Frontiers on Healthcare Research

ISSN: 3032-7725
Journal homepahe: frontiersonhealthcare.org

Publisher: Rumah Sakit dr. M. Djamil, Padang, West Sumatra, Indonesia

Characteristics of Cancer Patients Enrolled for Radiotherapy in Andalas University Hospital

Muhammad Azzel Hanggara[1*], Fathiya Juwita Hanum[2], Adrial[3]

[1]Faculty of Medicine, Universitas Andalas, Padang, 25127, Indonesia

[2]Department of Radiotherapy, Faculty of Medicine, Universitas Andalas, Padang, 25127, Indonesia

[3]Department of Parasitology, Faculty of Medicine, Universitas Andalas, Padang, 25127, Indonesia

* Corresponding author.
E-mail address: hanggaraazzel@gmail.com

Article information

Submitted
15-07-2024

Accepted
02-09-2024

Published
25-02-2025

Abstract

Background: Cancer remains a significant global health burden, with radiotherapy being a crucial treatment modality. However, data on the characteristics of cancer patients undergoing radiotherapy in West Sumatra is limited. This study aims to analyze the demographic and clinical characteristics of patients receiving radiotherapy at Andalas University Hospital.
Methods: A retrospective descriptive study was conducted on 510 cancer patients who underwent radiotherapy between 2019 and 2020. Data were collected from medical records, including demographics, cancer types, staging, and treatment history.
Results: Breast cancer (42.5%) was the most common malignancy, with a higher prevalence in female patients (72.5%), particularly in the 45–64 age group. Stage IV (26.1%) was the most frequently recorded staging, though nearly 50% of cases lacked staging data, highlighting documentation gaps. The majority of patients were from West Sumatra (78.6%), with a significant number referred from other provinces, emphasizing Andalas University Hospital's role as a regional referral center for radiotherapy.
Conclusion: The findings underscore the high prevalence of late-stage cancer diagnoses and incomplete medical records, necessitating enhanced cancer registration systems and early detection programs. Strengthening data management and accessibility is crucial for improving cancer care and treatment outcomes in West Sumatra.

Keywords: *Cancer, radiotherapy, patient characteristics, andalas university hospital, late-stage diagnosis, cancer registry*

Introduction

Cancer is one of the leading non-communicable diseases with the highest global mortality rate. It is characterized by the uncontrolled proliferation of abnormal cells, which have the ability to invade and spread to other cells and tissues in the body.[1] The World Health Organization (WHO) identifies cancer as one of the leading causes of death worldwide.[2]

Data from the Global Burden of Cancer (GLOBOCAN), published by the WHO and cited from the 2018 Ministry of Health Data Centre, reported that by 2018, there were 18.1 million cancer cases and 9.6 million cancer-related deaths worldwide. The number of cancer-related deaths is projected to continue rising, reaching more than 13.1 million by 2030. Furthermore, the International Agency for Research on Cancer (IARC) estimates that one in every five males and one in every five females worldwide will develop cancer during their lifetime.[3]

According to the 2018 Basic Health Research released by the Ministry of Health of the Republic of Indonesia, the cancer incidence rate was 136.2 per 100,000 population, ranking 8th in Southeast Asia and 23rd in Asia. In Indonesia, lung cancer had the highest incidence among men, with a rate of 19.4 per 100,000 population and an

average mortality rate of 10.9 per 100,000 population, followed by liver cancer with an incidence of 12.4 per 100,000 population and an average mortality rate of 7.6 per 100,000 population.[2]

According to the West Sumatra Provincial Health Office, there were 1,017 female cancer patients in West Sumatra in 2017, compared to 729 male patients. The number of cancer cases increased in 2018, with 1,272 cases among females and 1,124 among males. In 2019, the number of female cancer patients in West Sumatra further increased to 1,658, while the number of male cancer patients declined to 692.[4]

