The global, regional, and national burden and quality of care index (QCI) of kidney cancer; a Global Burden of Disease systematic analysis 1990–2019

Mohamad Mehdi Khadembashiri  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Erfan Ghasemi  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Mohamad Amin Khadembashiri  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Sina Azadnajafabad  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Sahar Saeedi Moghaddam  
Kiel Institute for the World Economy

Mohamad Eslami  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Mohammad-Mahdi Rashidi  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Mohammadreza Naderian  
Tehran Heart Center, Cardiovascular Diseases Research Institute, Tehran University of Medical Sciences, Tehran, Iran

Zahra Esfahani  
Department of Biostatistics, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Naser Ahmadi  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Nazila Rezaei  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Sahar Mohammadi Fateh  
Non-Communicable Diseases Research Center, Endocrinology and Metabolism Population Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Farzad Kompani  
Division of Hematology and Oncology, Children's Medical Center, Pediatrics Center of Excellence, Tehran University of Medical Sciences, Tehran, Iran

Bagher Larijani
Research Article

Keywords: Kidney cancer, Epidemiology, Quality of Health Care, Mortality, Disability-adjusted Life Years, Global burden of disease

Posted Date: February 3rd, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2538913/v1

License: ☛ ☞ This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

Background

Kidney cancer is a prevalent cancer worldwide. The incidence and mortality rates of Kidney Cancer (KC) have risen in recent decades. The quality of care provided to KC patients is a concern for public health. Considering the importance of KC, in this study, we aim to assess the burden of the disease, gender and age disparities globally, regionally and nationally to evaluate the quality and inequities of KC care.

Methods

The 2019 Global Burden of Disease study provides data on the burden of the KC. The secondary indices, including mortality-to-incidence ratio, disability-adjusted life years (DALYs)-to-prevalence ratio, prevalence-to-incidence ratio, and years of life lost (YLLs)-to-years lived with disability (YLDs) ratio, were utilized. These four newly merged indices were converted to the quality-of-care index (QCI) as a summary measure using principal component analysis (PCA). QCI ranged between 0 and 100, and higher amounts of QCI indicate higher quality of care. gender disparity ratio (GDR) was calculated by dividing QCI for females by males to show gender inequity.

Results

The global age-standardized incidence and mortality rates of KC increased by 29.1% (95% uncertainty interval 18.7 to 40.7) and 11.6% (4.6 to 20.0) between 1990 and 2019, respectively. Globally, the QCI score for KC increased by 14.6% during 30 years, from 71.3 to 81.6. From 1990 to 2019, the QCI score has increased in all Socio-demographic Index (SDI) quintiles. By 2019, the highest QCI score was in regions with a high SDI (93.0), and the lowest was in low SDI quintiles (38.2). Based on the World Health Organization regions, the QCI score was highest in the Region of the Americas, with Canada having the highest score (99.6) and the lowest in the African Region, where the Central African Republic scored the lowest (17.2). In 1990, the GDR was 0.98, and in 2019, it was 0.97 showing an almost similar QCI score for females and males.

Conclusion

Although the quality of care for kidney cancer has improved from 1990 to 2019, there is a significant gap between nations and different socioeconomic levels. This study provides clinicians and health authorities with a global perspective on the quality of care for KC and identifies the existing disparities.

