Jurnal RSMH Palembang
Journal Homepage: http://jurnalrsmh.com/index.php/JRP

Dr. Mohammad Hoesin Hospitals Cancer Incidence: Hospital-Based Cancer Registration Data

Citra Dewi[1*], Dian Puspita[2], Sandria[1], Romi Ramkita[3]
[1]Anatomical Pathology Department, Medical Faculty, Universitas Sriwijaya, Palembang, Indonesia
[2]Pediatric Department, Medical Faculty, Universitas Sriwijaya, Palembang, Indonesia
[3]Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

ARTICLE INFO

Keywords:
Cancer registry
Hospital-based
Malignant
Mohammad Hoesin
Neoplasm

Corresponding author:
Citra Dewi

E-mail address:
citrafarahkayla@outlook.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/JRP.v4i2.48

ABSTRACT

Dr. Mohammad Hoesin Hospitals Cancer Incidence: Hospital-Based Cancer Registration Data. Cancer worldwide is summarized through a complex process called cancer registries. Based on data from the Global Burden of Cancer Study (GLOBOCAN), there will likely be approximately 10 million cancer-related deaths and 19.3 million new cases of cancer globally in 2020. However, Indonesia still does not have cancer incidence data based on population, as well as hospital-based cancer incidence data, especially the Dr. Mohammad Hoesin General Hospital Palembang, the main referral center for cancer in the South Sumatra region. This study aims to determine the distribution of cancer cases based on gender, age, organs, and cell origin in Dr. Mohammad Hoesin General Hospital Palembang for the period 2012-2019. This is an observational-descriptive study with 3413 samples taken from hospital cancer registry data, including topography, cell origin, age, and gender data from January 1, 2012, to December 31, 2019. The data is then processed and presented as distribution and frequency on tables and graphs using the SPSS application version 26. Cancer is prevalent in 63.5% of women and 36.5% of men. More than 53% of cases of cancer are diagnosed in the age range of 41-60 years. Acute lymphoblastic leukemia, infiltrating duct carcinoma, and adenocarcinoma are the most common cases of cancer in the age groups 0-20 years, 21-40 years, and >40 years, respectively. Based on location, breast, cervix-uteri, and colon occupy the 3rd highest position. By origin, 72% of cancer came from epithelial cells (carcinoma), 281 cases came from lymphoid cells (lymphoma), and 96 cases came from mesenchymal cells (sarcoma). Cancer generally occurs in females, patients aged 41-60 years, the most common location of the breast, and originates from epithelial cells (carcinoma).

1. Introduction

Cancer is still a major health problem worldwide. The need for accurate data on a country's cancer burden might be the first step to formulating a policy to reduce this burden. Cancer data worldwide is summarized through a complex process called cancer registries.

A cancer registry is an ongoing process of collecting systematic, reportable data on the incidence, characteristics, and outcomes of cancer to help assess and control the impact of cancer in society.[3] Currently the software used for cancer registration in Indonesia is Sistem Registrasi Kanker Indonesia (SRiKandI).[4]

Based on data from the Global Burden of Cancer Study (GLOBOCAN), it is estimated there are 19.3 million new cases of cancer and nearly 10 million cancer deaths occurring in 2020 worldwide. This year, breast cancer has surpassed other cancers, as the most commonly diagnosed cancer with 2.3 million new cases (11.7%), followed by lung (11.4%), colorectal (10%), prostate (7.3%), and stomach

(5.6%). Lung cancer remains the leading cause of death from cancer, with an estimated 1.8 million deaths followed by colorectal, liver, stomach, and breast cancers.[5] Breast cancer also has the highest incidence rate in Indonesia in 2020 at 16.6% of cases, followed by cervical cancer at 9.2%, lung cancer at 8.8%, colorectal cancer at 8.6%, and liver cancer at 5.4%.[6] In 2019, according to the World Health Organization (WHO), cancer was the leading cause of death before the age of 70 in 112 of 183 countries, and the third highest cause of death in 23 countries including Indonesia.[5,6]

Based on the data above, the Indonesian government has prioritized oncology programs to reduce morbidity and death rates due to cancer. However, currently, Indonesia still does not have data on the population of cancer incidence, as well as data on cancer incidence based on hospital-based data, especially the Dr. Mohammad Hoesin General Hospital Palembang which is the main referral center for cancer in the South Sumatra region. Therefore, this study is designated to determine the distribution of cancer-based on hospital-based cancer registration data, so it is expected that Dr. Mohammad Hoesin General Hospital Palembang has basic data on the incidence of cancer.

