


Influence of Age on 2040 Cancer Burden in the Older Population of the Gulf Cooperation Council (GCC) Countries: Public Health Implications

Sohaila Cheema, MBBS, MPH¹ , Patrick Maisonneuve, Dipl.Eng², Albert B. Lowenfels, MD³, Amit Abraham, MD, MPH¹, Sathyanarayanan Doraiswamy, MBBS, MD, DHealth¹, and Ravinder Mamtani, MD¹

Abstract

Introduction and Study Aims: The underlying population of global regions varies widely and is a major determinant of regional cancer differences. The aims were to: (1) estimate the cancer burden in Gulf Cooperation Council (GCC) countries in 2040 for the ≥ 70 population and (2) assess the public health implications for this cancer increase.

Methods: We used Global Cancer Observatory (GLOBOCAN) estimates of cancer incidence and mortality for people aged 70 years or more in GCC countries from 2018 to 2040 from the International Agency for Research on Cancer. For population growth, we used data for the same period from the Population Division of the United Nations Department of Economic and Social Affairs. From these, we calculated the predicted increase in the number of cancer cases and cancer deaths from 2018 to 2040 and the proportion of cases/deaths represented by those aged 70+ for the 2 time periods.

Findings: In the GCC countries, the predicted number of newly diagnosed cancers and cancer deaths in the older population will increase by 465% and 462% respectively due to demographic changes—greater than other countries in the World Health Organization Eastern Mediterranean Region, or in countries of similar economic development. The largest predicted increases will be for Qatar and the United Arab Emirates. Based on the predicted population age, cancer burden among older people in the GCC countries will increase by approximately 460%.

Conclusion: By the year 2040, the relationship between cancer and age will cause a 4- to 5-fold increase in the cancer burden in the GCC. These predictable changes will require additional planning and resources to provide appropriate healthcare.

Keywords

Gulf Cooperation Council, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, cancer, trends, demography

Received December 02, 2020. Received revised March 31, 2021. Accepted for publication May 30, 2021.

¹ Institute for Population Health, Weill Cornell Medicine-Qatar, Doha, Qatar

² Division of Epidemiology and Biostatistics, IEO European Institute of Oncology IRCCS, Milan, Lombardia, Italy

³ Department of Surgery and Department of Family Medicine, New York Medical College, Valhalla, NY, USA

Corresponding Author:

Sohaila Cheema, Institute for Population Health, Weill Cornell Medicine-Qatar, Education City, Qatar Foundation, P.O. Box: 24144, Doha, Qatar.

Email: soc2005@qatar-med.cornell.edu



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

Introduction

The Gulf Cooperation Council (GCC) countries comprise 57.4 million persons residing in Bahrain, Oman, Kuwait, Saudi Arabia, Qatar, and United Arab Emirates, of whom 49% are expatriates.^{1,2} Compared to other regions, GCC countries are wealthy, but their populations are young, with a median age around 30 years. However, because of their abundant energy resources, the GCC per capita income is higher than other regions with young populations. Nowadays, the average life expectancy in GCC countries surpasses 77 years and about half of the population is currently under age 30.^{3,4} GCC countries are currently in a state of demographic transition, facing a future where a much larger fraction of the population will be older, with an increased risk of all chronic diseases, including cancer.

In addition, the GCC has one of the world's highest rates of obesity, a strong risk factor for cancer at all ages.⁵ Smoking, another strong risk factor for cancer, is moderately prevalent in the GCC: according to the WHO global report on trends in prevalence of tobacco smoking 2000-2025, the 2016 age-standardized prevalence of tobacco smoking ranges from 15.6% (Oman) to 37.6% (Bahrain) in males and from 0.5% (Oman) to 5.8% (Bahrain) in females.⁶ The combination of increasing age and the likely persistence of lifestyle factors linked to cancer will lead to a rise in cancer incidence over the next 2 decades, strongly affecting the entire healthcare system in the GCC.⁷

Older people are less likely to consult their healthcare provider, as they are likely to attribute their symptoms to aging. This results in delayed or missed diagnoses.⁸ Further, older persons with cancer are more likely to suffer from mental health consequences as a result of the diagnosis. Depression may negatively affect their cognitive ability, as well as their will to live.⁸ Older people are often frail and need careful evaluation by oncologists to select the safest and most effective therapy. In the Middle East, geriatricians and geriatric oncologists are currently in short supply.⁷ Building a sufficient specialist workforce able to care for the predictable increased burden of cancer in the older population requires advanced planning. Health promotion programs targeting nutrition and physical activity have proven beneficial for older persons with cancer and can help maintain their independence over the long term. However, these are often lacking.⁹ In addition, end of life care is another issue that needs advanced planning at the population level.