Introduction

In 2020 Kidney cancer (KC) is the fourteenth most prevalent cancer worldwide. There are various forms of KC, with renal cell carcinoma being the most prevalent. Renal cell carcinoma is divided into subtypes based on histology, such as papillary, clear cell, and chromophobe, in which prognosis and biological behavior vary. (1) Additionally, there are less common types, urothelial carcinoma, sarcoma, lymphoma, and Wilms tumor. Wilms tumor is a common form of pediatric kidney cancer. (2) In 2020 KC global incidence was 431,288 (2.2% of all new cancer cases) and accounted for 179,368 deaths (1.8% of all deaths caused by cancers), also 271,249 of all KC cases were males, and 160,039 were females which makes kidney cancer the ninth most common cancer among males and fourteenth among females. (3) males had nearly two times the age-standardized incidence and mortality rates of KC. (4) According to statistical analyses, the incidence rate and mortality rate of KC patients are projected to rise by 2030. (5, 6) Due to the rise in the incidence and mortality rate for KC, it should be taken into consideration. (7)
The World Health Organization (8) defines the quality of care as “the extent of which healthcare services are provided to individuals and populations to improve desired health outcomes.” (9) In general, the quality of healthcare is improving over time, however, it has not uniformly improved. (10–14) Possible inequities based on age, gender, race, and socioeconomic disparities in the incidence and mortality of KC may be due to a variety of risk factors, such as smoking, obesity, and past medical histories like hypertension. Access to diagnostic and treatment facilities can also contribute to the variation in quality of care for KC between countries. (3, 7, 15, 16) Consequently, it is crucial to be aware of the disparities, as this provides pertinent information about KC to policymakers in countries with a lower level of care quality.

Some indicators, such as the concentration index and horizontal inequity, have been developed to analyze inequities in health systems (17, 18); however, no all-inclusive and objective index exists to compare the quality of care and inequities. We introduce the previously developed Quality of Care Index (QCI), for KC in this study, which evaluates the distinct components of quality of care across age groups, genders, and world regions. This study aimed to assess the burden and quality of care of KC across countries and regions for both sexes from 1990 to 2019 using the Global Burden of Disease (19) 2019 data using the QCI.

**Methods**

**Data Collection**

Data were collected from GBD 2019, which contains data on 369 diseases and 87 risk factors for 204 nations and territories from the Institute for Health Metrics and Evaluation (19). IHME coordinates the GBD study, which provides mortality, incidence, prevalence, years of life lost (YLLs), years lived with disability (YLDs), and DALYs. In this study, the 10th revision of the International Classification of Diseases (ICD-10) codes of “C64-C64.2, C64.9-C65.9, Z80.51, Z85.52-Z85.54” and “C64-C65.9, D30.0-D30.1, D41.0-D41.1” were utilized to identify malignant neoplasms of the Kidney in the claim and cause of death data, respectively. Data included all epidemiological measures and metrics for KC (GBD code: B.1.20). (20, 21)

**QCI**

Epidemiological parameters including incidence, prevalence, mortality, DALYs, YLLs, and YLDs are used to quantify the epidemiologic status of certain diseases. The secondary indices included the following: mortality-to-incidence ratio, DALYs-to-prevalence ratio, prevalence-to-incidence ratio, and YLLs-to-YLDs ratio, which all are proxies of quality of care as following. Considering a steady incidence of KC, the mortality-to-incidence ratio indicates that a higher mortality rate suggests worse conditions. The prevalence-to-incidence ratio indicates that, for a given incidence rate, a higher prevalence indicates better management that prevents death. The DALYs-to-prevalence ratio suggests that a higher DALYs indicates a lower quality of treatment for regions with the same prevalence. Lastly, the YLLs-to-YLDs ratio demonstrates the impact of the health system in delaying fatalities, with higher values indicating poorer health conditions. These four newly merged indices were converted to the QCI as a summary measure using principal component analysis (PCA). (22) It ultimately combines all four indices into a single index representing most of the combined data points. Calculations for the four secondary indices were as follows: (23)

\[
\text{Mortality to incidence ratio} = \frac{\# \text{Age} - \text{standardized Mortality}}{\# \text{Age} - \text{standardized Incidence}}
\]

\[
\text{DALYs to prevalence ratio} = \frac{\# \text{Age} - \text{standardized DALYs}}{\# \text{Age} - \text{standardized Prevalence}}
\]

\[
\text{Prevalence to incidence ratio} = \frac{\# \text{Age} - \text{standardized Prevalence}}{\# \text{Age} - \text{standardized Incidence}}
\]
QCI calculated as follow:

\[
QCI(x) = \frac{[\text{PCA}_{\text{score}}(x) - \text{minPCA}_{\text{score}}]}{[\text{maxPCA}_{\text{score}}(x) - \text{minPCA}_{\text{score}}]}
\]

X represents a data point. Higher amount of QCI indicate higher quality of care.

