

Unpacking the Clinical Burden of Leukemia in GCC: Implications for Patient Care

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Abstract: Cancer constitutes a substantial global health challenge, which is poised to intensify primarily due to the growing elderly population globally. Leukemia, being a type of hematological cancer, presents unique diagnostic complexities compared to solid cancers, contributing to elevated levels of morbidity and mortality across various regions worldwide, resulting in a substantial clinical burden. Employing data sourced from the WHO Global Health Expenditure Database and the Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease for the year 2019, this study undertakes an analysis of the prevalence, Years of Life Lost (YLLs), Years Lived with Disability (YLDs), Disability-Adjusted Life Years (DALYs), and healthcare expenditure in Gulf Cooperation Council (GCC) nations in comparison to the global figures.

1 INTRODUCTION

Global cancers are considered a major contributor to disease burden worldwide and are expected to continue growing for the next upcoming decades. Cancer resulted in a total of 9.6 million deaths and 233.5 million disability-adjusted life years (DALYs) in 2017 (Sung et al., 2021). Hence, the need for cancer reduction strategies is regarded as a primary goal recognized by the United Nations (UN) (Cheatley et al., 2020).

Notably, leukemia is considered one of the most concerning cancer types worldwide, and it is divided into five major subcategories, namely acute myeloid leukemia (AML), chronic myeloid leukemia (CML), acute lymphocytic leukemia (ALL), chronic lymphocytic leukemia (CLL), and others.

According to GLOBOCAN, leukemia was classified as the 11th leading cause of all cancer-related mortality (466,003 out of a total 9,958,133 cancer-related deaths) (Sung et al., 2021). Therefore, an analysis of disease burden, leukemia in particular, allows a better understanding of leukemia trends and spreads, in order to assist health practitioners in disease management and rational allocation of healthcare resources (Cheatley et al., 2020).

In this study, we investigate the clinical burden of leukemia through key indicators such as YLLs, YLDs, DALYs, and healthcare expenditures in GCC countries in comparison to global statistics. The aim of this paper is to also understand leukemia's incidence and resulting deaths for more structured prevention measures and improved clinical practice.

2 CLINICAL BURDEN

2.1 Related Works

Leukemia is a deadly hematological disease that not only affects different age groups and poses a threat to human development due to increased subsequent deaths, but it also creates a significant burden on both the healthcare system and society (Lin et al., 2021).

In 2015, leukemia resulted in 12 million DALYs globally, with 97% and only 3% coming from YLLs and YLDs, respectively (Ou et al., 2020). DALY is used as an index of the combined quantity and quality of life of a population, equating to the sum of YLDs and YLLs.

Leukemia can be categorized into two main categories: Acute and chronic. Unlike the acute type, chronic leukemia is a class of slower growing cells

that can take up to several years to progress. According to Yao et al., global deaths and DALYs decreased slightly for chronic lymphocytic leukemia (CLL) from 1990 to 2019 (Yao et al., 2021). Moreover, the burden of death and DALY was mainly affected by socio-demographic index (SDI), such that the disease burden of CLL decreased in higher SDI countries, while increasing in lower ones. This could be due to the quality of healthcare provided in developed countries compared to developing ones.

Similarly, the average potential years of life lost (AYLL) was used for ALL to evaluate its societal burden (Ahmad et al., 2023). Although ALL is considered as a rare disease, it still represents a significant health burden corresponding to a high AYLL due to declining survival rates among adults and increased incidence rate among children (Ahmad et al., 2023).

In the same context, a study was performed to investigate the incidence rate, mortality rate, DALY and its change trend of AML during the period extending from 1990 until 2017 in 195 countries. The analysis revealed a gradual increase in both incidence and mortality rates of AML, with males and elderly being more prone to develop the disease (Lin et al., 2021).

Comparably, a study undertaken to explore the global burden of CML between 1990 and 2017 revealed a higher incidence and mortality of CML in males compared to females. In addition, the highest burden was reported in each of Andean Latin America, Central Sub-Saharan Africa, and Southeast Asia (Lin et al., 2021). While the age-standardized death rate (ASDR) decreased during the period under study in high SDI regions, the health-related burden of CML remains a challenge for the low-SDI regions, suggesting that appropriate strategies are yet to be developed and adopted in these regions (Ning et al., 2020).