2. Methods

This study is an observational study with a descriptive research design. Three thousand four hundred and thirteen samples were taken, using the total sampling technique, from the cancer registry data of Dr. Mohammad Hospital Hoesin Palembang from January 2012 until December 2019. The research variables used were gender, age, organs (topography), and cell origin. Age variables were grouped into 9 group categories based on age decade, while organ variables (topography) were grouped into 43 organ groups and cancer cell origin variables were grouped based on ICD-O. The complete data is then processed and presented as distribution and frequency on tables and graphs using the SPSS application® version 26.

3. Results

Cancer distributin-based on sex

As many as 36.5% of cases occurred in men and 63.5% of cases occurred in women (Table 6.1). Five hundred and one cancer cases (23%) that occurred in women were infiltrating duct carcinoma, 218 cases (10%) of adenocarcinoma, and 179 cases (8.2%) of non-keratinizing squamous cell carcinoma (Table 1). In men, adenocarcinoma is the most common cancer, with as many as 273 cases (22.1%), followed by non-Hodgkin lymphoma as many as 91 cases (7.3%), and non-keratinizing squamous cell carcinoma as many as 87 cases (7.1%).

Table 1. Three cancers are most often by sex

Gender	n	n (%)	Most frequent cancer (n)*
Man	1247	36.5	1. Adenocarcinoma (273) 2. Non-Hodgkin lymphoma (91) 3. Non-keratinizing squamous cell carcinoma (87)
Woman	2166	63.5	1. Infiltrating duct carcinoma (501) 2. Adenocarcinoma (218) 3. Non-Keratinizing squamous cell carcinoma (179)

* Ranked 1, 2, 3, respectively

Cancer-based on age group

%, besides age range of >80 years as much as 1.4%. It shows that more than 53% of cancer cases are diagnosed in the age range of 41-60 years (Table 2).

Table 2. Three cancers are most common by age group

Age group (years)	n	n (%)	3 most common cancers found in each age group (n%)*
0-10	102	3	1. Acute lymphoblastic leukemia (24,5%) 2. Acute leukemia (23.5%) 3. Non-Hodgkin lymphoma (17,6%)
11-20	102	3	
21-30	190	5.6	1. Infiltrating duct carcinoma (17.1%) 2. Adenocarcinoma (9.4%) 3. Non-keratinizing squamous cell carcinoma (7,6%)
31-40	464	13.6	
41-50	870	25.5	1. Adenocarcinoma (16.8%) 2. Infiltrating duct carcinoma (15.5%) 3. Non-keratinizing squamous cell carcinoma (8,2%)
51-60	938	27.5	
61-70	489	14.3	
71-80	211	6.2	
>80	47	1.4	

*Ranked 1,2,3, respectively

Acute lymphoblastic leukemia is the most common cause of cancer (24.5%) in the age group of 0-20 years, followed by acute leukemia (23.5%), and non-Hodgkin lymphoma (17.6%). In the 21-40-year-old age group, infiltrating duct carcinoma is the most common cause of cancer (17.1%), followed by adenocarcinoma (9.4%), and non-keratinizing squamous cell carcinoma (7.6%). In the >40 age group, adenocarcinoma is the most common cause of cancer (16.8%), followed by infiltrating duct carcinoma (15.5%), and non-keratinizing squamous cell carcinoma (8.2%) (Table 2).

Cancer based on location (topography)

Based on the location of cancer, the 10 highest cancer cases came from breast (24.4%), cervix-uteri (10.9%), colon (10.4%), lung (6.01%), ovaries (4.08%), hematopoietic and reticuloendothelial system (4.02%), pharynx (4.01%), thyroid (3.06%), skin (3.01%), and lymph nodes (2.07%).

