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Research Article

UNVEILING THE CANCER PATTERNS AMONG ADOLESCENTS AND YOUNG ADULTS (AYAS) IN A TERTIARY CARE CANCER CENTRE OF TAMIL NADU: A CROSS-SECTIONAL RETROSPECTIVE EPIDEMIOLOGICAL STUDY

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A B S T R A C T

Background and objective: While cancer in adolescents and young adults (AYAs) has gained increasing attention, limited clinical and epidemiological data exist, especially in developing countries like India. This study aims to fill this gap by investigating the prevalence of various cancer types among AYAs.
Methods: We conducted a retrospective analysis of AYA cancer cases (aged 15-39 years) from January 1, 2017, to December 31, 2021. Demographics, diagnoses (categorized using the Birch classification), and clinical outcomes were collected and reviewed for their distribution based on gender ratio, age range and histological types.
Results: Of 7,677 total cases, 1,155 (15.04%) were AYAs, with a gender ratio of 1.51:1 (female:male). A significant portion (47.71%) of AYAs fell within the 35-39 years age group, while only 8.4% were in the 20-24 years age group. The most prevalent cancer types were carcinomas (68.06%), followed by leukemias (16.02%) and lymphomas (7.62%). Carcinomas predominantly affected the breast, head & neck, genitourinary and gastric tract. Soft tissue sarcomas, rectal carcinomas, and head & neck cancers showed similar prevalence in both genders. Gender-specific patterns revealed breast carcinomas as the leading cancers in females, while leukemia, lymphomas and testes carcinomas were predominant in males.
Conclusion: This study provides valuable insights into the epidemiology of cancer among AYAs in Tamil Nadu. The observed differences in cancer distribution, compared to previous reports, can be attributed to regional factors and genetic variations. This study also contributes to the understanding of AYA cancer in India and highlights the need for tailored approaches to address the unique challenges faced by this population.

INTRODUCTION

According to US Surveillance Epidemiology and End Results (SEER) program as well as Report of the Adolescent and Young Adult (AYA) Oncology Progress Review Group of National Cancer Institute (NCI), AYA defined as individuals aged 15 to 39 years, represent a transitional phase in life marked by physical, emotional, and social changes (NCI, 2023; NCI, 2006). While cancer predominantly affects adults, the incidence and patterns of it among adolescents and young adults (AYAs) has remained significantly underexplored in existing literature as well as underserved in cancer care (Choi et al., 2022). In addition, compared to older patients, AYAs have unique characteristics of cancer and higher risk of long-term and late effects, including infertility, sexual dysfunction, cardiovascular disease and development of future other cancers (Miller et al., 2020; Chao et al., 2019; Chao et al., 2016), therefore AYAs patients have garnered/gained increasing attention.

In India, the burden of cancer is substantial, with varying prevalence and patterns across different regions (Mathur et al., 2022). Tamil Nadu, a southern state known for its diverse demographics and robust healthcare infrastructure, has observed a rising trend in cancer incidence. Though the occurrence of cancer is relatively lower in AYAs compared to older adults, the demographic structure of Tamil Nadu, is predominantly youthful (Sathishkumar et al., 2022). Furthermore, despite extensive/comprehensive data on cancer in the adult population being available, there is a significant research gap exists in the realm of AYA patients. This vital age group has been relatively overlooked and a lack of data persists regarding their experiences with cancer mainly due to data of this age group are often presented in aggregate with pediatrics or children age group data, masking the important differences across AYA age groups (Miller et al., 2020). Moreover, a growing body of evidence suggest that tumors occurring in AYAs exhibit unique molecular characteristics compared to both pediatric/younger individuals and older adults. This observation potentially implies variations in the

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underlying causes and the efficacy of treatments (Tricoli and Bleyer, 2018; Tricoli et al., 2016; Sender et al., 2015). Therefore, understanding the pattern of cancers among AYAs is crucial for developing tailored strategies that address the unique challenges posed by various malignancies in this age group.

This study aimed to contribute to the existing body of knowledge by shedding light on the epidemiology of cancers among AYAs from a tertiary cancer center in Tamil Nadu. Our main objective revolves around investigating the descriptive epidemiology of cancer in AYAs within one cancer center, as well as comparing our findings with available data from both Indian and Western literature. By analyzing the demographic characteristics such as age, gender, incidence, site distribution, and the probable risk factors responsible for cancers, we seek to identify patterns that may inform targeted interventions, resource allocation, and research priorities. Additionally, uncovering any disparities in cancer care among AYAs could guide efforts to ensure equitable access to high-quality treatment and support services. The insights gained from this research can pave the way for improved healthcare planning, policy formulation, and ultimately, enhanced outcomes for adolescents and young adults grappling with cancer.