2.2 Epidemiology

This section focuses on leukemia prevalence and incidence rate analysis in the Gulf Cooperation Council (GCC). The latter comprises Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE), serving as a regional, intergovernmental alliance with both political and economic objectives. While these nations share a common geographical region and numerous connections, each country exhibits distinctive traits in its healthcare systems, strategies, and various socio-economic factors. This individuality underscores the

importance of studying the specific prevalence of leukemia within this region.

Table 1: Population structure of GCC.

Country	Male-to-Female Ratio	Expatriate (%)	Median Age
Qatar	2.57	86%	33.8
UAE	2.18	89%	30.3
Kuwait	1.58	68%	37.2
Bahrain	1.54	54%	32.7
Oman	1.44	43%	29
Saudi Arabia	1.36	48%	30.4

Table 1 displays the population composition of GCC countries. It underscores the significant male-to-female ratio in all these nations, primarily resulting from a substantial influx of expatriates who come to this region for employment opportunities, but often do not bring their families along. This migration pattern also contributes to the notable proportion of individuals aged 15-64, as indicated in Figure 1. However, it's worth noting that this scenario may be different for Oman, which has the lowest expatriate percentage (43%) and the youngest median age (29 years) among all the GCC nations.

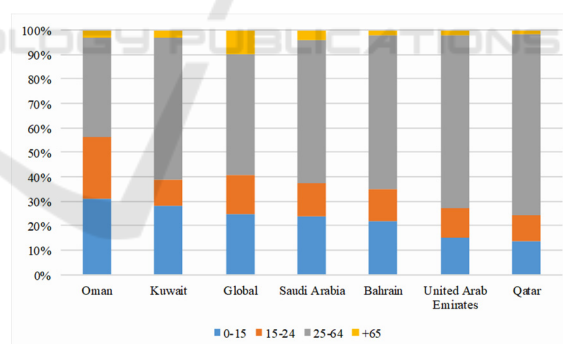


Figure 1: The population age structure of GCC countries in 2019.

On a global scale, the incidence rate of Leukemia stands at approximately 8.3 cases per 100,000 people, with a slight upward trend observed from 2010 to 2019. When compared to GCC countries, we find a notably lower incidence rate, ranging from 3.86 to 5.12 cases per 100,000 individuals. Figure 2 illustrates the case of Oman, which experienced a declining trend during this period. Kuwait, on the other hand, displayed a decreasing trend up to 2013, followed by an increasing trend from 2013 to 2019.

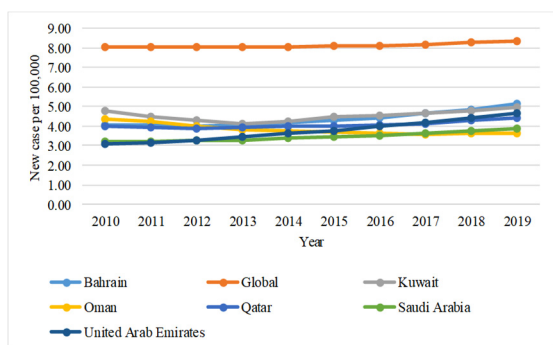


Figure 2: Incidence rate of GCC countries compared to global rates in 2019 across all sexes and all ages.

The incidence rate reflects the number of new cases diagnosed each year, offering insights into the annual rate of occurrence. Nevertheless, when it comes to understanding the overall impact of the disease, the prevalence rate plays a pivotal role. Prevalence represents the proportion of the population that possesses a specific characteristic, in this case, the ongoing burden of leukemia, over a defined time period. It takes into account not only new cases, but also those who have been living with the condition for long.

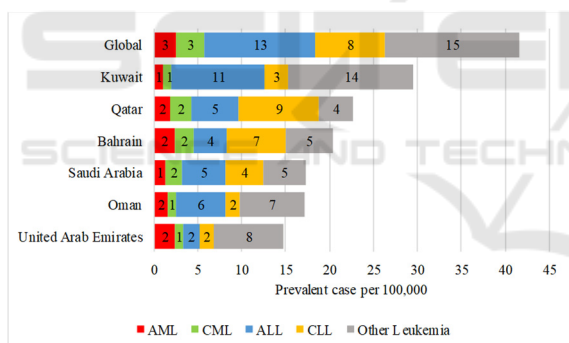


Figure 3: Prevalence of leukemia and its subtypes per 100,000 cases in GCC compared with global trends for all sexes and all ages in 2019.