Several studies have provided international estimates of future cancer rates for major global regions.^{10,11} The aim of this study is to describe the potential burden of cancer in people aged 70 years or more in 2040 for the 6 GCC countries, and to discuss the public health implications of the cancer increase. These estimates will be useful to healthcare providers and enable policy makers to take appropriate action to face the impending increase in the number of people with newly diagnosed cancer in the region.

Materials and Methods

Cancer Predictions

We retrieved predictions of cancer incidence and mortality for people aged 70 years or more in GCC countries from 2018 to 2040 from the GLOBOCAN database (Cancer Tomorrow) of the International Agency for Research on Cancer.¹² The sources and methods used in compiling the national cancer incidence estimates in GLOBOCAN 2018 have been published together with key results for 36 cancer types in 185 countries.¹³⁻¹⁵ Cancer projections in GLOBOCAN were made assuming constant age-specific cancer rates over time, with the variation in number being solely attributable to changes in the age distribution of the population. Country-specific methods for collecting reference age-specific cancer incidence and cancer mortality rates are similar but vary slightly from country to country. For all 6 GCC countries, cancer incidence rates were obtained from national cancer registries while mortality rates were estimated from national incidence estimates by modeling, using incidence: mortality ratios derived from cancer registry data in neighboring countries.¹²

Population Predictions

We obtained population estimates from prospects of population growth for the same period from the Population Division of the United Nations Department of Economic and Social Affairs.¹⁶

Analysis

For this study, we prepared for each GCC country and for all GCC countries combined, population pyramids for males and females illustrating the distribution of various age groups in the population in 2015 and in 2040. We also prepared summary tables with the estimated number of people with newly diagnosed cancer and number of cancer deaths for the entire GCC and for individual GCC countries during the same period. We also compared projections for cancer incidence in the GCC with anticipated change in selected countries with varying demographics from other regions.

This study is based on previously anonymized data, and therefore does not require institutional review board/ethics approval.

Results

Figure 1 presents demographic change and Table 1 the overall cancer incidence and mortality data among males and females aged 70 years or more for all GCC countries and for individual GCC countries in 2018 and in 2040. Age-gender-pyramids showing the predicted demographic change in each of the GCC countries are provided in Supplemental Figure 1.

For males, the proportion of the population aged 70 or more will increase from 1.3% to 6.6%. As a result the overall number of older people with newly diagnosed cancers in this age-group is estimated to increase by 540% (from 3,401 to 21,765) over