To address the increasing number of cancer patients in West Sumatra, three primary treatment modalities are utilized: radiotherapy, chemotherapy, and surgery. Radiotherapy, in particular, is a treatment modality that employs ionizing radiation (X-rays and gamma rays) and other particles to destroy cancer cells while minimizing damage to surrounding healthy tissues.[5] The fundamental principle of radiotherapy is the precise delivery of targeted radiation doses to eradicate tumors within a predetermined area (the target volume), while ensuring minimal exposure to adjacent normal tissues. This approach has been significantly enhanced by advancements in radiotherapy technology and computational systems.[5,6]

Despite the increasing use of radiotherapy in cancer management, published data on cancer patients undergoing radiotherapy in West Sumatra remains limited. Hutajulu et al. analyzed treatment patterns and outcomes of nasopharyngeal carcinoma patients in Indonesia, emphasizing the need for further regional studies.[7] They also examined national health insurance data to understand cancer patient characteristics, yet comprehensive regional data is lacking.[8] Riyanto et al. highlighted challenges in radiotherapy access and adherence, underscoring the importance of studying patient demographics and treatment barriers.[9]

To date, no study has comprehensively analyzed cancer patients receiving radiotherapy in this region. This study aims to fill that gap by providing demographic and clinical insights, facilitating treatment evaluation, identifying healthcare disparities, and improving cancer care in West Sumatra. Specifically, it examines cancer patients at Andalas University Hospital, a key cancer treatment center in the region. The findings are expected to guide healthcare professionals and policymakers in optimizing cancer treatment strategies and resource allocation.[7–9]

Methods

Study Design

This study employs a descriptive observational design with a retrospective approach to analyze the characteristics of cancer patients undergoing radiotherapy at Andalas University Hospital, Padang, Indonesia. The study was conducted from January 2019 to December 2020, utilizing secondary data from medical records to assess patient demographics, cancer staging, and treatment patterns.

Population and Sampling

The study population consists of all cancer patients who underwent radiotherapy at Andalas University Hospital during the study period. A total sampling method was applied, including 510 patients with complete medical records. The inclusion criteria for this study were cancer patients who had undergone radiotherapy treatment at Andalas University Hospital between January 2019 and December 2020 and had complete medical records, including demographic data, diagnosis, and staging information. Patients were excluded from the study if their medical records were incomplete, particularly if key information such as staging or treatment history was missing, or if they had received radiotherapy outside the study period or at a different institution.

Variables and Operational Definitions

This study examines both dependent and independent variables to understand patient characteristics and treatment outcomes. The dependent variable in this study is the cancer stage at diagnosis, which is categorized into Stage 1, Stage 2, Stage 3, and Stage 4 based on medical record documentation. The independent variables

include demographic characteristics such as age, gender, education level, and occupation, as well as clinical characteristics such as cancer type, treatment history, and radiotherapy status.

Data collection and Presentation

Data were collected from secondary sources, specifically medical records of cancer patients at Andalas University Hospital. The collected data were processed and categorized according to research objectives. Demographic characteristics, including age, gender, education level, and occupation, were presented in frequency tables with percentages. The distribution of cancer staging was displayed in tabular and graphical formats to illustrate trends in patient presentation at different stages. Additionally, treatment characteristics, including radiotherapy status and cancer type, were summarized descriptively. All findings were accompanied by narrative explanations to provide context and highlight key patterns.

Data Analysis

Descriptive statistical analysis was conducted to summarize patient characteristics, cancer staging, and treatment patterns. The collected data were analyzed using IBM SPSS Statistics, and results were presented in descriptive summaries and statistical tables.

Ethical Considerations

This study received ethical approval from the Ethics Committee of the Faculty of Medicine, Andalas University under ethical approval number 639/UN.16.2/KEP-FK/2022.

