

Socio-economic and rural-urban differences in healthcare and catastrophic health expenditures among cancer patients in China: analysis of the China Health and Retirement Longitudinal Study

Yang Zhao (✉ Wzhao@georgeinstitute.org.cn)

The George Institute for Global Health

Shenglan Tang

Duke University

Wenhui Mao

Duke University

Tomi F Akinyemiju

Duke University

Research

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Abstract

Background

In China, cancer deaths account for one-fifth of all deaths and exert a heavy toll on patients, families, healthcare systems, and society as a whole. This study aims to examine socio-economic and rural-urban differences in treatment, healthcare service utilization and catastrophic health expenditure (CHE) among Chinese cancer patients, and to investigate the relationship between different treatment types and healthcare service use as well as incidence of CHE.

Methods

We analyzed a nationally representative sample from the China Health and Retirement Longitudinal Study including 17,224 participants in 2011 and 19,569 participants in 2015. Multivariable regression models were performed to investigate the association of cancer treatments with healthcare service utilization and CHE.

Results

The age-adjusted prevalence of cancer is 1.37% for 2011 and 1.84% for 2015. Approximately half of the cancer patients utilized treatment for their disease, with a higher proportion of urban residents (54%) than rural residents (46%) receiving cancer treatment in 2015. CHE declined by 22% in urban areas (25% in 2011 and 19% in 2015) but increased by 31% in rural areas (25% in 2011 to 33% in 2015). There was a positive relationship between cancer treatment and outpatient visit (OR = 2.098, 95% CI = 1.453, 3.029), admission to hospital (OR = 1.961, 95% CI = 1.346, 2.857) and CHE (OR = 1.796, 95% CI = 1.231, 2.620). Chemotherapy and surgery were each associated with a 2-fold increased risk of CHE.

Conclusions

Meaningful changes to improve health insurance benefit packages are needed to ensure universal, affordable and patient-centered health coverage for the Chinese cancer patients.

Background

Chronic non-communicable diseases (NCDs) has become the leading cause of global disease burden. Cancers rank as a major contributor to a burden on the healthcare systems in several countries. In China, evidence suggested that there were over 4 million new cancer cases diagnosed, and almost 3 million cancer deaths occurred in 2018, which accounted for a high percentage of total cancer cases (about 23%) and deaths (30%) worldwide [1]. In China, cancer deaths account for one-fifth of all deaths, and exerts a heavy toll on patients, families and the whole health systems.

To mitigate the healthcare and financial burden of NCDs including cancers, the central government of China has launched a new round of comprehensive healthcare system reforms since 2009, focusing on healthcare delivery, basic public health service, medical insurance, essential medicine system and public hospital reform. Most of these measures were designed to improve the access to quality and affordable care for patients with NCDs and health outcomes [2, 3]. In 2015, URBMI (Urban Residents Basic Medical Insurance) and NCMS (New Rural Cooperative Medical System) were integrated into one urban–rural resident health insurance scheme, which enhance the financial risk protection for patients with cancers [4, 5]. In addition, the Critical Illness Health Insurance and supplementary medical insurance programs were developed to offer extra benefits packages to citizens with severe chronic diseases. The reform and consolidation of three-level medical institutions (including primary healthcare centers, secondary hospitals and tertiary hospitals) aimed at providing coordinated diagnoses, treatment, and follow-up care to Chinese cancer patients [6]. Despite the launch of China healthcare system reform in 2009, few empirical data have evaluated the impact of the comprehensive health reforms on cancer health expenditure.

We hypothesize that reformed medical insurances and healthcare delivery systems could further reduce catastrophic health expenditures (CHE) among patients with cancer in both rural and urban regions of China. The CHE in this study is defined as the point at which annual household healthcare expenses exceeded 40% of non-food household expenditures, a measure of degree of financial risk to patients with cancer. Although the new round of health reforms have been implemented at the national level, it may take time to translate the investments into equitable health service use among people with different socio-economic status (SES) [7].