Sixty percent of cancers originating from the breast organ are infiltrating duct carcinoma, followed by carcinoma, NOS (9.6%), and infiltrating lobular carcinoma (8.3%). Thirty-four percent of cervix-uterine cancers are non-keratinizing squamous cell carcinoma, followed by keratinizing squamous cell carcinoma, and endometrioid adenocarcinoma. As many as 62.6% of cancer originating from the colon organs are adenocarcinoma, followed by mucinous adenocarcinoma (15.7%), and signet ring cell carcinoma (5.1%). And from the lung organs, 38% of malignant neoplasms are adenocarcinoma, followed by carcinoma, NOS (18.8%), and squamous cell carcinoma (10.1%).

Twenty-five percent of ovarian cancer are serous cystadenocarcinoma, followed by clear cell adenocarcinoma (18.3%), and endometrioid adenocarcinoma (11%). Acute lymphoblastic

leukemia (21.8%) is the most found cancer from the hematopoietic and reticuloendothelial system, followed by acute myeloid leukemia (19.7%) and acute leukemia (18.3%). There are 54.3% of pharyngeal non-keratinizing squamous cell carcinoma, despite carcinoma, NOS (13.6%), and non-Hodgkin lymphoma (7.9%). In the thyroid gland, papillary carcinoma is the most found malignant neoplasma (74.6%), followed by carcinoma, NOS (4.1%), and anaplastic carcinoma (3.3%). There are 3 malignant neoplasms from the skin such as basal cell carcinoma (27.1%), keratinizing squamous cell carcinoma (7.5%), and non-keratinizing squamous cell carcinoma (7.5%) mostly frequent. Also in the lymph node, 74.7% of cancers were non-Hodgkin lymphoma, Hodgkin lymphoma (7.7%), and metastatic carcinoma, NOS (4.4%) (Table 3).

Table 3. The three most common cancers based on topography

Topography	n	Rank 1	n (%)	Rank 2	n (%)	Rank 3	n (%)
Payudara	831	Infiltrating Duct Carcinoma	60,3	Carcinoma, NOS	9,6	Infiltrating Lobular Carcinoma	8,3
Cervix-uteri	373	Non-keratinizing Squamous Cell Carcinoma	34	Keratinizing Squamous Cell Carcinoma	12,9	Endometrioid Adenocarcinoma	10,9
Kolon	356	Adenocarcinoma, NOS	62,6	Mucinous Adenocarcinoma	15,7	Signet Ring Cell Carcinoma	5,1
Paru	208	Adenocarcinoma, NOS	38	Carcinoma, NOS	18,8	Squamous Cell Carcinoma	10,1
Ovarium	164	Serous Cystadenocarcinoma	25	Clear Cell Adenocarcinoma	18,3	Endometrioid Adenocarcinoma	11
Hematopoietic and RES	142	Acute Lymphoblastic Leukemia	21,8	Acute Myeloid Leukemia	19,7	Acute Leukemia	18,3
Faring	140	Non-keratinizing Squamous Cell Carcinoma	54,3	Carcinoma, NOS	13,6	Non-Hodgkin Lymphoma	7,9
Kelenjar Tiroid	122	Papillary Carcinoma	74,6	Carcinoma, NOS	4,1	Anaplastic Carcinoma	3,3
Kulit	107	Basal Cell Carcinoma	27,1	Keratinizing Squamous Cell Carcinoma	7,5	Non-keratinizing Squamous Cell Carcinoma	7,5
Kelenjar Getah Bening	91	Non-Hodgkin Lymphoma	74,7	Hodgkin Lymphoma	7,7	Metastasis Carcinoma, NOS	4,4

A total of 824 cases of cancer in women originated from the breast, 373 cases from the cervix-uteri, 167 cases from the colon, 164 cases from ovaries, and 101 cases from the thyroid gland. A total of 189 cases of cancer in men occurred in colonic organs, 154 cases in the lungs, 99 cases in the pharynx, 88 cases in the blood and reticuloendothelial system, and 62 cases in the lymph nodes (Table 4).