Results

The descriptive analysis indicates that the majority of cancer patients who underwent radiotherapy were aged between 45 and 54 years (30.78%). The female population was larger than the male population, comprising 72.5% and 27.5%, respectively. Most patients were from West Sumatra Province (80.5%), with housewives being the most common occupation (44.8%). Stage IV was the most frequently diagnosed stage (26.1%), and breast cancer was the most prevalent diagnosis (42.5%). (Table 1)

The descriptive analysis of cancer patients undergoing radiotherapy at Andalas University Hospital indicated that the majority were aged 45-54 years (30.8%), followed by 55-64 years (25.9%), with female patients (72.5%) outnumbering males (27.5%). Most patients were from West Sumatra (78.6%), particularly Padang (44.9%), and the most common occupation was housewife (44.5%). Senior high school (33.35%) and bachelor's degree (29.4%) were the most common educational levels, while 2.4% of patients were uneducated. Breast cancer (42.5%) was the most prevalent diagnosis, followed by rectal (6.9%), cervical (6.1%), brain tumors (5.5%), and nasopharyngeal cancer (4.1%). Among patients with recorded staging, Stage IV (26.1%) was the most frequently diagnosed, yet nearly 50% of cases lacked staging data, indicating documentation gaps. These findings emphasize the hospital's role as a key cancer treatment center and highlight the need for enhanced early detection, improved medical record-keeping, and targeted interventions, particularly for late-stage cases and vulnerable populations. (Table 1)

Table 1. The General Characteristics of Patients Treated with Radiotherapy at Andalas University Hospital

Variable	Frequency	%
Age		
<5	0	0,0%
5-14	5	1,0%
15-24	16	3,1%
25-34	34	6,7%
35-44	92	18,0%
45-54	157	30,8%

55-64	132	25,9%
65-74	57	11,2%
>75	17	3,3%
Variable	Frequency	%
Gender		
Male	140	27,5%
Female	370	72,5%
Educational Level		
Uneducated	12	2,4%
Elementary School	67	13,1%
Junior High School	94	18,4%
Senior High School	170	33,35%
Bachelor Degree	150	29,4%
Unknown	17	3,3%
Occupation		
Unemployment	3	0,6%
Labour	7	1,4%
Housewife	227	44,5%
Civil servant	70	13,7%
Entrepreneur	61	12,0%
Student	19	3,7%
Merchant	23	4,5%
Farmer	32	6,3%
Retired	40	7,8%
Unknown	25	4,9%
Etc	3	0,6%
Residence Address		
Aceh	1	0,2%
North Sumatra	5	1,0%
West Sumatra	401	78,6%
Riau	41	8,0%
Jambi	41	8,0%
Bengkulu	5	1,0%
South Sumatra	2	0,4%
Jakarta	1	0,2%
West Kalimantan	1	0,2%
Unknown	12	2,4%
Origin		
Padang	180	44,9%
Padang Pariaman	35	8,7%
Agam	28	7,0%
Tanah Datar	17	4,2%
Dharmasraya	9	2,2%
Solok	35	8,7%
Sijunjung	20	5,0%
Payakumbuh	23	5,7%
Pesisir Selatan	26	6,5%
Pasaman	22	5,5%
Padang Panjang	6	1,5%
Diagnosed		
Breast Cancer	217	42,5%
Rectal Cancer	35	6,9%

Cervix Cancer	31	6,1%
Brain tumor	28	5,5%
Nasopharynx Cancer	21	4,1%
Variable	Frequency	%
Etc	175	34,3%
Unknown	3	0,6%
Stage		
Stage 1	8	1,6%
Stage 2	30	5,9%
Stage 3	85	16,7%
Stage 4	133	26,1%
Unknown	254	49,8%

The analysis of cancer distribution by gender among patients undergoing radiotherapy at Andalas University Hospital reveals significant differences in cancer prevalence between males and females. Among male patients, the most common cancer type was rectal cancer (17.9%), followed by nasopharyngeal cancer (11.4%), brain tumors (9.3%), thyroid cancer (2.9%), and tongue cancer (2.9%). A substantial proportion of male patients (53.6%) had other types of cancer categorized as "etc.," while 2.1% had unknown diagnoses. In female patients, breast cancer (58.4%) was the predominant diagnosis, followed by cervical cancer (8.4%), brain tumors (4.1%), rectal cancer (2.7%), and liposarcoma (1.9%). A notable proportion of female patients (24.6%) had other unspecified cancer types, while no cases had missing diagnostic data. (Tabel.2)