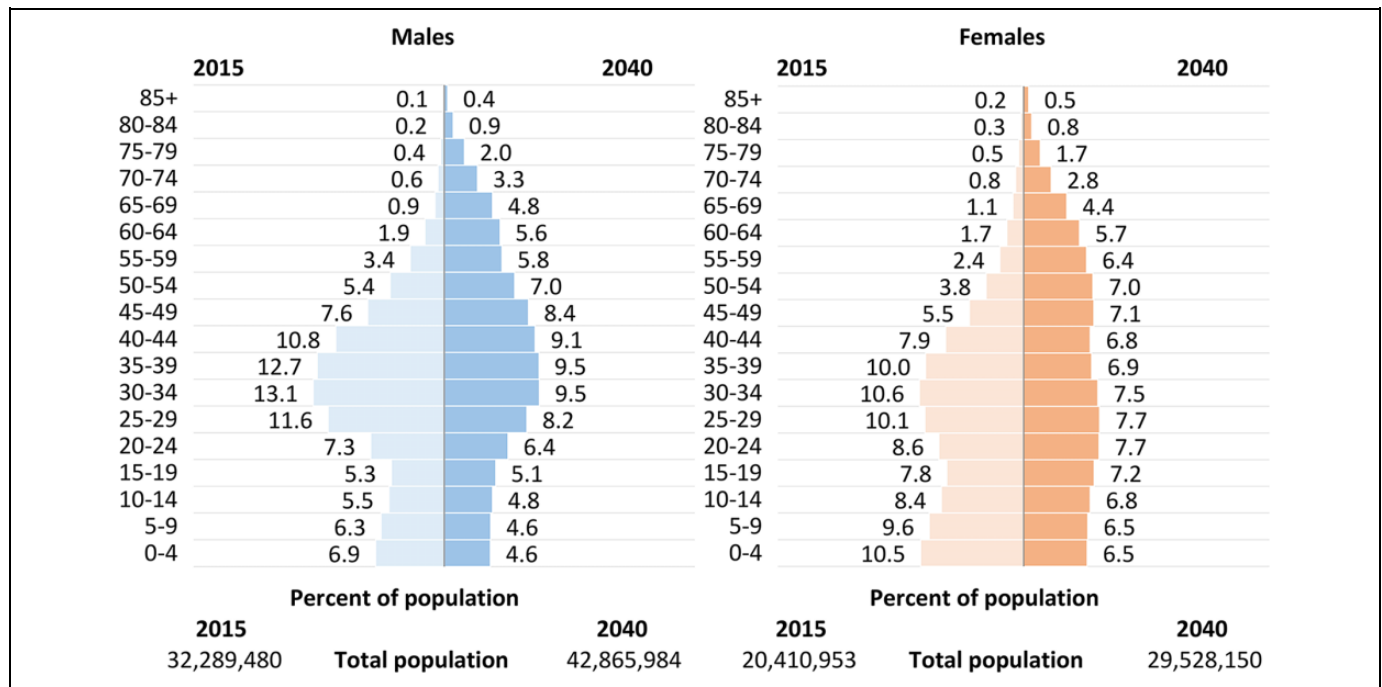


Figure I. Demographic changes in all GCC countries.

Table I. Cancer Projections for Older Males and Females (≥ 70 Years) in all GCC Countries.*

Predicted number of new cancer cases	Males			Females		
	2018	2040	% Change	2018	2040	% Change
All GCC Countries	3,401 (18.0)	21,765 (40.8)	+540%	2,341 (12.2)	10,687 (22.7)	+357%
Bahrain	124 (25.8)	816 (47.4)	+558%	68 (12.0)	356 (26.7)	+424%
Kuwait	331 (21.7)	2,427 (51.2)	+633%	217 (10.7)	1,614 (30.4)	+644%
Oman	229 (11.7)	1,259 (23.0)	+450%	157 (11.9)	482 (16.4)	+207%
Qatar	124 (16.3)	1,629 (51.5)	+1214%	57 (11.6)	403 (25.9)	+607%
Saudi Arabia	2,191 (18.0)	11,398 (38.5)	+420%	1,645 (13.5)	5,843 (22.1)	+255%
United Arab Emirates	402 (20.7)	4,236 (48.7)	+954%	197 (7.6)	1,989 (21.1)	+910%

Predicted number of cancer deaths	Males			Females		
	2018	2040	% Change	2018	2040	% Change
All GCC Countries	2,374 (24.3)	14,929 (47.3)	+529%	1,612 (22.1)	7,453 (33.9)	+362%
Bahrain	99 (31.9)	652 (52.8)	+559%	61 (20.8)	317 (38.4)	+420%
Kuwait	222 (26.4)	1,624 (56.3)	+632%	160 (20.0)	1,178 (42.7)	+636%
Oman	174 (16.1)	946 (27.6)	+444%	130 (22.0)	405 (26.1)	+212%
Qatar	93 (21.5)	1,216 (57.4)	+1208%	52 (22.4)	366 (38.2)	+604%
Saudi Arabia	1,534 (25.2)	7,826 (46.1)	+410%	1,055 (23.9)	3,656 (32.5)	+247%
United Arab Emirates	252 (24.1)	2,665 (53.8)	+958%	154 (16.0)	1,531 (33.1)	+894%

* Numbers in parentheses indicate the proportion of cases/deaths represented by those aged 70+.

this time period. In 2018, only 18.0% of all cancers were diagnosed among older males, but this proportion will increase to 40.8% in 2040. The largest relative increases are expected in Qatar and in the United Arab Emirates (+1214% and +954% respectively) while the relative increase will vary from +420% to +633% for the remaining 4 GCC Countries. A similar pattern is predicted for overall cancer mortality in these countries.