Previous research had reported the relationship between cancers and socio-economic characteristics, including China, showing that higher socio-economic status is associated with greater likelihood of routine screening, incidence of cancer, cancer treatment utilization and better survival. [8–12]. Other studies in China have examined socio-economic and gender inequalities in the incidence of cancer as well as mortality [17, 18], and differences in treatment utilization [19]. Researchers also investigated socio-economic differences among patients with NCDs, such as hypertension, diabetes, stroke, chronic obstructive pulmonary disease as well as multiple chronic diseases [20–25]. However, there is limited evidence of the financial burden of cancer care in China across socio-economic groups. [26] In addition, few studies have evaluated whether CHE varies by treatment types (eg. Chinese traditional or western medicine), or estimated the impact of the 2009 health reforms on health service utilization among cancer patients [13–16].

Our research is with the aim of: (1) investigating changes of the burden and socio-economic differences in CHE among Chinese adults with cancers; (2) assessing whether CHE varies by treatment type, and (3) examining relationships between different types of cancer therapy and healthcare service use as well as the incidence of CHE.

Methods

Data Source

In this study, data was obtained from the China Health and Retirement Longitudinal Study (CHARLS) in 2011 and 2015, and details of the study methodology have been published elsewhere [27]. The CHARLS is a biennial survey, which aimed to be representative of Chinese adults aged 45 years and above. CHARLS study design is similar to the Health and Retirement Study (HRS) and other established related ageing surveys [27]. Study questionnaires covered the domains of demographics, health status and functioning, healthcare and insurance, household income and consumption as well as clinical risk factors (blood pressures) [27].

To ensure ample representativeness at the national level, CHARLS sampled 150 counties and 450 villages/urban communities across 28 provinces, using multi-stage stratified probability-proportionate-to-size (PPS) sampling. A total of 17,708 and 21,097 individuals were interviewed in 2011 (baseline) and 2015 (3rd wave). Final data were available for 17,224 participants in 2011 and 19,569 participants in 2015, after excluding participants with missing values of socio-demographic and/or cancer treatment information. A total of 234 individuals (in 2011) and 368 participants (in 2015) self-reported clinically-diagnosed cancers.

Cancer Care Indicators

We identified six types of cancer treatments/therapies: Chinese traditional medication (TCM) only, western modern medication only (refers to taking western medication excluding TCM and chemotherapy medications for cancer treatment), TCM & western medication, surgery, chemotherapy and radiation therapy. The overall treatment was defined as receipt of any TCM or Western medicine treatment (having one or more types of the five therapies). In terms of health services utilization, this study included 1) outpatient care (participants were asked whether they had any outpatient visit during last month); 2) inpatient care (participants were asked whether they had any hospitalization and how many nights of hospital stay during last year). Medical expenditures were also collected in CHARLS, which included total health expenditure, reimbursed part of expenditure, and out-of-pocket spending for outpatient services in the past month and the inpatient care in the past year.

We apply the indicator of CHE to measure the financial risk or economic burden for the household with family member suffering cancers. There were two common criteria of CHE definition: 1) out-of-pocket payments (OOP) over 40% of the household's capacity to pay (using household's expenditure on non-food consumption as proxy), and 2) over 10% of total household income/expenditure [28–30]. Following previous studies, we defined CHE as OOP for healthcare equaling or exceeding 40% of the household's capacity to pay [29]. The OOP health expenditure (household's capacity to pay) was considered as the numerator (denominator). CHE was coded as “yes” if the proportion over 40% and “no” if not.

The SES was assessed using the Socio-economic Index score, and calculated based on educational attainment, occupation and household consumption expenditure. This research used Li's scale for Chinese residents (version 2010) [31] as a standard scale. This scale, commonly used in social science

research in China [32–35], was modified based on the scale first proposed by Duncan [36]. Educational level, occupation and household consumption expenditure were classified to assign scores and summarized as a comprehensive Socio-economic Index score. Based on the Socio-economic Index scores, all subjects were classified as low (< 10 scores) and high SES class (≥ 10 scores).

Statistical Analysis

This study applied Chi-square tests to examine the SES differences in types of cancer treatment, outpatient and inpatient service use as well as incidence of catastrophic medical expenditure. For continuous variables including nights of hospitalization and OOPE of health care, we used t-tests to analyze SES group differences. Based on the pooled two-wave data of cancer patients, we performed multivariable logistic regressions to investigate the association of cancer treatment with outpatient visit, hospitalization as well as incidence of CHE, adjusting for socio-demographic factors. Covariates in the regression analyses included gender, age, marital condition, education status, location residence, region in China and social health insurance enrolled.