Tabel 2. Gender-Based Distribution of Cancer Types Among Radiotherapy Patients at Andalas University Hospital

Variable	Frequency	%
Cancer in Males		
Thyroid cancer	4	2.9%
Tongue cancer	4	2.9%
Brain tumor	13	9.3%
Rectal cancer	25	17.9%
Nasopharynx cancer	16	11.4%
Etc	75	53.6%
Unknown	3	2.1%
Cancer in Females		
Breast cancer	216	58.4%
Cervical cancer	31	8.4%
Brain tumor	15	4.1%
Rectal cancer	10	2.7%
Liposarcoma cancer	7	1.9%
Etc	91	24.6%
Unknown	0	0.0%

The analysis of cancer distribution by age among radiotherapy patients at Andalas University Hospital shows that breast cancer (67.4%) is most prevalent, peaking in the 35-54 age group (65.9%). Rectal cancer (10.9%) is more common in older adults, especially those aged 65-74 years (31.4%). Cervical cancer (9.6%) primarily affects women aged 25-54 years (35.4%), while brain tumors (8.7%) are more frequent in younger patients, particularly those under 24 years (35.7%). Nasopharyngeal cancer (6.5%) is mostly found in individuals aged 35-64 years (76.5%). With the highest cancer incidence occurring between 35-64 years (75.6%), these findings highlight the need for age-specific screening programs, particularly for breast and cervical cancer in women, rectal cancer in older adults, and brain tumors in younger populations, to improve early detection and treatment outcomes. (Tabel 3)

Tabel 3. Age-Based Distribution of the Five Most Common Cancers Among Radiotherapy Patients at Andalas University Hospital

Types of Cancer Based on Location		Age (years)								TOTAL
	<5	5-14	14-24	25-34	35-44	45-54	55-64	65-74	>75	
Breast	n	0	0	11	40	82	61	21	2	**217**
	%	0,0	0,0	5,1	18,4	37,8	28,1	9,7	0,9	**100**
		0,0	0,0	55,0	63,5	75,9	69,3	55,3	66,7	**65,4**
Rectal	n	0	1	4	6	7	6	11	0	**35**
	%	0,0	2,9	11,4	17,1	20,0	17,1	31,4	0,0	**100**
		0,0	12,5	20,0	11,5	5,8	7,4	29,7	0,0	**10.5**
Cervix	n	0	0	1	11	7	10	2	0	**31**
	%	0,0	0,0	5,0	17,5	6,5	11,4	5,3	0,0	**100**
		0,0	0,0	4,0	16,4	6,7	12,3	5,4	0,0	**9,3**
Brain Tumor	n	3	6	4	4	5	5	1	0	**28**
	%	10,7	21,4	14,3	14,3	17,9	17,9	3,6	0,0	**100**
		75,0	75,0	2,0	6,3	4,6	5,7	2,6	0,0	**8,4**
Nasopharynx	n	1	1	0	2	7	6	3	1	**21**
	%	10,0	10,0	0,0	10,0	50,0	0,0	20,0	0,0	**100**
		25,0	12,5	0,0	3,2	6.5	6,8	7,9	33.3	**6.3**
TOTAL	**n**	**4**	**8**	**20**	**63**	**108**	**88**	**38**	**3**	**322**
	%	**1,2**	**2,5**	**7,8**	**18,9**	**32,3**	**25,2**	**11,5**	**0,6**	**100**
		100,0	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Discussions

A total of 510 medical records were analyzed, comprising 140 male and 370 female cancer patients. The gender disparity observed in this study is primarily due to the high incidence of breast and cervical cancer, which predominantly affect female patients. These two cancer types are the most common among patients undergoing radiotherapy at Andalas University Hospital. This finding aligns with the 2018 *RISKESDAS* report, which reported a prevalence of 0.37‰ for female cancer patients compared to 0.13‰ for males.[3]