The total number of deaths in older males will increase from 2,374 in 2018 to 14,929 deaths in 2040 (+529%), and the proportion of cancer deaths represented by those aged 70 years or more will double from 24.3% to 47.3% during the same time period. When looking at specific forms of cancer, prostate cancer will remain the most frequent cancer in both time periods (from 607 to 4,115 older men with newly diagnosed cancer,

Predicted number of new cancer cases (%)			
	2018	2040	% change
All GCC countries	5742 (15.1)	32,452 (32.3)	+465%
Viet Nam	32,002 (19.6)	95,674 (33.8)	+199%
China	1,298,236 (30.4)	3,319,800 (50.0)	+156%
Brazil	170,735 (32.4)	429,810 (46.3)	+152%
Egypt	30,494 (23.9)	68,932 (28.9)	+126%
India	243,013 (21.2)	534,604 (28.3)	+120%
USA	687,868 (40.6)	1,283,650 (55.1)	+87%
UK	209,926 (52.3)	333,365 (61.9)	+59%
Italy	193,761 (51.0)	284,405 (62.2)	+47%
Japan	544,178 (62.2)	674,677 (68.4)	+24%

Figure 2. Estimated percent increase in the number of older people with newly diagnosed cancer for GCC and other selected countries with varying demographics: 2040 compared to 2018. * Numbers in parentheses indicate the proportion of cases/deaths represented by those aged 70+.

+578%), followed by colorectal cancer (from 485 to 3,113 older men with newly diagnosed cancer, +542%), and lung cancer (from 366 to 2,341 older men with newly diagnosed cancer (+540%). The largest absolute increase (617% from 84 to 602 older men with newly diagnosed cancer) will be observed for gallbladder cancer (Supplemental Table 1).

For females, the proportion of the population aged 70 or more will increase from 1.8% to 5.8% leading to an increase of 357% (from 2,341 to 10,687 older women with newly diagnosed cancer) in the overall number of people with newly diagnosed cancer. The proportion of cancer diagnosed in older women will increase from 12.2% in 2018 to 22.7% in 2040. The largest relative increases are expected in the United Arab Emirates (+910%), in Kuwait (+644%) and in Qatar (+607%), while the relative increase will vary from +207% to +424% for the remaining 3 GCC countries. Again, a similar pattern is predicted for overall cancer mortality, as the total number of deaths in older females will increase from 1612 in 2018 to 7,453 deaths in 2040 (+362%), and the proportion cancer deaths represented by those aged 70 years or more will increase from 22.1% to 33.9% during the same period. There will be an increase of newly diagnosed breast cancer from 370 to 1,885 women (+409%), an increase of newly diagnosed cancer of the corpus uteri from 414 to 1,607 women (+288%), and an increase of newly diagnosed colorectal cancer from 273 to 1,181 women (+333%). Among females, the largest absolute increase (468% from 91 to 517 women with newly diagnosed cancer) will be observed for pancreatic cancer (Supplemental Table 1).

Figure 2 presents data for anticipated change in the total cancer burden among older people in 2040 compared to 2018 for GCC countries and select countries characterized by demographic diversity. The anticipated 465% overall increase in cancer incidence for the GCC region for both sexes combined, is far greater than that predicted for other developing countries or highly developed countries. The overall cancer burden in older people for both sexes combined is predicted to increase

by 199% in Vietnam, 156% in China, 152% in Brazil, 126% in Egypt, 120% in India, 87% in the United States, 59% in the United Kingdom and 47% in Italy. In contrast, the predicted increase for Japan, a country where demographic change during the next decades will be very marginal, is only 24%.

Individual country-specific results for individual GCC countries are provided in Supplemental Tables 2 and 3.

For comprehensiveness, we compiled similar cancer projections for males and females of all ages in all GCC countries, both singly and combined (Supplemental Figures 2 and 3 and Supplemental Tables 4 and 5). For all GCC countries combined, the predicted number of people with newly diagnosed cancer for all ages will increase by 164% due to demographic change (110%, from 32,304 to 69,937 in people <70 years compared to 465%, from 5,742 to 32,452 in people ≥70 years).