Formerly, we evaluated the quality of care for thyroid, brain and central nervous system, liver, pancreas, lip and oral cavity, breast, gallbladder and biliary tract, hematologic malignancies, bladder and colorectal cancers, in addition to cardiovascular diseases using the present index and the results were promising for the mentioned causes of diseases. (24–38)

**QCI Validation**

We validated the QCI for KC by two previously introduced and validated indices by IHME and GBD data named healthcare access and quality index (HAQI) and universal health coverage (UHC). (39, 40) The Healthcare Access and Quality (HAQ) Index is calculated on a scale ranging from 0 to 100 based on death rates from 32 causes of death that might be prevented with timely and adequate medical care. Using countries as random effects, a mixed effect regression model with QCI as the dependent variable and inpatient health care utilization, outpatient health care utilization, mortality, prevalence, and attributed death rates to all KC risk factors as independent variables was implemented. Pearson's correlation coefficient of the fitted dependent variable and the HAQ Index was about 0.77.

We also analyzed the correlation between QCI and the Universal Health Coverage (UHC) Effective Coverage Index, which measures the extent to which high-quality healthcare services are made available to all those in need without financial barriers. We employed a mixed-effect regression model using QCI as the dependent variable and inpatient and outpatient healthcare utilization, mortality, prevalence and attributed death rates to all KC risk factors as independent factors. Countries were taken into account as random effects. Using this model, we estimated a Pearson's correlation coefficient of around 0.75.

**Gender Disparity Ratio (GDR)**

The GDR was calculated by dividing the QCI scores of females by those of males. The values closer to one indicate less inequity between men and women. Values greater than one indicated the higher quality of care for females, while values less than one indicated the higher quality of care for males.

\[
GDR = \frac{QCI_{\text{for females}}}{QCI_{\text{for males}}}
\]

**Age Disparity**

This study utilized age groupings with 5-year intervals (i.e., under 5, 5–9, 10–14, ..., 85–89, 90–94, 95 plus). Age-standardized rates were calculated using the GBD world population standard. (19)

**Geographic and Socioeconomic Classifications**

We used WHO regions, which are grouped into six areas: African Region (AFR), Region of the Americas (AMR), South-East Asian Region (SEAR), European Region (EUR), Eastern Mediterranean Region (EMR), and Western Pacific Region (WPR). Comprehensive information on the countries within each region is available on WHO website. (8) Socio-demographic Index (SDI) is an index based on per capita income, average educational attainment, and total fertility rate in females under 25. This study used SDI quintiles to organize the world's areas into five distinct groups: High SDI, High-middle SDI, Middle SDI,
Low-middle SDI, and Low SDI quintile regions. (41) Additionally, we evaluated KC QCI according to World Bank Income level (WBIL). The World Bank divides the world’s economies into four income groups based on the preceding year’s gross national income (42) per capita in current US dollars: low, lower-middle, upper-middle, and high-income countries. (43)

**Statistical Analysis**

The R version 3.6.0 and R studio statistical software for Windows (http://www.r-project.org/, RRID: SCR 001905, Vienna, Austria) was utilized to run analyses and generate tables and figures. Reporting the primary indices in this manuscript, the 95% UI (12) was calculated by obtaining 1000 samples from the posterior distribution and noting the 25th and 975th values. The present study’s analysis and procedures were conducted in accordance with the publicly available QCI protocol. (23) The age-standardization technique was employed to make the results of the primary measures comparable across locations and the provided rates in this study refer to age-standardized rates of the epidemiologic measures.