As depicted in Figure 3, all GCC countries exhibit lower prevalence rates for overall leukemia, ranging from 14.72 to 29.55 cases per 100,000 people. These figures contrast with the global prevalence rate of 41.64 cases per 100,000 individuals. Among the GCC nations, Kuwait reports the highest prevalence rate for total leukemia at 29.55 cases per 100,000 people, while the UAE registers the lowest prevalence rate, standing at 14.72 cases per 100,000.

Upon analyzing the prevalence of various subcategories of leukemia in the GCC countries, the following observations were made:

The prevalence rates for AML in GCC countries range from 1.08 in Kuwait to 2.45 in the UAE, all of which are lower than the global rate of 2.55.

In the case of CML, the prevalence rates in GCC countries range from 0.88 in both Oman and the UAE to 2.39 in Qatar, which are also lower than the global rate of 3.25.

For ALL, the prevalence rate in the GCC ranges from 1.83 in the UAE to 10.56 in Kuwait, all of which are lower than the global rate of 12.61.

Additionally, Qatar is the exception, with a prevalence rate of 9.22 for CLL, which exceeds the global rate of 7.84. This particularity in Qatar's CLL prevalence rate warrants further analysis to understand the factors behind this higher pattern.

For other leukemia subtypes, while all GCC countries exhibit prevalence rates lower than the global rate of 15.40, only Kuwait's prevalence rate is close to the global rate at 14.23. The remaining GCC countries show prevalence rates ranging from 3.83 in Qatar to 7.87 in the UAE.

To estimate the burden of leukemia, our study utilizes DALYs (Disability-Adjusted Life Years), where one DALY signifies the loss of one year of complete health. DALYs are calculated by summing the years of life lost due to premature mortality (YLLs) and the years lived with a disability (YLDs) attributed to prevalent cases of the disease within a community (GBD, 2019). The formula for DALYs is:

$$DALYs = YLLs + YLDs.$$

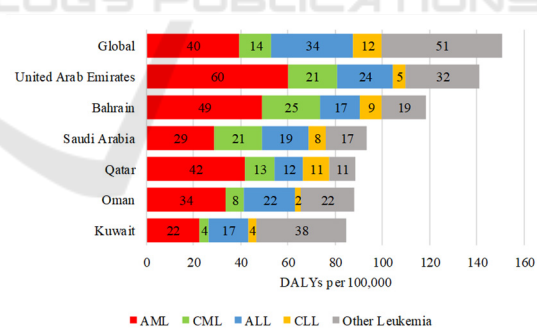


Figure 4: DALYs per 100,000 cases of leukemia in GCC countries compared to global trends for all sexes and all ages in 2019.

Figure 4 provides an insight into the total leukemia burden in GCC countries, which ranges from 84.77 to 141.26 DALYs per 100,000. These rates are notably lower than the global average of 150.67 DALYs per 100,000. This is consistent with the expectation that lower prevalence rates in GCC countries would result in a lower overall burden.

Nevertheless, we notice that despite having the lowest prevalence rate of total leukemia among GCC countries, the UAE has the highest burden. Conversely, Kuwait, with the highest prevalence rate of total leukemia, reports the lowest burden. These discrepancies suggest that additional factors might be influencing the burden and require further investigation.

In addition, the burden of myeloid leukemia, both acute and chronic, in GCC countries exceeds the global burden. This is especially notable in the UAE and Bahrain for AML and CML. In Qatar, only the AML burden exceeds the global average, while in Saudi Arabia, it's the CML burden that surpasses the global level. Approximately 98% of the total leukemia burden, calculated using DALYs, is attributed to YLLs. This indicates that premature mortality plays a substantial role in the overall disease burden.

These findings underscore the need for further research to understand the factors contributing to variations in leukemia burden within the GCC countries, including the unexpected burden disparities between prevalence rates and the potential factors influencing YLLs in this context.