The data demonstrates that among the GCC countries, Saudi Arabia, with a current population of about 32 million inhabitants (60% of the total population of GCC countries), will have the largest effect on the overall absolute age-related increase in cancer burden. In 2018, about two-thirds of incident cancers and cancer deaths within the GCC originated in this country; in 2040, Saudi Arabia will still shoulder more than half of the total cancer burden in the GCC.

Discussion

In this manuscript, our aim was to provide an estimate of the burden of cancer for the approximately 50 million persons currently living in the 6 GCC countries. Although the average median age of the GCC countries is similar to other global regions, several other characteristics of this population including income,¹⁷ obesity rates¹⁸ and frequency of diabetes^{19,20} are higher than most other world regions.^{17,21}

Expatriates comprise almost half of the total population in the GCC, suggesting that about half of the estimated new cancers will develop in the expatriate population.²² Many expatriates are likely to retire and return to their home countries, so

they may not contribute to the older population in GCC, a factor that was not taken into account in our projections. However, currently several GCC countries are offering long-term (UAE)²³ or permanent residency (Qatar)²⁴ for the expatriate population, so a proportion of them are likely to remain settled in these countries. However, it is possible that over the next few decades, some of the expatriate population within the GCC nations may be replaced by locally trained members of the GCC population. If so, then as these local workers become older and remain in the GCC region, it will add to the cancer burden. Since cancer incidence is strongly age-dependent, current cancer rates in the GCC are relatively low, but there will be a substantial increase in cancer incidence over the next 2 decades, as a demographic shift from a younger to an older population occurs. Within the GCC, the number of people with newly diagnosed cancer will more than double, and increase by 465% in the older population, straining the existing capacity of healthcare systems within the region. A similar trend is foreseen for cancer mortality, since mortality data were estimated from national incidence estimates modeled on incidence: mortality ratios from cancer registry data in neighboring countries.

What will be the major cancers among the older population within the GCC in 2040? For males, the 3 commonest tumors are predicted to be prostate cancer, colorectal cancer, and lung cancer. For females, breast, corpus uteri and colorectal cancer will be the predominant tumors. Overall, colorectal, breast, and lung cancer will be 3 of the commonest tumors in the GCC countries, similar to the prediction for countries in other regions. Screening rates for colorectal cancer, and for breast cancer are low in Arab populations.^{25,26} The prevalence of waterpipe smoking in both males and females is increasing which will result in an increase in overall cancer rates.²⁷ More aggressive efforts to combat smoking will be needed to partially offset the anticipated age-related increase in cancer incidence.

In recent years GCC countries have become wealthier, and poor lifestyle behaviors such as unhealthy nutrition habits, inadequate physical activity, and predominantly sedentary behaviors have become increasingly common in the region, with concomitant increase in the rates of obesity and diabetes.²⁸ It has been established that such lifestyle factors are strong predictors of cancer in later life.^{5,29} Consequently, addressing the increasing cancer burden and focusing on preventive measures that modify lifestyle factors is highly relevant for the GCC. The burgeoning population in the GCC countries, increasing life expectancy, and burden of chronic disease have all resulted in and will continue to require a governmental response to substantially increase investment in healthcare services. Several GCC countries have prioritized modernization of medical facilities, development of a specialized healthcare workforce, fostering of preventive care and improvement in therapeutics, as well as collaboration with international partners.³⁰⁻³²

Early cancer detection and prevention strategies can be implemented to ensure better outcomes for GCC populations. For instance, Saudi Arabia established a free national breast

cancer screening program in 2015, although there is a very low rate of participation due to lack of public awareness: in one study, 89% of respondents reported never having a clinical breast examination and 92% reported never having a mammogram.³³ In a separate study of colorectal cancer screening in Saudi Arabia, only 5.64% of those surveyed reported utilization.³⁴ Breast cancer screening is widely available free of charge in the United Arab Emirates, with utilization rates estimated to be approximately 10%.³⁵ Qatar has instituted a free national breast and colorectal cancer surveillance program as well.³⁶ However, overall screening utilization remains low in the GCC countries, likely due to a lack of awareness, social stigma and varying sociocultural beliefs.^{25,26} Measures to strengthen primary care across the GCC to comprehensively engage in evidence-based cancer screening and to encourage the general population to make use of these screening programs are essential.