**Results**

**The burden of kidney cancer**

The global age-standardized incidence rate of KC in 1990 and 2019 was 3.5 (95% UI: 3.4 to 3.6) and 4.6 (4.2 to 4.9) per 100,000, respectively. It shows a 29.1% (18.7 to 40.7) increase between 1990 and 2019. The age-standardized death rate increased by 11.6% (4.6 to 20.0) between 1990 and 2019 from 1.9 (1.8 to 1.9) to 2.1 (1.9 to 2.2) per 100,000. Also, the age-standardized DALYs rate per 100,000 was 47.3 (45.2 to 49.4) in 1990 and 49.6 (46.5 to 52.9) in 2019 (Table 1).
Table 1
Incidence, prevalence, DALY and death rate of kidney cancer in 1990 and 2019. DALYs: disability-adjusted life year, SDI: Socio-demographic Index

<table>
<thead>
<tr>
<th>Location</th>
<th>1990</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incidence</td>
<td>Prevalence</td>
</tr>
<tr>
<td>Global</td>
<td>3.5</td>
<td>15.4</td>
</tr>
<tr>
<td>WHO Regions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African region</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>Region of Americas</td>
<td>7.3</td>
<td>38</td>
</tr>
<tr>
<td>South-east Asian Region</td>
<td>0.8</td>
<td>2.6</td>
</tr>
<tr>
<td>European region</td>
<td>6.4</td>
<td>28.7</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>1.1</td>
<td>4.3</td>
</tr>
<tr>
<td>Western Pacific Region</td>
<td>1.7</td>
<td>6.8</td>
</tr>
<tr>
<td>World Bank Income Levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Income</td>
<td>7.1</td>
<td>35.9</td>
</tr>
<tr>
<td>Upper Middle Income</td>
<td>2.4</td>
<td>9.5</td>
</tr>
<tr>
<td>Lower Middle Income</td>
<td>1.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Low Income</td>
<td>1.1</td>
<td>3.1</td>
</tr>
<tr>
<td>SDI Quintiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High SDI</td>
<td>7.3</td>
<td>37</td>
</tr>
<tr>
<td>High-middle SDI</td>
<td>4.3</td>
<td>18.4</td>
</tr>
<tr>
<td>Middle SDI</td>
<td>1.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Low-middle SDI</td>
<td>0.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Low SDI</td>
<td>0.8</td>
<td>2</td>
</tr>
</tbody>
</table>

The age-standardized incidence and death rates per 100,000 were highest in high SDI quintiles in 1990 and 2019, and the lower the SDI quintiles, the lower the age-standardized incidence and death rate. Age-standardized DALYs rate have increased in all SDI quintiles from 1990 to 2019 except in High SDI quintiles, which decreased by 4.2% (-8.2 to -0.3). Also, similar results were derived from WBIL compared to SDI quintiles for age-standardized DALYs, incidence, and death rates in 1990 and 2019. For instance, DALYs decreased by 0.6% (-4.5 to 3.4) in 2019 compared to 1990 only in High-income WBILs, whereas DALYs increased in other WBILs. (Table 1 and Supplementary Table 1)

Qci

Globally, the age-standardized QCI score for KC increased by 14.6% between 1990 and 2019, from 71.3 to 81.6 (ΔQCI = 10.3). In addition, the age-standardized QCI score for females was 75.8, and for males, it was 78.1 in 2019, compared to...
66.2 and 67.6 for females and males, respectively, in 1990, indicating that males had a slightly higher QCI score in both 1990 and 2019. (Fig. 1 and Table 2)

Table 2
Age-standardized QCI for kidney cancer in 1990 and 2019 by gender with GDR. QCI = Quality of Care Index; GDR = Gender Disparity Ratio; WHO = World Health Organization; SDI = Socio-demographic Index