To explore differential relationships across the wealth groups, we also conducted subgroup analyses with logistic regression models stratified by the SES Index. The adjusted odds ratio (OR) and 95% confidence intervals (CI) were reported for logistic regression analyses in this study. The weighted prevalence of cancers were also reported considering nonresponse data and the complex, multistage design of CHARLS study. P values less than 0.05 were considered as statistically significant. Statistical analyses were conducted using STATA software (version 15.0; StataCorp LLC College Station, Texas, United States).

Results

Table 1 presents the socio-demographic characteristics of participants and cancer patients among Chinese people aged 45 years and above in 2011 and 2015. The prevalence of cancer increased from 1.36% (234 of 17,224) in 2011 to 1.88% (368 of 19,569) in 2015. The age-adjusted prevalence of cancer is 1.37% for 2011 and 1.84% for 2015. The prevalence of cancer was higher in people who: were female; had social health insurance; were located in the eastern region and unemployed individuals than those who: were male; without health insurance, lived in the western region and being employed

Table 1
The prevalence of cancer among Chinese adults in 2011 and 2015

	2011				2015			
	N	n	% (1)	% (2)	N	n	% (1)	% (2)
Total	17,224	234	1.36	1.25	19,569	368	1.88	2.05
Gender								
Male	8,397	86	1.02	0.90	9,526	116	1.22	1.56
Female	8,827	148	1.68	1.58	10,043	252	2.51	2.51
Age (years)								
45–55	6,255	89	1.42	1.23	6,699	116	1.73	2.14
55–65	6,355	76	1.20	1.16	6,611	134	2.03	2.09
≥ 65	4,614	69	1.50	1.38	6,259	118	1.89	1.90
Marital status								
Married/partnered	14,970	214	1.43	1.32	16,891	324	1.92	2.07
Never married/divorced	2,254	20	0.89	0.88	2,678	44	1.64	1.91
Residence location								
Urban area	6,967	103	1.48	1.18	7,908	164	2.07	2.30
Rural area	10,257	131	1.28	1.32	11,661	204	1.75	1.79
Region								
East	6,572	112	1.70	1.47	7,477	156	2.09	2.50
Central	6,489	78	1.20	1.17	7,236	137	1.89	1.84
West	4,163	44	1.06	0.96	4,856	75	1.54	1.50
Health insurance								
No	1,352	13	0.96	0.70	3,109	42	1.35	1.23
Yes	15,872	221	1.39	1.30	16,460	326	1.98	2.23
Education level								
Primary school/below	11,476	156	1.36	1.25	13,517	258	1.91	2.16
Middle school/above	5,748	78	1.36	1.26	6,052	110	1.82	1.84

Note: % (1), the unweighted prevalence of cancers; % (2), the weighted prevalence of cancers. The age-adjusted prevalence of cancer is 1.37% for 2011 and 1.84% for 2015.

	2011				2015			
Employment status								
No	5,817	113	1.94	1.73	6,791	193	2.84	2.70
Yes	11,407	121	1.06	0.95	12,778	175	1.37	1.63
Note: % (1), the unweighted prevalence of cancers; % (2), the weighted prevalence of cancers. The age-adjusted prevalence of cancer is 1.37% for 2011 and 1.84% for 2015.								

Table 2 shows the treatment\therapy condition among Chinese adults with cancers. Overall, approximately half of the cancer patients utilized treatment for their disease, with a higher proportion of urban residents (54%) than rural residents (46%) receiving cancer treatment in 2015. In addition, a higher proportion of high versus low SES patients utilized cancer treatment. Taking western medication and surgery were the two main type of treatment for cancers. People with a high SES level received more medication treatment, surgery and chemotherapy than low SES patients in China.