Furthermore, national cancer strategies, encompassing the twin foci of quality healthcare and research, do not currently exist for all countries in the GCC.³⁷ Policymakers need to ensure allocation of adequate budget, infrastructure, resources and equipment to manage the imminent rise in cancer burden. Qatar, for instance, launched a National Cancer Strategy in 2011, followed by the National Cancer Framework 2017-2022. While the former predominantly focused on building infrastructure, the latter aims to engineer capacity and expertise through stakeholder engagement, enhanced screening programs and services, strengthening the national cancer registry, and improvements in healthcare delivery.³⁸ Qatar has also set in place policies to increase sustainable investment in basic and translational cancer research and developed key indicators and metrics to monitor and evaluate programs according to the country's needs.³⁸ Culturally appropriate prevention strategies to address lifestyle behaviors are being incorporated in schools, workplaces and primary healthcare facilities.³⁸ This is especially important, given the low rates of cancer awareness and perpetuation of misconceptions in the country.²⁵ Bolstering quality improvement, patient safety programs and further investment in healthcare technology would be advisable.

There is a dearth of adequately trained healthcare professionals in the GCC, leaving the countries heavily reliant on healthcare professionals from other parts of the world. Furthermore, few physicians have had experience managing cancers arising in older population. Initiatives to enhance localized professional health education, ensure capacity building across the GCC countries, and leverage the expertise of prestigious institutions outside the region in global partnerships can strengthen healthcare systems and improve population health.³⁹

Certain considerations must be kept in mind for older persons who have been diagnosed with cancer. They are more likely to have comorbid conditions, cognitive deficits, mental health issues and a greater propensity for falls. Furthermore, older persons with cancer are likely to have older caregivers, who may themselves suffer from health problems.⁴⁰ Policies must be put into place to ensure appropriate care is provided to

older people with cancer must also be inclusive of diverse cultural practices and beliefs.

Cancer causes tremendous suffering to individuals and their families, so managing the cancer burden is important not just to reduce suffering in patients and their families, but also to mitigate financial demands on the families as well as the healthcare systems. While treating cancer is challenging, a substantial proportion of the cancer burden can be prevented by adopting the culture of a healthy lifestyle. By addressing poor dietary habits and inadequate levels of physical activity, the countries of the GCC can make significant progress in alleviating the cancer burden.⁹

This study has several weaknesses. One major weakness is that many of the countries are small, limiting the current numbers of people with cancer, implying that extrapolation into the future is likely to be imprecise. Another weakness is that the estimates selected from the GLOBOCAN database ignore potential changes in risk factors, another potential source of imprecision. However, the age-related increase in cancer incidence is likely to be much stronger than the potential benefit from any ameliorations in risk factors.

A final weakness relates to potential changes in mortality. In the past few decades there have been remarkable discoveries that have reduced cancer mortality such as vaccination for hepatitis B and for cervical cancer. And there is the real possibility that future mortality rates will be lower because of new therapeutic discoveries coupled with “personalized medicine.”

This study’s strengths include: (1) a country-specific and a composite overview of cancer burden for the GCC countries and the larger region; (2) detailed information about estimates of overall and organ-specific cancers. These features will help healthcare organizations, health planners, and physicians develop plans to care for the anticipated increased volume of cancer patients.

In conclusion, by comparing projected cancer incidence in 2040 with 2018, we measured the predicted increase for individual countries and the total combined number of people with newly diagnosed cancer for all GCC countries among the older population. For males in the ≥ 70 age group, cancers are predicted to increase by 540%; for females by 357%. These changes, based solely on predictable aging of the GCC population, do not consider any change in underlying risk factors. The estimates are likely to be imprecise but are sufficiently accurate to guide healthcare organizations within the region. Regional planners in GCC countries need to be aware of the magnitude of increase in cancer incidence to plan strategies to cope with the anticipated increased case load. There is an urgent need to increase the number of trained geriatricians and oncologists, who have experience in managing the special problems of cancer arising in the older population. With respect to cancer prevention in older people, only by urgent attention to current poor lifestyle habits, can we successfully reduce the anticipated future increase in the burden of cancer.