The highest proportion of cancer patients by age group was observed in individuals aged 45–54 years, with 157 patients (30.8%). These findings are consistent with data from the 2018 RISKESDAS West Sumatra report and a 2019 study in Singapore, both of which identified the 45–54 and 55–64 age groups as the most prevalent for cancer cases. According to data from the Research and Development Agency (Litbangkes), Ministry of Health of the Republic of Indonesia, unhealthy behaviors and poor dietary habits—such as insufficient consumption of vegetables and fruits—are major contributing factors to cancer vulnerability in individuals aged 35–54 years, a high-risk age range for cancer development.[4]

The analysis of education levels among cancer patients receiving treatment at Andalas University Hospital reveals that the majority have an education level equivalent to senior high school, accounting for 170 patients (33.35%). This is followed by those with a bachelor's degree (S1), totaling 150 individuals (29.4%). Patients with a junior high school education account for 94 cases (18.4%), while those with only an elementary school education represent 67 cases (13.1%). These findings align with research by Juwita et al. (2018), which suggests that patients with higher education levels tend to exhibit greater adherence to disease prevention and treatment, leading to better cancer management and outcomes.[10-12]

The analysis of occupational distribution among cancer patients at Andalas University Hospital indicates that the majority are housewives (44.5%), followed by civil servants (13.7%), entrepreneurs (12.0%), and retired

individuals (7.8%). The predominance of housewives, particularly among patients diagnosed with breast cancer (42.5%), aligns with the high incidence of female cancers in this study. This distribution reflects broader trends in developing countries, where a significant proportion of women engage in domestic roles. According to the 2018 RISKESDAS report, breast and cervical cancers are the most prevalent malignancies in West Sumatra, primarily affecting females. Additionally, the 2019 Central Bureau of Statistics reported that 38.53% of Indonesian women are employed in the formal sector, while approximately 48 million work in non-formal occupations, including as housewives. However, while this data highlights a demographic trend, establishing a direct correlation between occupation and cancer risk requires further investigation, particularly regarding patients' employment history and the timing of their cancer diagnosis.[3]

Among the 510 cancer patients studied, 401 (78.6%) had complete demographic data, with 109 (21.4%) originating from outside West Sumatra Province. The highest proportion of patients came from Padang (44.9%), followed by Padang Pariaman (8.7%), Solok (8.7%), Agam (7.0%), Pesisir Selatan (6.5%), and other districts in West Sumatra. This distribution suggests that while Padang serves as the primary treatment center, a significant number of patients come from surrounding districts, likely due to disparities in healthcare infrastructure and the availability of cancer treatment services.

Furthermore, 21.4% of patients were referred from outside West Sumatra, emphasizing the role of Andalas University Hospital as a regional referral center for radiotherapy. This is reinforced by the limited number of radiotherapy facilities in the province, with only two hospitals—RSUP Dr. M. Djamil and Andalas University Hospital—offering radiotherapy services, both located in Padang. The concentration of radiotherapy centers within the city underscores the hospital's crucial role in providing cancer treatment for both local and out-of-province patients. However, to comprehensively assess the impact of geographic disparities on cancer care access, further studies are needed to evaluate travel distances, waiting times, and potential treatment delays for referred patients.[13]

The frequency distribution of radiotherapy patients by diagnosis indicates that breast cancer is the most prevalent, accounting for 217 cases (42.5%). This is followed by rectal cancer with 35 cases (6.9%), cervical cancer with 31 cases (6.1%), brain tumors with 28 cases (5.5%), and nasopharyngeal cancer with 21 cases (4.1%). Additionally, a diverse group of other cancer types, including thyroid cancer, collectively accounts for 175 cases (34.3%).

According to GLOBOCAN Indonesia 2020, breast cancer ranks as the most common cancer, followed by cervical cancer, lung cancer, and rectal cancer. While the national trend highlights lung cancer as a leading malignancy, this study primarily focuses on patients receiving radiotherapy, where breast and cervical cancers remain dominant.[14]

Out of 510 cancer cases, only 256 patients had documented cancer staging data at Andalas University Hospital. Among these, 133 patients (26.1%) were diagnosed at stage 4, 85 patients (16.7%) at stage 3, 30 patients (5.9%) at stage 2, and only 8 patients (1.6%) at stage 1. Staging information was not recorded for 254 patients (49.8%), either due to incomplete medical records or the absence of staging documentation from respective departments.