<table>
<thead>
<tr>
<th>Location</th>
<th>QCI</th>
<th>GDR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1990</td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>Female</td>
</tr>
<tr>
<td>Global</td>
<td>71.3</td>
<td>66.2</td>
</tr>
<tr>
<td>WHO Regions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African region</td>
<td>28.5</td>
<td>27.1</td>
</tr>
<tr>
<td>Region of Americas</td>
<td>55.6</td>
<td>67.7</td>
</tr>
<tr>
<td>South-east Asian Region</td>
<td>73.3</td>
<td>71.2</td>
</tr>
<tr>
<td>European region</td>
<td>84.3</td>
<td>75.0</td>
</tr>
<tr>
<td>Eastern Mediterranean Region</td>
<td>44.2</td>
<td>42.0</td>
</tr>
<tr>
<td>Western Pacific Region</td>
<td>63.6</td>
<td>56.8</td>
</tr>
<tr>
<td>World bank Income Levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Income</td>
<td>82.6</td>
<td>76.8</td>
</tr>
<tr>
<td>Upper Middle Income</td>
<td>61.0</td>
<td>59.0</td>
</tr>
<tr>
<td>Lower Middle Income</td>
<td>51.1</td>
<td>52.3</td>
</tr>
<tr>
<td>Low Income</td>
<td>34.5</td>
<td>31.8</td>
</tr>
<tr>
<td>SDI Quintiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High SDI</td>
<td>83.5</td>
<td>77.6</td>
</tr>
<tr>
<td>High-middle SDI</td>
<td>68.9</td>
<td>66.3</td>
</tr>
<tr>
<td>Middle SDI</td>
<td>54.9</td>
<td>52.6</td>
</tr>
<tr>
<td>Low-middle SDI</td>
<td>38.5</td>
<td>36.9</td>
</tr>
<tr>
<td>Low SDI</td>
<td>21.2</td>
<td>18.0</td>
</tr>
</tbody>
</table>

From 1990 to 2019, the age-standardized QCI score has increased in all SDI quintiles. By 2019, the highest value was in regions with a high SDI (93.0), and the lowest was in low SDI quintiles (38.2). Despite a wide gap in age-standardized QCI score between high and low SDI quintiles, the increase in QCI score was higher in lower SDI quintiles by 2019 compared to 1990. For instance, the growth of age-standardized QCI score in low and low-middle SDI was 79.7% from 21.2 to 38.2 and 50.2% from 38.5 to 57.9, while it was 11.4% in high SDI quintiles, which QCI score changed from 83.5 to 93.0. (Fig. 2)

The age-standardized QCI score was consistently highest in the Region of the Americas and lowest in the African Region, given the WHO regions. In the American region, the age-standardized QCI score was 84.3 in 1990 and 89.5 in 2019, whereas in the African region, it was 28.5 in 1990 and 44.0 in 2019. The difference in QCI between the highest and lowest WHO regions decreased from 55.8 in 1990 to 45.5 in 2019.

At national levels, Canada (QCI = 99.6), the United States (99.5), and Italy (99.0) owned the highest age-standardized QCI scores, and Central African Republic (17.2), Somalia (19.7), and South Sudan (24.9) owned the lowest score in 2019.
Equatorial Guinea (304.6%) and Eritrea (244.4%) had the highest increase in QCI between 1990 and 2019. Only the Democratic People's Republic of Korea experienced a fall in its QCI score (3.2%). (Supplementary Table 2)

**Inequity patterns:**

### Age Disparity

In 2019, assessing the global QCI scores for KC in various age groups, we found disparities on a global scale between various age groups, with the highest score in the age group of 20–29 years (QCI = 90.4) and the lowest over 80 years. Within different SDI quintiles, countries with low and low-middle SDI primarily ranked below the global average for all age groups. Contrarily, the QCI scores for KC across all ages in countries with a high SDI were higher than the global average. QCI scores in the middle and high-middle SDI were higher than the global average score under 30–35 and 55–59 years, respectively. While QCI scores were lowest in the 85–89 age group, they began to rise in all SDI quintiles except for High SDI. This pattern was almost similar in WBIL Except for ages below nine and above 74 years, where the score begins to decline modestly, the global QCI score for various age patterns nearly remains constant for all ages. Although this reduction occurs at younger ages in middle and low SDI quintiles, this pattern is consistent across all SDI quintiles. Additionally, barring high SDI quintiles, the score increases once more at ages over 94. The QCI score for various WBIL exhibits a remarkably similar trend. Only the QCI score for high-income countries is higher than the global QCI score at ages higher than 44. (Fig. 2)