Table 2
The proportion of cancer treatment in China, by the socioeconomic group

Variables	2011				2015			
	N	n	%	P value	N	n	%	P value
Overall treatment								
Urban area	103	54	52.43	0.937	164	89	54.27	0.098
Rural area	131	68	51.91		204	93	45.59	
SES Index, low level	156	81	51.92	0.926	191	89	46.60	0.254
SES Index, high level	78	41	52.56		177	93	52.54	
All	234	122	52.14		368	182	49.46	
TCM only								
Urban area	103	4	3.88	0.478	164	12	7.32	0.094
Rural area	131	3	2.29		204	7	3.43	
SES Index, low level	156	4	2.56	0.587	191	8	4.19	0.380
SES Index, high level	78	3	3.85		177	11	6.21	
All	234	7	2.99		368	19	5.16	
Western medication only								
Urban area	103	28	27.18	0.372	164	30	18.29	0.776
Rural area	131	29	22.14		204	35	17.16	
SES Index, low level	156	36	23.08	0.518	191	29	15.18	0.195
SES Index, high level	78	21	26.92		177	36	20.34	
All	234	57	24.36		368	65	17.66	
TCM & Western medication								
Urban area	103	8	7.77	0.266	164	25	15.24	0.329
Rural area	131	16	12.21		204	24	11.76	
SES Index, low level	156	18	11.54	0.361	191	22	11.52	0.292

*Overall treatment defined as receipt of any TCM or Western medicine treatment

**Western modern medication in this study exclude chemotherapy medications

***Surgery, chemotherapy and radiation each evaluated separately, although patients might receive a combination of all three

Variables	2011				2015			
SES Index, high level	78	6	7.69		177	27	15.25	
All	234	24	10.26		368	49	13.32	
Chemotherapy								
Urban area	103	15	14.56	0.199	164	25	15.24	0.907
Rural area	131	12	9.16		204	32	15.69	
SES Index, low level	156	17	10.90	0.664	191	28	14.66	0.648
SES Index, high level	78	10	12.82		177	29	16.38	
All	234	27	11.54		368	57	15.49	
Surgery								
Urban area	103	28	27.18	0.664	164	47	28.66	0.314
Rural area	131	39	29.77		204	49	24.02	
SES Index, low level	156	47	30.13	0.474	191	41	21.47	0.036
SES Index, high level	78	20	25.64		177	55	31.07	
All	234	67	28.63		368	96	26.09	
Radiation therapy								
Urban area	103	7	6.80	0.463	164	14	8.54	0.429
Rural area	131	6	4.58		204	13	6.37	
SES Index, low level	156	9	5.77	0.840	191	14	7.33	0.996
SES Index, high level	78	4	5.13		177	13	7.34	
All	234	13	5.56		368	27	7.34	
*Overall treatment defined as receipt of any TCM or Western medicine treatment								
**Western modern medication in this study exclude chemotherapy medications								
***Surgery, chemotherapy and radiation each evaluated separately, although patients might receive a combination of all three								

Table 3 describes trends in health service utilization, health spending and CHE among Chinese cancer patients between 2011 and 2015. There was increasing health service utilisation among cancer patient in China from 2011 to 2015 (Outpatient visit, 26–30%; Admission rate, 23–30%; Average hospitalization nights, 3.41 to 3.81). In 2011, residents living in rural areas had a higher proportion of outpatient visits but less OOPE for outpatient care than urban residents. However, by 2015, this gap had narrowed for

outpatient visits, OOPE for outpatient care more than tripled in rural areas (mean 517 in 2011 versus 3893 in 2015 and declined significantly (mean 4494 in 2011 and 1564 in 2015) in urban areas. Between 2011 and 2015, CHE declined by 22% in urban areas (25% in 2011 and 19% in 2015) but increased by 31% in rural areas (25% in 2011 to 33% in 2015). In 2011, low SES cancer patients had significantly lower OOPE for inpatient care compared with high SES patients, however by 2015 this gap had narrowed and was no longer significant. In 2015, there was no significant difference in CHE among low versus high SES cancer patients, although the prevalence of CHE was increased slightly in both groups compared with 2011.