MATERIALS AND METHODS

Study design and Criteria

All individuals aged 15-39 years who were diagnosed with various forms of cancer and pursued/sought medical care at the Government Rajaji Hospital in Alwarpuram, Madurai, Tamil Nadu, between January 1, 2017, and December 31, 2021, were considered for inclusion in this retrospective descriptive cross-sectional study.

Data collection techniques and management

A pre-designed semi-structured form was developed to collect data through the review of medical records of participants. Relevant information, such as age, gender and cancer diagnosis, was extracted. This allowed for the collection of accurate and objective data regarding their clinical profile and treatment journey. The collected data from medical records, were compiled and entered into a secure electronic database. Data entry was performed by trained personnel using a double-entry method to minimize errors. The database was regularly backed up and secured to maintain data integrity and confidentiality.

Statistical analysis

Descriptive statistics were used to analyze and summarize the collected data. Categorical variables were presented as frequencies (proportions) and percentages. The data were organized and presented in a way that allows for the identification and characterization of the clinico-epidemiological patterns of different cancers within the study population. Subgroup analyses were conducted to explore variations in clinico-epidemiological patterns based on different cancer types and gender.

RESULTS

Out of the total 7400 cases registered within the span of four year, 1155 cases (15.61%) belonged to the 15-40 years age group. As depicted in Table 1, there were 694 females and 461 males with a gender ratio of 1.51:1. A clinically significant portion of the patient population was distributed within the 36-40 age group, constituting 551 individuals (47.7%). Following this, the 31-35 age group accounted for 254 patients (22%), succeeded by the 26-30 age group (n=145, 12.6%) and 15-20 year age group encompassed 108 patients (9.3%), while only 97 patients (8.4%) were belonged to the 21-25 age range.

Table 1 Age and sex distribution of the study cohort

Age group	Male n (%)	Female n (%)	Total N (%)
15-19	81 (17.6)	27 (3.9)	108 (9.3)
20-24	60 (13)	37 (5.3)	97 (8.4)
25-29	62 (13.4)	83 (12)	145 (12.6)
30-34	89 (19.3)	165 (23.8)	254 (22)
35-39	169 (36.7)	382 (55)	551 (47.7)
Grand Total	**461 (100)**	**694 (100)**	**1155 (100)**

The distribution of cancer types among AYAs as per the Birch Classification is outlined in Table 2. Among males, the most prevalent category was group 8: Carcinoma except skin with 219 cases (47.5%), followed by group 1: Leukemia, with 123 cases (26.7%) and group 2: Lymphomas with 58 cases (12.6%). Among several carcinomas, head and neck carcinoma was most common types of cancer. In case of females, group 8: carcinomas (except skin) was the most common with 567 cases (81.7%), preceded by group 1: Leukemia with 62 cases (8.9). Indeed, breast cancer was most common with a total of 266 cases (38.3%). Further, the prevalence of soft tissue sarcoma and carcinoma of rectum along with head & neck were numerically similar in both gender. These findings offer insights into the distinct patterns of cancer distribution in the AYA population.

Table 2 Distribution of Cancers in AYA according to Birch Classification

Birch Classification	Male	Female	Total
	n (%)	n (%)	N (%)
Group 1: Leukemia	**123 (26.7)**	**62 (8.9)**	**185 (16)**
Acute lymphocytic leukemia (ALL)	50	21	71
Acute myeloid leukemia (AML)	24	12	36
Chronic lymphocytic leukemia (CLL)	1	1	2
Chronic myeloid leukemia (CML)	48	28	76
Group 2: Lymphomas	**58 (12.6)**	**30 (4.3)**	**88 (7.6)**
Hodgkin lymphoma (HL)	33	19	52
Non-Hodgkin lymphoma (NHL)	25	11	36
Group 3: CNS tumors	**12 (2.6)**	**8 (1.2)**	**20 (1.7)**
Group 4: Bone tumors	**30 (6.5)**	**11 (1.6)**	**41 (3.6)**
Group 5: Soft tissue sarcomas	**19 (4.1)**	**16 (2.3)**	**35 (3)**
Group 6: Germ cell tumors	**23(4.9)**	**14(2)**	**37(3.2)**
Group 7: Melanoma and skin carcinoma	**2**	**1**	**3(0.2)**
Group 8: Carcinomas except skin	**194 (42.5)**	**552 (79.6)**	**746 (64.5)**
Carcinoma of thyroid	0	0	0
Carcinoma of Head and Neck	50	54	104
Carcinoma of Lung	22	14	36
Carcinoma of Breast	0	266	266
Carcinoma of Stomach	34	44	78

Carcinoma of Esophagus	32	18	50
Carcinoma of Colon	22	16	38
Carcinoma of Rectum	22	21	43
Carcinoma of Testes	23	0	23
Carcinoma of Bladder	12	4	16
Carcinoma of Ovary	0	56	70
Carcinoma of Cervix	0	50	50
Carcinoma of Endometrium	0	9	9
Group 9: Miscellaneous specified neoplasms	0	0	0
Group 10: Unspecified malignant neoplasms	0	0	0
Grand Total	**461 (100)**	**694 (100)**	**1155 (100)**