### Gdr

In 1990, the global age-standardized GDR was 0.98, and in 2019, it was 0.97, indicating a slight decline. It showed that males received slightly better care for KC in both years. Globally, the GDR scores across various age groups ranges from 0.87 for more than 95 years to 1.26 in under 5 years in 2019, also the ratio was mainly between 0.92 (more than 95 years) to 1.29 (under 5 years) in 1990. In 2019, GDR was more than 1 in all SDI quintiles except High SDI (0.96). Considering the various ages group and SDI quintiles, GDR got the maximum value in the age group of 85–89 years in all SDI quintiles as the highest GDR was reported in the Low SDI (2.50). (Fig. 2)

### Discussion

The main findings of this study highlighted many of the epidemiologic features of KC in different scales. The age-standardized incidence, death, and DALYs rates of KC have increased from 1990 to 2019. Also, the age-standardized incidence and mortality rates were highest among high SDI quintiles and lowest among low SDI quintiles in 1990 and 2019. DALYs increased in all SDI quintiles except high SDI quintiles, which slightly decreased. Global age-standardized QCI score rose from 1990 to 2019, and in all SDI quintiles, it also increased; additionally, the growth of the age-standardized QCI score was higher in lower SDI quintiles. In accordance with WHO regions, the age-standardized QCI score was highest in the region of Americas and lowest in African regions in 1990 and 2019. WHO regions’ QCI gap decreased by 2019 compared to 1990, similar to SDI quintiles. Nationally, Canada had the highest QCI score, followed by the United States and Italy, while the Central African Republic was the worst. The evaluation of the global trend of gender inequity reveals that men received slightly better care. In regions with a low SDI, the ratio of quality of care disparities between men and women surprisingly favored women.

Globally, increasing incidence, death, and DALYs rates for KC indicate the importance of this disease. This increase in incidence may be attributable to global aging (44), an increase in global life expectancy (45, 46), and better, more accurate diagnostic methods. (47, 48) Smoking, hypertension, and low physical activities are possible risk factors for KC. (49, 50) As an example, globally, hypertension prevalence is on the rise. Yet, hypertension awareness, treatment, and blood pressure management remain low (51), which could be associated with increased age-standardized incidence and death rates of KC. As demonstrated in the results, KC incidence and mortality rates were higher in nations with a high SDI in 2019. This finding
may result from a more efficient KC diagnosis due to novel diagnostic methods recently implemented in high-income countries, such as AI-based methods (47), screening, an increase in the number of healthcare facilities, and their improved accessibility.

Despite the increased prevalence of KC in regions with a high SDI, the age-standardized QCI score is higher in these countries. In Canada (a high SDI country), which has the highest age-standardized QCI score (99.6), the Canadian KC information system (CKCis) provides demographical, pathological, clinical, and epidemiological information on KC (52, 53), thereby empowering policymakers and healthcare providers to prepare higher-quality care for KC patients. There is also a genetic screening guideline for hereditary renal cell cancers in Canada, which leads to earlier detection of tumors and better outcomes due to earlier diagnosis. (47, 54) Also KC Canada is a nationwide network of patients, caregivers, and health professionals working to provide support, information, and advocacy for care pathways and treatment options to patients affected by KC. (55)

On the other hand, possible factors for the lower quality of care in African regions include a lack of social awareness, inadequate health care supply, a lack of resources, and the absence of preventative actions. (56) Patients from African regions may have a shorter clinical course due to a considerable gap between their cultural and societal attitudes and those of their physicians, which could be bridged via education. Additionally, poverty drives the majority of patients to abandon their treatment plans. Inaccurate identification of the cause of death in African regions results in bias in death registration. (57) Due to a lack of access to treatment, a large number of patients with KC likely die without ever receiving a formal diagnosis. Thus, the construction of cancer registries and surveillance systems could equip policymakers with a more accurate understanding of the situation and the ability to allocate resources to reduce the burden of KC. (58, 59)

In this study, the quality of treatment provided to men was marginally superior, according to an interpretation of the global gender disparity pattern. In contrast to similar research on thyroid, liver, and pancreatic cancers, the QCI for KC favors women in low SDI quintiles and men in high SDI quintiles. Men have twice the risk of developing KC compared to women. (60) A better outcome for KC in women could be one of the causes of a higher QCI in low SDI countries. (61) Cultural concerns can influence referring to medical centers, receiving medical care, and continuing therapy, all of which contribute to gender inequity.