Table 3
Health service utilisation and health spending among cancer patients in China, by the socioeconomic group

	2011		2015	
	%	P value	%	P value
Outpatient visits, last month (%)				
Urban area	18.45	0.007	26.22	0.115
Rural area	34.35		33.82	
SES Index, low level	23.72	0.247	29.84	0.798
SES Index, high level	30.77		31.07	
All	26.07		30.43	
Admission rate, last year (%)				
Urban area	25.24	0.401	32.32	0.362
Rural area	20.61		27.94	
SES Index, low level	21.15	0.439	25.65	0.065
SES Index, high level	25.64		34.46	
All	22.65		29.89	
Nights in hospital, last year (mean)				
Urban area	4.20	0.115	4.09	0.313
Rural area	2.79		3.58	
SES Index, low level	2.96	0.136	3.46	0.246
SES Index, high level	4.32		4.18	
All	3.41		3.81	
OOPE for outpatient care*, CNY (mean)				
Urban area	4494	0.008	1564	0.107
Rural area	517		3893	

Note: In this study, we defined catastrophic health expenditure as medical OOPE equalling or exceeding 40% of the household's expenditure on non-food consumption.

* Out-of-pocket expenditure among cancer patients with outpatient visit

** Out-of-pocket expenditure among cancer patients with inpatient care

	2011		2015	
SES Index, low level	2121	0.278	2225	0.189
SES Index, high level	1093		3826	
All	1820		3025	
OOPE for inpatient care*, CNY (mean)				
Urban area	19612	0.175	16566	0.468
Rural area	12477		16153	
SES Index, low level	10372	0.028	13851	0.189
SES Index, high level	25225		18360	
All	15977		16352	
Catastrophic health expenditure (%)				
Urban area	25.24	0.993	19.51	0.003
Rural area	25.19		33.33	
SES Index, low level	26.28	0.595	28.80	0.468
SES Index, high level	23.08		25.42	
All	25.21		27.17	
Note: In this study, we defined catastrophic health expenditure as medical OOPE equalling or exceeding 40% of the household's expenditure on non-food consumption.				
* Out-of-pocket expenditure among cancer patients with outpatient visit				
** Out-of-pocket expenditure among cancer patients with inpatient care				

Table 4 suggests a positive relationship between cancer treatment and outpatient visit (OR = 2.098, 95% CI = 1.453, 3.029), admission to hospital (OR = 1.961, 95% CI = 1.346, 2.857) and CHE (OR = 1.796, 95% CI = 1.231, 2.620). Chemotherapy (OR = 2.53, 95% CI: 1.55, 4.12) and surgery (surgery: OR = 2.15, 95% CI: 1.44, 3.20) were each associated with a 2-fold increased risk of CHE, after controlling all socio-demographic covariates. This association was stronger among high SES groups (chemotherapy OR = 3.16, 95% CI: 1.44, 6.90; surgery: OR = 2.36, 95% CI: 1.24, 4.49) compared with low SES groups (chemotherapy OR = 2.77, 95% CI: 1.41, 5.41; surgery OR = 2.07, 95% CI: 1.22, 3.51). There were no significant associations observed for TCM with CHE overall or by SES.

Table 4

Differential impacts of the cancer treatment on health service use and catastrophic health expenditure

Treatment type	Outpatient visits			Admission to hospital			Catastrophic health expenditure		
	OR	95% CI		OR	95% CI		OR	95% CI	
All cancer patients									
Overall cancer treatment	2.098	1.453	3.029	1.961	1.346	2.857	1.796	1.231	2.620
TCM only	2.002	0.886	4.525	0.771	0.297	1.999	1.187	0.481	2.928
Western medication only	1.227	0.792	1.902	1.503	0.970	2.329	1.204	0.767	1.889
TCM & western medication	1.904	1.142	3.176	1.001	0.576	1.739	1.201	0.696	2.072
Chemotherapy	1.823	1.115	2.979	3.622	2.233	5.874	2.530	1.551	4.126
Surgery	1.750	1.187	2.580	2.041	1.371	3.037	2.146	1.437	3.204
Radiation therapy	0.845	0.400	1.788	3.310	1.714	6.393	1.675	0.847	3.314
SES Index, low level									
TCM only	2.740	0.824	9.109	0.662	0.139	3.155	1.367	0.394	4.741
Western medication only	1.348	0.736	2.467	1.027	0.530	1.989	0.819	0.435	1.545
TCM & western medication	1.570	0.778	3.169	0.997	0.452	2.199	0.948	0.446	2.012
Chemotherapy	2.222	1.118	4.414	3.496	1.773	6.890	2.766	1.414	5.410
Surgery	1.422	0.833	2.425	1.811	1.031	3.183	2.072	1.224	3.507
Radiation therapy	1.314	0.518	3.331	3.827	1.584	9.246	1.663	0.680	4.065
SES Index, high level									
TCM only	1.321	0.406	4.300	0.791	0.232	2.698	0.956	0.246	3.717
Note: Logistic regressions adjusted for: age, gender, marital status, residence location, region, health insurance. The bold values refer to P < 0.05 from the multivariable regression analysis.									
*Overall treatment defined as receipt of any TCM or Western medicine treatment									
**Western modern medication in this study exclude chemotherapy medications									
***Surgery, chemotherapy and radiation each evaluated separately, although patients might receive a combination of all three									