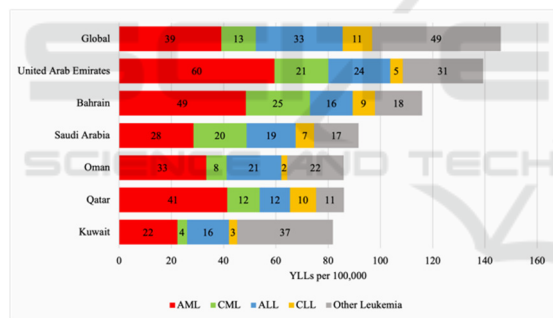


Figure 5: YLLs per 100,000 cases of leukemia in GCC countries compared to the global rates for all sexes and all ages in 2019.

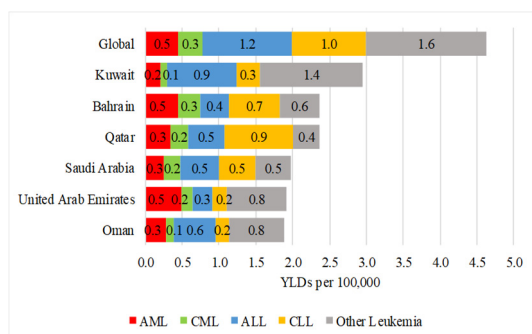


Figure 6: YLDs per 100,000 cases of leukemia in GCC countries compared to the global rates for all sexes and all ages in 2019.

3 HEALTH EXPENDITURES

Health expenditure encompasses all financial outlays related to the provision of healthcare services, family planning initiatives, nutrition programs, and assistance for health-related disasters. However, it does not include expenses for drinking water and sanitation. Health funding represents a critical element within healthcare delivery systems (WHO, 2023).

In the GCC region, healthcare expenditure draws from three primary sources:

- Government Health Expenditure, which represents the portion of a country's Gross Domestic Product (GDP) allocated to healthcare by the government.
- Out-of-Pocket Payments (OOP), which are direct payments made by individuals to healthcare providers as compensation for the services they receive.
- Prepaid Private Spending, which includes the combined spending through both compulsory and voluntary private health insurance schemes (WHO, 2023).

As per Figure 7, it is clear that the healthcare expenditures in all GCC countries surpass the global average of 1,108 USD per person, with one exception being Oman. Oman reports a healthcare expenditure of 817 USD per person. These differences in healthcare expenditure levels among GCC countries can reflect varying economic capacities, healthcare system structures, and government healthcare funding policies.

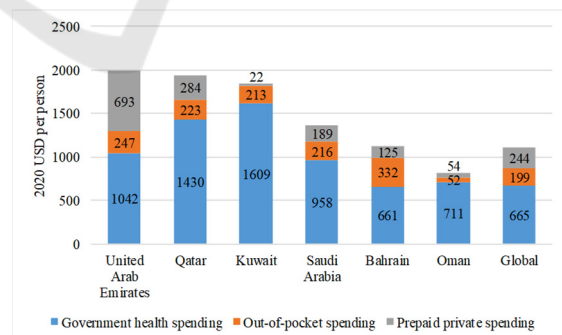


Figure 7: Health expenditure and spending sources in GCC compared to global trends in 2019.

Among GCC countries, the breakdown of healthcare expenditure shows some interesting variations, including the UAE leading the GCC with the highest healthcare expenditure per person at 1,983 USD. It also has the highest prepaid spending at 693

USD per person. Next, Qatar follows the UAE with a healthcare expenditure of 1,938 USD per person. While Kuwait has the highest government health spending at 1,609 USD per person, it reports the lowest prepaid private spending at 22 USD per person. Finally, Bahrain has the highest out-of-pocket spending at 332 USD per person.

Healthcare expenditure serves several essential purposes, including reducing the burden of diseases, addressing capacity constraints, and improving access to healthcare facilities by reducing waiting times. The GCC region has implemented various quality assurance strategies to bring their healthcare systems in line with global standards, ensuring high-quality healthcare services in multiple dimensions.

Universal Health Coverage (UHC) is a crucial index that assesses the effectiveness of healthcare coverage. It examines service coverage across various population health needs and evaluates the extent to which these services contribute to enhanced health outcomes. UHC is an essential framework for measuring and promoting equitable access to healthcare services for all individuals within a population (WHO, 2023).