Abbreviations

GCC, Gulf Cooperation Council; GLOBOCAN, Global Cancer Observatory.

Authors’ Note

All data generated or analyzed during this study are included in this published article (and its supplementary information files). Original data are available at the IARC Global Cancer Observatory web site (<http://gco.iarc.fr/>).

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Sohaila Cheema, MBBS, MPH  <https://orcid.org/0000-0002-5874-4059>

Supplemental Material

Supplemental material for this article is available online.

References

1. GCC Statistical Center (GCC-STAT). GCC Statistical Atlas. 2018;4. Updated November 17, 2020. Accessed March 18, 2021. https://gccstat.org/images/gccstat/docman/publications/GCC_ATLAS_2020_V7_17_Nov_2020_2.pdf
2. Shayah MH, Zehou S. Employment in the Gulf Cooperation Council (GCC) Countries: Current Issues and Future Trends. In: *2nd International Conference on Social Science, Public Health and Education (SSPHE 2018)*; November 25-27, 2018; Sanya, China. Atlantis Press; 2019:412-415.
3. The Economist: Economist Intelligence Unit. *The GCC in 2020: The Gulf and Its People*. 2009.
4. Khoja T, Rawaf S, Qidwai W, Rawaf D, Nanji K, Hamad A. Health care in Gulf Cooperation Council countries: a review of challenges and opportunities. *Cureus*. 2017;9(8):e1586-e1586.
5. Arnold M, Leitzmann M, Freisling H, et al. Obesity and cancer: an update of the global impact. *Cancer Epidemiol*. 2016;41:8-15.
6. World Health Organization (WHO). *WHO Global Report on Trends in Prevalence of Tobacco Smoking 2000-2025*. Published 2018. Accessed February 17, 2021. <https://apps.who.int/iris/bitstream/handle/10665/272694/9789241514170-eng.pdf>
7. Hajjar RR, Atli T, Al-Mandhari Z, Oudrhiri M, Balducci L, Silbermann M. Prevalence of aging population in the Middle East and its implications on cancer incidence and care. *Ann Oncol*. 2013;24(suppl 7):vii11-vii24.
8. Estapé T. Cancer in the elderly: challenges and barriers. *Asia Pac J Oncol Nurs*. 2018;5(1):40-42.
9. Demark-Wahnefried W, Morey MC, Sloane R, et al. Reach out to enhance wellness home-based diet-exercise intervention promotes reproducible and sustainable long-term improvements in health behaviors, body weight, and physical functioning in older, overweight/obese cancer survivors. *J Clin Oncol*. 2012;30(19):2354-2361.