Treatment type	Outpatient visits			Admission to hospital			Catastrophic health expenditure		
	OR	95% CI		OR	95% CI		OR	95% CI	
Western medication only	1.210	0.625	2.344	2.325	1.247	4.334	1.791	0.912	3.519
TCM & western medication	2.087	0.955	4.562	0.916	0.414	2.031	1.629	0.713	3.720
Chemotherapy	1.338	0.636	2.817	3.864	1.875	7.962	3.156	1.442	6.907
Surgery	2.223	1.232	4.012	2.404	1.341	4.311	2.364	1.243	4.496
Radiation therapy	0.228	0.048	1.077	2.457	0.871	6.931	1.940	0.634	5.937
Note: Logistic regressions adjusted for: age, gender, marital status, residence location, region, health insurance. The bold values refer to P < 0.05 from the multivariable regression analysis.									
*Overall treatment defined as receipt of any TCM or Western medicine treatment									
**Western modern medication in this study exclude chemotherapy medications									
***Surgery, chemotherapy and radiation each evaluated separately, although patients might receive a combination of all three									

Discussion

As this nationally representative study indicated, there was increasing trends in the prevalence of cancer, outpatient and inpatient service use among Chinese middle-aged and elderly adults between 2011 and 2015. About half of cancer patients utilized cancer treatment for their disease, with a higher proportion in the urban versus rural residents in 2015. Those patients with high socio-economic degree received a high proportion of surgery and chemotherapy compared with low SES patients in 2015. There was also a substantial increase in CHE among rural patients from 2011 to 2015 and a substantial decrease among urban patients in the same time period. Utilization of chemotherapy and surgery appeared to drive the CHE increase, regardless of SES.

There are likely several factors contributing to the observed urban-rural differences in cancer care that needs to be addressed to increase the equitable access to healthcare in future. First, cancer care is provided as specialized services, and generally secondary or higher levels hospitals have the capacity to provide such care. Rural residents have less geographic access to cancer care comparing with urban areas, and some patients need extended travel and additional expenses to urban cities to get specialized cancer services [37]. During the period of the Coronavirus Disease 2019 (COVID-19) pandemic, patients may face more challenges in accessing cancer care. COVID-19 pandemic could disrupt the access to essential healthcare and likely exacerbate existing disparities since rural residents are more likely to be negatively by travel restrictions for access to specialized health services [38–40]. Public health efforts

will be needed to address the impact of delayed diagnosis and suboptimal care in these rural populations to minimize adverse health outcomes among patients with cancer.

Second, previous studies have documented the urban-rural disparity in availability of medical resources in China [41, 42]. Research has generally found that residents living in rural areas would be less likely to use healthcare services with same quality due to the unbalanced economic development [43, 44]. Consistent with other studies, people in rural areas are more likely to have a shortage of healthcare service providers and lack social supports [45–47]. Previous research suggested that the number of licensed doctors and nurses, medical-technical personnel as well as beds per 1000 population in urban communities increased more than the number in rural communities in China from 2005 to 2017. [48] Registered doctors per thousand populations in urban areas were 2.57 times more than in rural areas in China in 2015 [49]. For this reason, cancer patients in rural areas may prefer using the services from a nearby urban area, even at the cost of higher financial burden.