Among patients with available staging data, the majority were diagnosed at stage 4, highlighting a concerning trend of late-stage cancer diagnoses. This pattern aligns with findings from the Hospital-Based Cancer Registry in Thailand (2016), which reported that most cancer patients presented with stage 4 disease at the time of diagnosis.[15,16]

According to Sharma et al., in countries with unevenly distributed education systems and a significant proportion of the population with low educational attainment, cancer patients are often diagnosed at stage 3 or 4 (advanced stage). This is primarily due to limited awareness of early cancer symptoms, as well as economic barriers that delay healthcare access. Consequently, many patients, particularly those in rural areas, are more likely to seek traditional or alternative treatments before consulting healthcare professionals.[11,12,17,18]

According to medical record analysis, the five most common cancers among male patients included rectal cancer (17.9%; 25 cases), followed by nasopharyngeal cancer (11.4%; 16 cases) and brain tumors (9.3%; 13 cases). This finding aligns with a 2018 study in Singapore, which also identified rectal cancer as the most prevalent cancer among men.[19] Similar finding was also reported by Yi et al (2021) which stated that female breast cancer was the higher followed by cervical cancer.[20]

Among female patients, the most common cancer was breast cancer, with 216 cases (58.4%), followed by cervical cancer (8.4%; 31 cases). These findings are consistent with data from Dharmais Cancer Hospital and the 2018 RISKESDAS report, which identified breast cancer as the leading malignancy among women, followed by cervical cancer.[3, 19] While these trends reflect broader cancer incidence patterns, further research is needed to assess whether these types of cancer also represent the most frequently treated cases in radiotherapy at Andalas University Hospital.

The five most common cancers by age group show that most cases occur in the 45–54 and 55–64 age ranges, with breast cancer being the most prevalent, followed by rectal cancer, cervical cancer, brain tumors, and nasopharyngeal cancer. However, a significant proportion of breast cancer cases (37.8%) also occur in the 35–44 age group, indicating an earlier onset in some patients.

According to the Malaysia National Cancer Registry Report (2016), breast cancer most commonly affects individuals aged 54–59 years, while rectal cancer and lung cancer peak at 60–69 years. A study from Singapore found that most women aged 40–59 years are diagnosed with breast cancer, followed by uterine and thyroid cancer, which aligns with findings from GLOBOCAN. Similarly, GLOBOCAN data indicate that among women aged 40–59 years, breast cancer is the most prevalent malignancy, followed by uterine and thyroid cancer.[14,19] While these trends reflect broader epidemiological patterns, further analysis is needed to determine how age-specific cancer incidence correlates with radiotherapy utilization at Andalas University Hospital.

This study analyzed the characteristics of cancer patients who underwent radiotherapy at Andalas University Hospital, Padang, between 2019 and 2020. However, a significant data limitation was identified, particularly regarding the lack of recorded cancer staging in medical records. This was primarily due to patients presenting with metastatic cancer from other sites and having undergone prior treatments such as chemotherapy. Additionally, many demographic records were either missing or incomplete, despite their importance in assessing patient characteristics and treatment patterns.

One of the major challenges in this study was the incomplete availability of essential patient data, including birth dates, addresses, and educational backgrounds, as well as diagnostic information such as staging data. To overcome these limitations, a more structured and integrated cancer registry system across Andalas University Hospital is essential to ensure accurate and comprehensive data collection for future epidemiological and clinical research.

Conclusions

This study analyzed the characteristics of cancer patients undergoing radiotherapy at Andalas University Hospital from 2019 to 2020. Breast cancer was the most prevalent, with most patients being women (72.5%), and the highest incidence in the 45–64 age group. A significant proportion (26.1%) were diagnosed at Stage IV, while nearly 50% lacked staging data, indicating gaps in medical records.