KC incidence rates climb progressively with age, reaching a peak at approximately 75 years of age. (49) Global QCI score for KC decreases with age generally. But as we can see in Fig. 2, two age extremities (under 5 and over 85) have the lowest global QCI score. The various histopathological characteristics of KCs may be a contributing factor. For example, the age trend for Wilms tumor is childhood. Wilms tumor is most prevalent in children aged 0 to 4 years (62), and RCC, the most common type of KC (63), is more prevalent in the elderly. (49) Young age is an independent prognostic factor for KC; hence, the prognosis and QCI score of KC decrease with age. (64)

This study first quantifies the quality of care for KC and gives numerous epidemiological metrics and burdens at the global, regional, and national levels, stratified by age and gender. QCI is a valid statistic that could be used as a single proxy measure to help policymakers by offering a clearer picture of inequities in medical care for KC among countries and regions. This is the first study evaluating the quality of care and possible inequities in access to healthcare services between various age and sex categories of patients with KC in different world areas using the GBD study 2019 results. The GBD study is one of the most thorough and up-to-date surveys of disease burden, although this research has some limitations, the majority of limitations were related to GBD techniques for data collection and reporting, therefore we could not modify them. First, the GBD does not classify the population by ethnicity, so racial inequity cannot be compared. Second, KC has various types, such as transitional-cell carcinoma, Wilms tumor, and renal cell carcinomas but, GBD didn't classify them and it represents all these different cancer types as KC. Each type of KC has a different age trend and prognosis that is better to be studied separately for more precise assessments. Third, in some low- and middle-income countries, data scarcity necessitates out-of-sample data validation techniques using the artificial intelligence which may
lead to less reliable results. Even when available, data might not have been obtained employing preferred measurements or case definitions.

**Conclusion**

In this study, QCI was investigated for KC as a practical method for assessing and comparing the quality of cancer care on varying scales. Although the quality of care for the disease has improved from 1990 to 2019, there is a significant gap between nations and territories. Given the disparities, promoting equality and narrowing the gap is essential. Considering the epidemiologic characteristics and disparities of KC care, there is a need for more efficient public healthcare planning.

**Declarations**

- **Ethical Approval and Consent to participate**

No individual data were used in this paper and the information is based on aggregated pre-existing online secondary data.

Data reported in this study was aggregated epidemiologic data and no individual data was reported.

- **Consent for publication**

Not applicable.

- **Availability of supporting data**

The dataset used as an input in this paper is available in the GBD repository, [http://ghdx.healthdata.org/gbd-results-tool](http://ghdx.healthdata.org/gbd-results-tool).

- **Competing interests**

The authors have no conflict of interest to disclose.

- **Funding**

This study had no funding support and received no grants.

- **Authors' contributions**


- **Acknowledgements**

The authors would like to acknowledge the Institute for Health Metrics and Evaluation for providing the GBD data. Also, we appreciate staff members of the Non-Communicable Diseases Research Center (NCDRC) and Endocrinology and Metabolism Research Institute (EMRI) at Tehran University of Medical Sciences for their kind technical supports.

**References**


8. "Regional Offices." Regional Offices N, www.who.int/about/who-we-are/regional-offices.


Figures

Kidney cancer

1990

2019

Age-standardized QCI (%)
- < 38.7
- [38.7 to 54.8]
- [54.8 to 67.3]
- [67.3 to 78.6]
- ≥ 78.6

Figure 1

The age-standardized quality of care index (QCI) pattern for kidney cancer by countries in 1990 and 2019 for both sexes.
Figure 2

(A). Age pattern of QCI for Kidney cancer among various SDI quintiles in 2019  
(B). Age pattern of QCI for Kidney cancer among various World Bank Income levels in 2019

Figure 3

The age-standardized GDR pattern for kidney cancer by countries in 1990 and 2019
Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTable1.docx
- SupplementaryTable2.docx