Table 4. Five most frequent locations of cancer

Male		Female	
Location	**n**	**Organ**	**n**
Colon	189	Breast	824
Lung	154	Cervix-Uteri	373
Phyarynx	99	Colon	167
Hematopoietic and RES	88	Ovarii	164

Distribution of cancer-based on cell origin

A total of 2457 cancer cases (72%) originated from epithelial cells (carcinoma), as well as from lymphoid cells (lymphoma) (8.2%), and mesenchymal cells (sarcoma) (Figure 1).

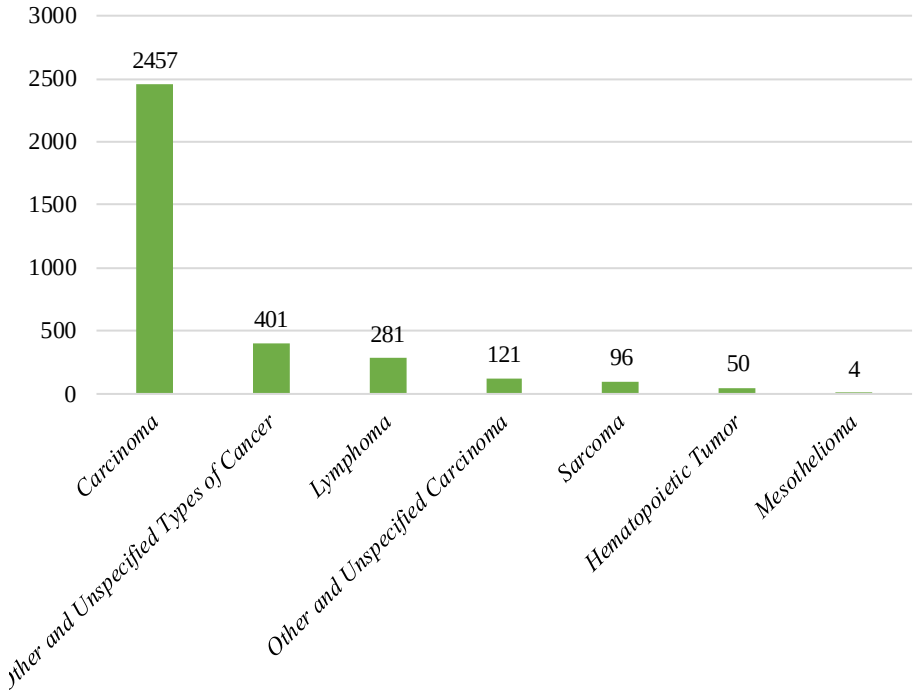

Figure 1. Distribution of cancer cases by cell origin. There were 2457 cases of cancer originating from epithelial cells (carcinoma).

4. Discussion

World data published by GLOBOCAN in 2021 states that the incidence of cancer in Southeast Asian women is higher than in men over the past 5 years.[6] The research of Gondhowiardjo et al showed that women have a 2 times higher risk than men for cancer.[21] These data are consistent with studies conducted which show that the prevalence of cancer in women is higher than in men. Infiltrating duct carcinoma occupied the first position as cancer compared to adenocarcinoma and non-keratinizing squamous cell carcinoma. This result is in line with research conducted by Gondhowiardjo et al and data released by the hospital's cancer registration of Dr. Sardjito Yogyakarta in 2008-2019, where infiltrating duct carcinoma is the most frequent case of malignancy in the breast.[21] On the other hand, the highest cancer that occurs in men comes from colorectal organs, where as many as 76.3% of cases are adenocarcinoma.[22]

In genetic and molecular studies, disease susceptibility varies between sexes. This can be caused due to different molecular and hormonal factors between men and women. The genetic and molecular gap between men and women contributes to differences in the incidence of different types of cancer. Men show a higher incidence of colon cancer than women. Genetic polymorphisms associated with certain enzymes may affect the risk of different carcinogenesis in males and females.[16,23]

Based on age, the distribution of cancer cases in this study is similar to the data released by Dr. Cipto Mangunkusumo Hospital as a National Referral Hospital in Indonesia, where most cancer cases are diagnosed at the age of decade 4 to decade 5.[21]

Data from the National Cancer Institute (NIH) showed the overall cancer incidence rate continues to rise with age, from less than 25 cases per 100,000 people in the age group under 20 years, to about 350 per 100,000 people in the age group 45-49 years, to more than 1,000 per 100,000 people in the age group 60 years and over.[14]