Third, patients in the rural areas face potentially more financial barrier to cancer care compared with patients in urban areas, likely due to more barriers in physical access to healthcare services, and high per-capita payment for cancer care. The social medical insurances likely contributes to urban-rural disparity in CHE through gaps in coverage and benefit packages [50]. While over 95% Chinese population are covered by basic medical insurances, the benefits packages can vary significantly across main social health insurances [5, 6, 23]. The per-capita fund of UEBMI is US\$424.7, whereas only \$61.2 for NCMS in 2015 [25]. The co-payment rates of NCMS (73.4%) was higher than UEBMI (36.8%) and URBMI (50.7%) in 2008 [51]. Herein, cancer patients in rural regions have lower reimbursement rates and lower annual maximum payment from insurance. Additionally, patients seek care from other county/prefectures usually have reduced reimbursement rates. In this case, if cancer patients from rural areas have to utilize cancer care from another city, they have to pay more proportion of their bill out-of-pocket. Such a heavy financial burden likely compels low SES and rural patients away from cancer treatment utilization, possibly explaining the large urban-rural disparity in inpatient care use than outpatient visits. Paying more attention to out of pocket expenses and financial implications of cancer treatment across health insurance schemes is need in future.

Finally, while the expenditures for cancer care are increasing in rural areas as well as urban areas, the uneven nature of economic development and low-level disposable income of rural residents may further contribute the urban-rural disparities in financial risk and treatment burden. The disposable income of urban citizens was 31,195 RMB per capita, which was three times higher than that of residents living in rural areas (11,422 RMB) in China in 2015 [52]. Medical expenditures due to cancer treatment, specifically surgery and chemotherapy, is likely to have significantly greater impact on rural patients, leading to increased risk of CHE and impoverishment [52]. In addition, since NCMS and URBMI were mainly financed by local county-level governments at the early stage of China new health system reform, the quality of benefit packages likely depends on local economic development [49].

We observed that those cancer patients with high socio-economic level were less likely to experience CH than low SES individuals, and by 2015, rural cancer patients had almost double the prevalence of CHE compared with urban cancer patients, suggesting that a potential unintended consequence of the health reform is widening of rural-urban disparities in CHE. The findings are consistent with previous research on trends in financial burden among residents with NCDs in China [25, 53]. Recent studies have documented a rapid rise in healthcare cost for cancer patients in China, however data on the population-level economic burden of cancers is limited and the reported expenditure per patient may be underestimated [54–60]. For example, a systematic review of the economic burden of liver cancer shows an increase in expenditure indicators (direct medical expenditure, annual expenditure per visit and annual expenditure per diem) from 1996 to 2015, with medication costs accounting for more than half of the overall expenditure (56. 6%) [57]. For colorectal cancer, the annual growth rate for medical expenditure per patient, per visit and per day increased from 6.9–7.8% from 1996 to 2015, respectively [58].

Policy Implications

The health insurance programs in China has had some positive impacts on healthcare utilization. For instance, we observed that outpatient visits and admissions in the past months increased between 2011 and 2015 in all socio-demographic groups examined. However, there are still challenges especially related to costs. Overall, the burden of cancer among Chinese adults is increasing and about one-fourth cancer patients experienced CHE. Yet disparities among urban-rural, and different SES still exist, even after the implementation of the national health insurance scheme.

To reduce financial burden of cancer and bridge the SES gaps, comprehensive changes to health insurance benefit packages and healthcare resource allocation are needed to ensure universal, affordable and patient-centered health coverage. First, the URBMI and the NCMS need to be further integrated in contribution, benefit package, as well as financial risk protection to accelerate the equitable access to health service in both urban and rural areas. Secondly, social health insurance benefit packages need to be further expanded. Health services, including medicines, with proved cost-effectiveness evidence can be added to the National Insurance Reimbursable List (NIRL). For instance, 17 and 22 anti-cancer medicines have been elected into the NIRL with significant price cut in 2018 and 2019, respectively, and have reduced the financial burden of cancer patients. [61, 62]. Thirdly, while the National Health Insurance is aiming at providing financial protection for essential care, the Critical Illness Medical Insurance (CIMI) should play an increasing role in providing financial support on catastrophic expenses, including cancer patients. In particular, the current CIMI in most regions followed the NIRL which prioritize the essential care [63]. To provide better protection on catastrophic expenses, CIMI should explore additional coverage on other therapies with proven health benefits. Furthermore, enhancing the capacity of the National Public Health Initiative can enhance cancer prevention strategies such as routine screening and case management. This might lead to early detection of cancer, reduced financial burden and improved cancer outcomes if diagnosed at early stages when cancer treatments are most effective. This approach might be especially critical given healthcare disruptions due to the COVID-19 pandemic.

