(1), 16–27.
2. Chen, W., Zheng, R., Baade, P. D., Zhang, S., Zeng, H., Bray, F., et al. (2016). Cancer statistics in China, 2015. *CA: A Cancer Journal for Clinicians, 66*(2), 115–132.
3. National Bureau of Statistics of China. (2010). *China statistical yearbook*. Beijing: China Statistics Press.
4. Huang, H., Shi, J., Guo, L., Zhu, X., Wang, L., Liao, X., et al. (2016). Expenditure and financial burden for common cancers in China: A hospital-based multicentre cross-sectional study. *Lancet, 388*, S10.
5. Zheng, R., Zeng, H., Zhang, S., Chen, T., & Chen, W. (2016). National estimates of cancer prevalence in China, 2011. *Cancer Letters, 370*(1), 33–38.
6. Zhou, T., Guan, H., Liu, G., & Ma, A. (2016). Comparison analysis on the EQ-5D-5L and the EQ-5D-3L for general population in China. *Chinese Health Economics, 35*(3), 17–20.
7. Dirven, L., Poll-Franse, L. V. V. D., Aaronson, N. K., & Reijneveld, J. C. (2015). Controversies in defining cancer survivorship. *Lancet Oncology, 16*(6), 610–612.
8. Mayer, D. K., Nasso, S. F., & Earp, J. A. (2017). Defining cancer survivors, their needs, and perspectives on survivorship health care in the USA. *Lancet Oncology, 18*(1), e11.
9. Chen, W., Zheng, R., Zeng, H., Zou, X., Zhang, S., & He, J. (2015). The incidences and mortalities of major cancers in China, 2011. *Chinese Journal of Cancer, 24*(1), 1–10.
10. Beck, S. L., Towsley, G. L., Caserta, M. S., Lindau, K., & Dudley, W. N. (2009). Symptom experiences and quality of life of rural and urban older adult cancer survivors. *Cancer Nursing, 32*(5), 359–369.
11. Burris, J. L., & Andrykowski, M. (2010). Disparities in mental health between rural and nonrural cancer survivors: A preliminary study. *Psycho-Oncology, 19*(6), 637–645.
12. Disipio, T., Hayes, S. C., Newman, B., Aitken, J., & Janda, M. (2010). Does quality of life among breast cancer survivors one year after diagnosis differ depending on urban and non-urban residence? A comparative study. *Health & Quality of Life Outcomes, 8*(1), 3.
13. Disipio, T., Hayes, S., Newman, B., & Janda, M. (2010). What determines the health-related quality of life among regional and rural breast cancer survivors? *Australian & New Zealand Journal of Public Health, 33*(6), 534–539.
14. Butow, P. N., Phillips, F., Schweder, J., White, K., Underhill, C., & Goldstein, D. (2012). Psychosocial well-being and supportive care needs of cancer patients living in urban and rural/regional areas: A systematic review. *Supportive Care in Cancer, 20*(1), 1–22.
15. Burris, J. L., & Andrykowski, M. (2010). Disparities in mental health between rural and nonrural cancer survivors: A preliminary study. *Psychooncology, 19*(6), 637–645.
16. Huang, H., Yang, J., Shi, J., Zheng, C., Gu, X., Liang, H., et al. (2017). Systematic review of quality of life in Chinese colorectal cancer patients. *Chinese Prevention Control Chronic Disease, 25*(08), 629–635.
17. Liu, L., Li, S., Min, W., & Gang, C. (2017). Comparison of EQ-5D-5L health state utilities using four country-specific tariffs on a breast cancer patient sample in mainland China. *Patient Preference & Adherence, 11*, 1049–1056.
18. Wang, L., Shi, J., Zhu, J., Huang, H., Bai, Y., & Liu, G., et al. (2018). Health-related quality of life and utility scores of patients with breast neoplasms in China: A multicenter cross-sectional survey. *The Breast, 39*, 53–62.

19. Cheng, H., Sit, J. W. H., & Cheng, K. K. F. (2016). Negative and positive life changes following treatment completion: Chinese breast cancer survivors' perspectives. *Supportive Care in Cancer, 24*(2), 791–798.
20. Zhao, Z., Pan, X., Huang, W., Wen, Y., Chen, F., Huang, H., et al. (2015). Quality of life among patients with esophageal/gastric cardia precancerous lesion or cancer: A one-year follow-up study. *Modern Prevention Medicine, 42*(24), 4417–4420.
21. Shandong Provincial Bureau of Statistics. (2017). *Shandong Statistical Yearbook, 2017*. Beijing: China Statistics Press.
22. Rand-Hendriksen, K., Ramos-Goñi, J. M., Augestad, L. A., & Luo, N. (2017). Less is more: Cross-validation testing of simplified nonlinear regression model specifications for EQ-5D-5L health state values. *Value in Health, 20*(7), 945–952.
23. Herdman, M., Gudex, C., Lloyd, A., Janssen, M., Kind, P., Parkin, D., et al. (2011). Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of Life Research, 20*(10), 1727–1736.
24. Brazier, J., Briggs, A., & Bryan, S. (2018). EQ-5D-5L: Smaller steps but a major step change? *Health Economics, 27*(1), 4–6.