According to SEER data, the average age to be diagnosed with cancer is 66 years. A similar pattern is seen in certain types of cancer. For example, the average age at diagnosis was 62 years for breast cancer, 67 years for colorectal cancer, 71 years for lung cancer, and 66 years for prostate cancer.[24]

Acute lymphoblastic leukemia is the most common cancer that occurs in the age group 0-20 years, followed by acute leukemia and non-Hodgkin lymphoma. This finding is in line with the research of Chang et al. which states that acute lymphoblastic leukemia is the most common malignancy that occurs in children, which arises due to the uncontrolled proliferation of lymphoid progenitor cells.[25] In the USA group of 21-40 years, infiltrating duct carcinoma, adenocarcinoma, and non-keratinizing squamous cell carcinoma are frequently found in this age group. Huang et al's research also states that more than 91% of cases of infiltrating duct carcinoma, which is the most common cause of cancer in women, are diagnosed at the age of more than 20 years.[26] In the >40 age group, adenocarcinoma ranks first as the most common cancer, followed by infiltrating duct carcinoma, and non-keratinizing squamous cell carcinoma. These results are consistent with data from Wismayer et al. that more than 80% of adenocarcinoma cases are diagnosed at the age of >40 years.[27]

Based on the topography, the 10 highest cancer cases in this study came from the breast, cervix-uteri, colon, lung, ovaries, hematopoietic and RES, pharynx, thyroid gland, skin, and lymph nodes. When further stratified by sex, most cases occurred in women originating from the breast organs, followed by the cervix-uteri, colon, ovaries, and thyroid gland. The high incidence of breast cancer in this study is in accordance with world data, and neighboring countries such as Malaysia, Singapore, and Thailand, where the ethnic profile is similar to that of Indonesia.[6] Data from GLOBOCAN noted that in 2020, 24.5% of cancer cases in women came from breast organs.[6] These results are also consistent with research conducted by Gondhowiardjo et al. at Dr. Cipto Mangunkusumo Hospital Jakarta, where breasts are the location of the most common cancer in women.[28]

When the results of the study were further stratified based on location, it was found that infiltrating duct carcinoma is the most common case of cancer in the breast organs. These results are consistent with the results of research by Gondhowiardjo et al and the Dr. Sardjito Hospital cancer registry team, placing infiltrating duct carcinoma in the first position as the most common cancer in the breast organs.[22,28] The most common cancer found in cervix-uterine in this study is similar to Gondhowiardjo et al, where non-keratinizing squamous cell carcinoma and keratinizing squamous cell carcinoma are the two most frequent types found in this organ besides adenocarcinoma, NOS.[28] Data

from the Dr. Sardjito hospital's cancer registry also placed squamous cell carcinoma in the first place as the most common cancer in the cervix followed by adenocarcinoma.[22]

For colorectal cancer, the results of this study are similar to world data which states that 90% of colorectal malignancies are adenocarcinomas and data from the Dr. Sardjito hospital's cancer registry, as well as lung cancer in both men and women (76,3%).[22]

Ovarial data cancer from Dr. Sardjito's cancer registrary had slightly different results from this study, which is the most frequent type of cancer found was adenocarcinoma type despite cystadenocarcinoma.[22]

Acute lymphoblastic leukemia is the most common type of cancer in hematopoietic and RES. This is similar to the results of research at RSCM, where the most common type of cancer is acute lymphoblastic leukemia (ALL), followed by chronic myeloid leukemia (CML), acute myeloid leukemia (AML), malignant neoplasm, multiple myeloma, and other types.[31] Furthermore, epidemiological data from various countries collected by Dong et al showed the highest incidence of cancer types in hematopoietic and RES organs was ALL, followed by AML, CML, and other types.[32]

According to the WHO classification, nasopharyngeal carcinoma is divided into three types: keratinizing squamous cell carcinoma (WHO type I), nonkeratinizing squamous cell carcinoma (WHO type II), and undifferentiated carcinoma (WHO type III). Type III carcinoma is the most common type found in RSCM (85%) and Iran's population.[33,34] On the contrary, the most common cancer type found in this study was nonkeratinizing squamous cell carcinoma (WHO type 2).