Given unprecedented effects of the COVID-19 on global healthcare systems, it would be inevitable that the pandemic would substantially negatively influence the cancer patients, health practitioners, and healthcare systems [64, 65]. Due to the COVID-19 outbreak, several healthcare services have to be postponed and even cancelled in many countries, leaving patients without access to essential health services [66]. Globally, 42% countries have partially or completely disrupted services for cancer treatment/therapy [67]. During the COVID-19 period, the waiting time for surgery and days in hospital was longer, and total expenditures for inpatient care increased in China [68]. To cancer patients, this means delayed diagnosis or treatment and further lead to disease progression. In many countries, tele-consultations became an emerging form to provide essential healthcare while limit the spread of COVID-19 [69]. However, the capacity for providing telemedicine varied greatly, and there is limited coverage on telemedicine by China's social health insurances, which may potentially make further disparities in health service use. In the post COVID-19 era, how to balance the health system emergency reaction with essential healthcare, how to best utilize new technology to improve access and equity will be emerging health policy issues.

Strengths and Limitations

This research utilized data from a China nationally representative study to investigate the trends and disparity in cancer treatments, healthcare service utilization and CHE from 2011 to 2015. Our study could contribute to a deeper understanding of socio-economic and rural-urban disparities in cancer treatment, health service utilization and expenditures. There are several significant limitations. This study used the measurements based on self-reported information of diagnosed cancer, treatment type and healthcare service use, which may lead to underestimate the prevalence of cancer and an under-reported utilization due to the recall bias [57]. Medical information regarding the severity of cancers had not been collected. The CHARLS survey only considered those middle-aged and elderly Chinese residents. Future research should also focus on the younger adults to explore the trends and disparities in cancer care and financial burden. Moreover, about 20% of total participants in CHARLS are with missing values of key dependent and independent variables during the survey conducted in 2011 and 2015.

Conclusions

The burden of cancer among Chinese adults is increasing. Socio-economic and urban-rural disparities in cancer treatment and health service use were largely determined by patient financial capability in China. The current social health insurance schemes are insufficient to address these disparities. A comprehensive health insurance policy of further expanding benefit packages and strengthening the Public Medical Assistance System, is essential for Chinese people with cancers.

Abbreviations

NCDs: Non-communicable diseases; CHE: catastrophic health expenditure; UEBMI: Urban Employees Basic Medical Insurance; URBMI: Urban Residents Basic Medical Insurance; NCMS: New Rural Cooperative Medical System; SES: Socio-economic status; CHARLS: China Health and Retirement

Longitudinal Study; PPS: probability-proportionate-to-size; TCM: Chinese traditional medication; OOP: out-of-pocket payments; OR: odds ratio; NIRL: National Insurance Reimbursable List; COVID-19: Coronavirus Disease 2019.

Declarations

Ethics approval and consent to participate

The Biomedical Ethics Review Committee of Peking University approved the CHARLS study, and all interviewees were required to provide informed consent. The ethical approval number was IRB00001052–11015.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are available in the China Health and Retirement Longitudinal Study repository. <http://charls.pku.edu.cn/pages/data/111/en.html>.

Competing interests

The authors declared that they have no competing interests.

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Authors' contributions

YZ and ST conceived and designed the study. YZ carried out the initial analysis. YZ, ST and TA interpreted the data. WM and YZ analysed the literature. YZ and WM wrote the first draft of the paper. TA, ST and WM provided advice on the first draft and revised the article critically for important intellectual content. All authors reviewed and had final approval of the submitted and published versions.

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