DISCUSSION

Despite its crucial implications, the AYA age group, encompassing individuals aged 15 to 39, has long remained an overlooked population in the realm of cancer research. The absence of dedicated studies has limited our understanding of the prevalence, distribution, and outcomes of different cancer types in this population, hindering the development of targeted interventions and strategies. This calls for focused research to bridge the existing knowledge gap and provide a clear picture of the epidemiology and impact of cancers on AYAs. Furthermore, the classification and management of cancers have traditionally been tailored to either pediatric or adult populations, leaving AYAs in a diagnostic and therapeutic dilemma.

In this study, we wanted to look into the distribution and patterns of cancers among AYAs, based on age and sex distribution, shedding light on the prevalence of specific cancer types in this age group. By elucidating the landscape of cancer occurrences in this cohort, we aim to contribute valuable insights that can inform targeted interventions, healthcare planning, and resource allocation. We compared our findings with currently available data from India, reported in GLOBOCAN 2020, which include prevalence, incidence and mortality rate of AYA versus overall cancer types (Sung et al., 2020). This study holds significant clinical importance for several reasons. Firstly, it addresses a critical gap in cancer research by focusing on AYAs, a population often understudied. Secondly, by identifying specific cancer patterns and characteristics within this age group in Tamil Nadu, it can lead to more precise diagnostic and treatment approaches, potentially improving survival rates and quality of life. Lastly, the findings have the potential to influence healthcare policies and resource allocation, ensuring that AYAs receive the specialized care and support as per need, thus making a substantial impact on their overall well-being.

In present study, we have noticed a noteworthy observation that 15.61% of total registered patients were fell in AYA category, a percentage that were numerically as well as clinically greater than 10.74% reported in GLOBOCAN 2020, 5.8% in urban population-based cancer registries (PBCRs) in India (Singh et al., 2016) and a mere 1.2% in PBCRs of England, as indicated by Arora and co-workers (Arora et al., 2012). There are several factors contributing to this variation, which include the distinct demographic structure of Indian population especially in Tamil Nadu region, as well as presence of robust healthcare infrastructure of this region might have contributed to expedite (accelerate) cancer diagnosis, potentially accounting for the observed upward trend in cancer incidence within this region (potentially contributing to the observed upward trajectory in cancer incidence rates within this region).

Subsequently, we computed the female-to-male (F:M) ratio, which stood at 1.51 in our study. This value was notably higher than the ratios reported in GLOBOCAN 2020 data for India (1.31%) (Sung et al., 2020) and the UK (1.04%) (Arora et al., 2012). Interestingly, our ratio is also deviating with the published data from Delhi by Singh and colleagues in 2016 (Singh et al., 2016), which reported a M:F ratio of 1.35:1 instead of F:M. This discrepancy might point to underlying factors such as gender bias or the influence of specific cancer types, such as breast, ovarian, and cervical cancers, which exhibit a female preponderance/predominance cancer in addition to inclusion of more number of female (higher number of female registered in study), influencing the observed gender ratio in cancer incidence. Having observed prevalence of cancer based on F:M ratio, we next examined distribution of patients based on age group. Herein, we found that the incidence of cancer tends to increase with age in AYAs. Specifically, a clinically and numerically significant proportion of patients, approximately 47.7%, were found in the 35-39 age group. This observation aligns with findings from various studies that have consistently shown a higher cancer burden among older AYAs compared to their younger counterparts (Bleyer et al., 2006; Arora et al., 2012; Moon et al., 2014; Kalyani et al., 2010).

However, it is crucial to recognize that this study has several limitations that should be taken into account when interpreting the findings. These include retrospective nature of our data collection, lack of pre-designed semi-structured questionnaire and patient follow-up possess inherent risk incomplete or inaccurate or bias medical records entry which necessitated face-to-face interactions with patients while collecting data, absence of an in-depth incidence and survival analysis and data from a single tertiary cancer center may not fully represent the broader AYA population in the region. These limitations necessitate the need for more extensive, multi-center, and long-term longitudinal research to comprehensively address the unique challenges faced by this population.

CONCLUSION

In our study, Incidence among AYA in GRH Maduai (15%) is slightly higher than Indian and World data . Spectrum of Cancers in AYA also differ in various cancer centres within India as well as in other countries around the world .Primary site distribution among AYA is unique compared to children & Adults .While the findings reveal important trends, we acknowledge the limitations of our retrospective data collection and sample size. Nevertheless, this research underscores the need for targeted approaches in AYA oncology, emphasizing the importance of further studies to better address the unique challenges faced by this population and improve their outcomes.

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