25. Luo, N., Liu, G., Li, M., Guan, H., Jin, X., & Rand-Hendriksen, K. (2017). Estimating an EQ-5D-5L Value Set for China. *Value in Health, 20*(4), 662–669.
26. Mcdonald, J. F., & Moffitt, R. A. (1980). The uses of tobit analysis. *Review of Economics & Statistics, 62*(2), 318–321.
27. Zhou, Z., Zhou, Z., Li, D., Wang, D., Shi, C., Shen, C., et al. (2015). Analyzing the health-related quality of life of urban and rural residents in Shaanxi: Estimation based on the EQ-5D value sets. *Chinese Health Economic, 34*(2), 13–16.
28. Group, T. A. S. (2017). Health-related quality of life and psychological distress among cancer survivors in Southeast Asia: Results from a longitudinal study in eight low- and middle-income countries. *BMC Medicine, 15*(1), 10.
29. Zhou, T., Guan, H., Ma, A., & Liu, G. (2016). Comparison between the EQ-5D-5L and the EQ-5D-3L for general population in China. *Chinese Health Economic, 35*(3), 17–20.
30. Pickard, A. S., Wilke, C. T., Lin, H. W., & Lloyd, A. (2007). Health utilities using the EQ-5D in studies of cancer. *Pharmacoeconomics, 25*(5), 365–384.
31. Kim, S. H., Kim, H. J., Lee, S., & Jo, M. (2012). Comparing the psychometric properties of the EQ-5D-3L and EQ-5D-5L in cancer patients in Korea. *Quality of Life Research, 21*(6), 1065–1073.
32. Mccaffrey, N., Kaambwa, B., Currow, D. C., & Ratcliffe, J. (2016). Health-related quality of life measured using the EQ-5D–5L: South Australian population norms. *Health & Quality of Life Outcomes, 14*(1), 133.
33. Xu, X., Wang, M., Li, S., & Chen, G. (2016). Analysis on the measurement of health utility value among patients with breast cancer. *Chinese Health Economics, 35*(3), 21–24.
34. Wu, H., & Sun, L. (2012). Comparison of EQ-5D value sets between UK and Japan and the Influences on the results of cost-utility. *Chinese Health Economics, 31*(7), 9–11.
35. Naik, H., Howell, D., Su, S., Qiu, X., Brown, M. C., & Vennettilli, A., et al. (2017). EQ-5D health utility scores: Data from a comprehensive Canadian cancer centre. *The Patient - Patient-Centered Outcomes Research, 10*(1), 1–11.
36. Shi, J. F., Huang, H. Y., Guo, L. W., Shi, D., Gu, X. Y., Han, L., et al. (2016). Quality-of-life and health utility scores for common cancers in China: A multicentre cross-sectional survey. *Lancet, 388*, S29–S29.
37. Guan, H., & Liu, G. (2015). Comparison analysis on health-related quality of life among urban and rural residents in four cities of China. *Chinese Health Economics, 34*(2), 5–12.
38. Weaver, K. E., Geiger, A. M., Lu, L., & Case, L. D. (2013). Rural-urban disparities in health status among US cancer survivors. *Cancer, 119*(5), 1050–1057.
39. Sullivan, R., Alatise, O. I., Anderson, B. O., Audisio, R., Autier, P., & Aggarwal, A., et al. (2015). Global cancer surgery: Delivering safe, affordable, and timely cancer surgery. *Lancet Oncology, 16*(11), 1193–1224.
40. Meng, Q., Fang, H., Liu, X., Yuan, B., & Xu, J. (2015). Consolidating the social health insurance schemes in china: Towards an equitable and efficient health system. *Lancet, 386*(10002), 1484–1492.
41. Grutters, J. P. C., Joore, M. A., Wiegman, E. M., Langendijk, J. A., de Ruysscher, D., Hochstenbag, M., et al. (2010). Health-related quality of life in patients surviving non-small cell lung cancer. *Thorax, 65*(10), 903–907.
42. Wang, N., Cao, F., Liu, F., Jia, Y., Wang, J., & Bao, C., et al. (2015). The effect of socioeconomic status on health-care delay and treatment of esophageal cancer. *Journal of Translational Medicine, 13*(1), 241.
43. Wang, Y., Wang, J., & Liu, Y. (2011). Analysis of clinical data of in-patients with gastric carcinoma in Peking University People's Hospital over the past ten years. *China Journal of Modern Medicine, 21*(5), 596–603.
44. Huo, Q., Cai, C., Zhang, Y., Kong, X., Jiang, L., & Ma, T., et al. (2015). Delay in diagnosis and treatment of symptomatic breast cancer in china. *Annals of Surgical Oncology, 22*(3), 883–888.
45. Shi, J., & Dai, M. (2017). Health economic evaluation of cancer screening in China. *Chinese Journal Prevention Medicine, 55*(2), 107–111.
46. Du, Y., Gregory, R., & Meng, X. (2006). Impact of the guest worker system on poverty and Wellbeing of migrant workers in Urban China. *Beijing Forum, 37*, 391–417.
47. Gong, P., Liang, S., Carlton, E. J., Jiang, Q., Wu, J., Wang, L., et al. (2012). Urbanisation and health in China. *Lancet, 379*(9818), 843–852.