The hospital serves as a regional referral center, with many patients coming from outside West Sumatra. However, incomplete demographic and clinical data remain a challenge. Strengthening cancer registries and improving early detection are essential for enhancing treatment outcomes and cancer care strategies in the region.

Acknowledgements

The researcher would like to express his thanks to all parties who helped in completing and perfecting this research.

Declarations of competing interest

No potential competing interest was reported by the authors.

References

1. Anorital A. Morbidity and multimorbidity in the elderly population in Indonesia. J Biotek Medisiana Indones. 2016;4(2).
2. Ministry of Health of the Republic of Indonesia. Cancer disease in Indonesia ranks 8th in Southeast Asia and 23rd in Asia. 2021.
3. Ministry of Health of the Republic of Indonesia. National Report on Basic Health Research (Riskesdas) 2018. Jakarta: Health Research and Development Agency; 2019.
4. Ministry of Health of the Republic of Indonesia. West Sumatra Provincial Report on Basic Health Research (Riskesdas) 2018. Jakarta: Health Research and Development Agency; 2019.
5. Fitriatuzzakiyyah N, Sinuraya RK, Puspitasari IM. Cancer therapy with radiation: the basic concept of radiotherapy and its development in Indonesia. Indones J Clin Pharm. 2017;6(4):311–20.
6. Handoko A, Hidayatullah H, Hidayanto E, Richardina V. Accuracy analysis of dose verification using standard phantom and replica phantom comparisons. Youngster Phys J. 2018;7(1):1–10.
7. Hutajulu SH, Indrasari SR, Mudigdo A, et al. Patterns of care and outcome analysis of nasopharyngeal carcinoma: An Indonesian single institution study. J Med Sci. 2024. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7541880
8. Hutajulu SH, Indrasari SR, Mudigdo A, et al. Characteristics and treatment patterns of patients diagnosed with nasopharyngeal carcinoma in Indonesia: A descriptive study using the national health insurance database. Beigene Medical. 2024.
9. Riyanto A, Wijayanto H, Suryani R, et al. Facing problems in radiotherapy for breast cancer patients in Indonesia: Evidence from a tertiary hospital in Yogyakarta. Asian Pac J Cancer Prev. 2024. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10134354
10. Juwita DA, Almahdy A, Afdhila R. The effect of patient characteristics on health-related quality of life in breast cancer patients at Dr. M. Djamil General Hospital, Indonesia. J Sains Farm Klin. 2018;5(2):126.
11. Gupta A, Wilson LE, Pinheiro LC, et al. Association of educational attainment with cancer mortality in a national cohort study of black and white adults: A mediation analysis. SSM Popul Health. 2023;24:101546.
12. Withrow DR, Freedman ND, Gibson JT, et al. Leading cancers contributing to educational disparities in cancer mortality in the US, 2017. Cancer Causes Control. 2021;32(11):1193-6.
13. Indonesian Radiation Oncology Association. Radiotherapy Center Data. PORI Indonesia. 2019.
14. GLOBOCAN. The Global Cancer Observatory - All cancers. Int Agency Res Cancer-WHO. 2020;419:199–200.
15. National Cancer Institute Thailand. Hospital-Based Cancer Registry Annual Report 2016. Thailand: National Cancer Institute Thailand; 2016.
16. Hohenstein NA, Chan JW, Wu SY, et al. Diagnosis, staging, radiation treatment response assessment, and outcome prognostication of head and neck cancers using PET imaging: A systematic review. PET Clin. 2020;15(1):65-75.
17. Sharma V, Kerr SH, Kawar Z, et al. Challenges of cancer control in developing countries: current status and future perspectives. Future Oncol. 2011;7(10):1213–22.
18. Kamaraju S, et al. Cancer prevention in low-resource countries: An overview of the opportunity. Am Soc Clin Oncol Educ Book. 2020;40:72-83.
19. National Registry of Diseases Office. Singapore Cancer Registry Annual Report 2015. Singapore; 2017.
20. Yi M, Li T, Niu M, et al. Epidemiological trends of women's cancers from 1990 to 2019 at the global, regional, and national levels: a population-based study. Biomark Res. 2021;9(1):55.