10. Pilleron S, Sarfati D, Janssen-Heijnen M, et al. Global cancer incidence in older adults, 2012 and 2035: a population-based study. *Int J Cancer*. 2019;144(1):49-58.
11. Pilleron S, Soto-Perez-de-Celis E, Vignat J, et al. Estimated global cancer incidence in the oldest adults in 2018 and projections to 2050. *Int J Cancer*. 2020;148:601-608.
12. Ferlay J, Ervik M, Lam F, et al. *Global Cancer Observatory: Cancer Today*. International Agency for Research on Cancer (IARC); 2018.
13. Curado MP, Edwards B, Shin HR, et al. *Cancer Incidence in Five Continents, Volume IX*. IARC Scientific Publications No. 160. 2007.
14. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2018;68(6):394-424.
15. Forman D, Bray F, Brewster DH, et al. *Cancer Incidence in Five Continents, Vol. X (Electronic Version)*. IARC; 2013.
16. United Nations Department of Economic and Social Affairs PD. *World Population Prospects: The 2017 Revision, Custom Data Acquired Via Website*. 2017.
17. The World Bank. *World Development Indicators: The World by Income and Region*. Updated 2021. Accessed March 18, 2021. <https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html>
18. World Obesity Federation. Global Obesity Observatory. Updated March 2021. Accessed March 18, 2021. <https://data.worldobesity.org/>
19. Meo SA, Sheikh SA, Sattar K, et al. Prevalence of type 2 diabetes mellitus among men in the Middle East: a retrospective study. *Am J Men's Health*. 2019;13(3):1557988319848577.
20. Meo SA, Usmani AM, Qalbani E. Prevalence of type 2 diabetes in the Arab world: impact of GDP and energy consumption. *Eur Rev Med Pharmacol Sci*. 2017;21(6):1303-1312.
21. Institute for Health Metrics and Evaluation (IHME). Global burden of disease results tool. Accessed March 18, 2021. <http://ghdx.healthdata.org/gbd-results-tool>
22. Gulf Labour Markets and Migration. GCC: total population and percentage of nationals and foreign nationals in GCC countries (National Statistics, 2010-2016) (with numbers). Published 2016. Accessed January 5, 2019. <https://gulfmigration.org/gcc-total-population-percentage-nationals-foreign-nationals-gcc-countries-national-statistics-2010-2016-numbers/>
23. Nagraj A. UAE unveils "golden card" permanent residency scheme for expats. *Gulf Business*. Published May 19, 2019. <https://gulfbusiness.com/sheikh-mohammed-unveils-golden-card-permanent-residency-scheme-expats/2019>
24. Atullah S. New law allows permanent residency for expats. *The Peninsula*. Published September 5, 2018. <https://thepeninsulaqatar.com/article/05/09/2018/New-law-allows-permanent-residency-for-expats2018>
25. Truong-Donnelly T, Al-Khater A-H, Bujassoum Al-Bader S, et al. Arab women's breast cancer screening practices: a literature review. *Asian Pac J Cancer Prev*. 2013;14(8):4519-4528.
26. Wilf-Miron R, Peled R, Yaari E, Vainer A, Porath A, Kokia E. The association between socio-demographic characteristics and adherence to breast and colorectal cancer screening: analysis of large sub populations. *BMC Cancer*. 2011;11:376.
27. Montazeri Z, Nyiraneza C, El-Katerji H, Little J. Waterpipe smoking and cancer: systematic review and meta-analysis. *Tob Control*. 2017;26(1):92-97.
28. Ng SW, Zaghloul S, Ali HI, Harrison G, Popkin BM. The prevalence and trends of overweight, obesity and nutrition-related non-communicable diseases in the Arabian Gulf States. *Obes Rev*. 2011;12(1):1-13.
29. Giovannucci E, Harlan DM, Archer MC, et al. Diabetes and cancer: a consensus report. *Diabetes Care*. 2010;33(7):1674-1685.
30. Almalki M, Fitzgerald G, Clark M. Health care system in Saudi Arabia: an overview. *East Mediterr Health J*. 2011;17(10):784-793.
31. Ghosh B. Health workforce development planning in the Sultanate of Oman: a case study. *Hum Resour Health*. 2009;7(1):47.
32. Goodman A. The development of the Qatar healthcare system: a review of the literature. *Int J Clin Med*. 2015;6(3):9.
33. El Bcheraoui C, Basulaiman M, Wilson S, et al. Breast cancer screening in Saudi Arabia: free but almost no takers. *PLoS One*. 2015;10(3):e0119051.
34. Gosadi IM. National screening programs in Saudi Arabia: overview, outcomes, and effectiveness. *J Infect Public Health*. 2019;12(5):608-614.
35. Elobaid YE, Aw TC, Grivna M, Nagelkerke N. Breast cancer screening awareness, knowledge, and practice among Arab women in the United Arab Emirates: a cross-sectional survey. *PLoS One*. 2014;9(9):e105783.
36. National Cancer Program Qatar. Breast and bowel screening. Published 2016. Updated March 2020. Accessed February 17, 2020. <http://screenforlife.qa/>
37. The Lancet Oncology. Addressing the burden of cancer in the Gulf. *Lancet Oncol*. 2014;15(13):1407.
38. Ministry of Public Health. *Achieving Excellence in Cancer Care: A Vision for 2022*. The National Cancer Framework 2017-2022; 2017.
39. Sheikh JI, Cheema S, Chaabna K, Lowenfels AB, Mamtani R. Capacity building in health care professions within the Gulf Cooperation Council countries: paving the way forward. *BMC Medical Educ*. 2019;19(1):83.
40. Rowland JH, Bellizzi KM. Cancer survivorship issues: life after treatment and implications for an aging population. *J Clin Oncol*. 2014;32(24):2662-2668.