Table 2 indicates that all GCC countries are experiencing an annual increase in the UHC Index. This positive trend aligns well with some of the countries that have the highest healthcare spending. It demonstrates a commitment to expanding and improving access to healthcare services and achieving equitable coverage across the GCC region, even in comparison to countries with significant healthcare expenditures (The Institute for Health Metrics and Evaluation, 2019).

Table 2: Comparison between GCC countries and three of the highest-ranked countries in terms of UHC index from 2010-2019.

Country	2010	2019
Australia	88.3	89.4
UK	86	87.9
USA	81.2	82.1
Kuwait	75	81.8
Qatar	76.3	80.4
Oman	61.6	71.2
Bahrain	66.3	70.6
Saudi	58.5	64.2
UAE	63.3	63.4

4 DISCUSSION

The rising incidence of leukemia in GCC countries necessitates an increase in healthcare capacity. The number of hospitals is steadily increasing in all GCC nations, reflecting a long-term strategy to address the growing demand for healthcare services. Qatar leads with the highest hospital-per-population ratio at 0.0019%, followed by Oman (0.0017%), the UAE (0.0016%), Saudi Arabia (0.0014%), Bahrain (0.0014%), and Kuwait (0.0006%). This reflects a commitment to enhancing healthcare infrastructure to meet the clinical burden of leukemia.

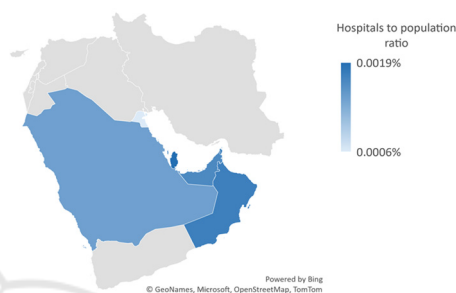


Figure 8: Hospital to population ratio in GCC in 2022.

The number of hospitals in Qatar increased from 30 in 2011 to 57 in 2022, while in Oman, it grew from 65 in 2012 to 88 in 2022. Further analysis on the capacity of these hospitals is needed in future studies.

Variations in leukemia prevalence in GCC countries may be attributed to risk factors in healthcare. These factors fall into three categories: Metabolic risks, behavioral risks, and environmental and occupational risks. Table 3 ranks these risk factors across GCC nations, providing insight into the differences in leukemia prevalence and trends.

Table 3: Risk Factors Ranking among GCC in 2019.

Risk Factors	UAE	Qatar	Saudi Arabia	Oman	Bahrain	Kuwait
High Body-Mass Index	1	1	1	1	1	1
High Fasting Plasma Glucose	4	2	3	3	2	2
High Blood Pressure	2	5	2	2	3	3
High LDL	5	9	7	5	7	7
Kidney Dysfunction	8	10	8	9	8	9
Tobacco	3	3	6	8	4	4
Dietary risks	7	6	4	4	6	5
Malnutrition		8	10	7		8
Low physical Activity	-	-	9	-	10	-
Drug Usage	9					
Air pollution	6	4	5	6	5	6
Occupational Risks	10	7		10	9	10

Table 3 underscores that metabolic risks, particularly high body-mass index, high fasting plasma glucose, and high blood pressure are the dominant risk factors in the GCC region. These factors consistently rank as the top risks in all GCC countries. Moreover, Tobacco intake is the third risk factor in Qatar and the UAE, and the fourth in Bahrain and Kuwait, while drug usage risk only features in the top ten risk factors in the UAE.

The age structure of the population is another factor influencing the variation in leukemia prevalence and clinical burden across GCC countries. Leukemia incidence rates tend to rise with age. Hence, countries with a significant elderly population may experience a greater leukemia burden as the proportion of elderly individuals increases. The GCC countries have a substantial expatriate population, originating from various regions worldwide, with a notable concentration from South Asian countries. This diversity calls for further studies to investigate potential relationships between nationality and leukemia incidence, considering genetic factors based on genome mapping.

5 CONCLUSIONS

In summary, the rising leukemia incidence in GCC countries necessitates increased healthcare capacity, with a steady growth in the number of hospitals. Variations in leukemia prevalence result from factors like metabolic risks, age structure, and the significant expatriate population. Metabolic risks, particularly high body-mass index, are prominent. Further research is needed to explore the relationship between nationality and leukemia incidence, considering genetic factors among the diverse expatriate population.

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