The surveillance, Epidemiology, and End Result Program's data show that from 1995 to 2018, there was 90% papillary thyroid carcinoma (PTC), followed by 4% in the form of follicular thyroid carcinoma (FTC), 2% Hurthle-cell carcinoma, 2% medullary thyroid carcinoma (MTC), and 1% anaplastic thyroid carcinomas (ATC) among thyroid cancer.[24] It is similar to the results of this study that the majority of thyroid cancer cases are of papillary thyroid carcinoma.

Skin cancer data from Cipto Mangunkusumo Hospital (2014-2017) and this study showed similar results, where the two most common types of skin cancer are basal cell carcinoma and squamous cell carcinoma (SCC).[21] Similarly, registry data from Australia, showed that basal cell carcinoma is the most common type of skin cancer, while melanoma cases account for only 10% of all cases.[35] But in the Japanese population, squamous cell carcinoma was found to be the first most common type of skin cancer cases (43.9%), followed by BCC (37.2%), and melanoma malignant (7.2%).[36]

According to 2020 GLOBOCAN data, non-Hodgkin lymphoma has a seven times higher incidence compared to Hodgkin lymphoma. Non-Hodgkin lymphoma cases are the fifth most common cases in the Cancer Registry at Dr. Sardjito Hospital, with a proportion of 5.4% of all cancer cases diagnosed in 2008-2018, and mostly occur in men. Cases of non-Hodgkin lymphoma in patients are dominated by diffuse large B-cell lymphoma subtype (43.3%).[22]

Cancer was divided into several groups based on cell origin. It refers to the international morphological code ICD-O. The first group is cancer derived from specific epithelial cells consisting of squamous and transitional cell carcinoma (codes 8051-8084, 8120-8131), basal cell carcinomas (codes 8090-8110), and adenocarcinomas (codes 8140-8149, 8160-8162, 8190-8221, 8260-8337, 8350-8551, 8570-8576, and 8940-8941). The second group is cancer originating from other specific epithelial cells and nonspecific epithelial cells consisting of other specific carcinomas such as giant cell and spindle cell carcinoma to non-small cell carcinoma (codes 8030-8046, 8150-8157, 8170-8180, 8230-8255, 8340-8347, 8560-8562, and

8580-8671), and unspecified carcinoma (NOS) such as carcinoma, NOS to Glassy cell carcinoma (codes 8010-8015, 8020-8022, and 8050).[37] The third group is cancer derived from lymphoid cells, consisting of T-cells and NK-cell neoplasms, to hodgkin lymphoma (codes 9670-9699, 9728, 9731-9734, 9761-9767, 9769, 9823-9826, 9833, 9836, 9940, 9700-9719, 9729, 9768, 9827-9831, 9834, 9837, 9948, 9650-9667, 9740-9742, 9750-9758, 9140). The fourth group is cancer of hematopoietic origin consisting of myeloid to mast cell tumors (codes 9840, 9861-9931, 9945-9946, 9950, 9961-9964, 9980-9987, 9740-9742). The fifth group is cancer derived from mesenchymal cells consisting of sarcoma and soft tissue tumors (codes 8680-8713, 8800-8921, 8990-8991, 9040-9044, 9120-9125, 9130-9136, 9141-9252, 9370-9373, and 9540-9582). The sixth group is another group of specific cancer and the group of non-specific cancer consists of malignant melanoma to a malignant tumor, clear cell type (codes 8720-8790, 8930-8936, 8950-8983, 9000-9030, 9060-9110, 9260-9365, 9380-9539, and 8000-8005). The last group is cancer mesothelioma (codes 9050-9055).[37]

More than half of cancer in this study is in line with research conducted by Saggioro et al, where the incidence of cancer cases originating from epithelial cells is higher than the origin of mesenchymal cells.[38] Previous research also showed that carcinomas are the most common cancer to be found (90%), while sarcoma, leukemia, and lymphoma account for only about 8% of human malignancies. Sanggioro et al also say that sarcoma is one of the rare forms of cancer. Not only rare, this type of cancer is also very heterogeneous because it consists of more than 70 different subtypes of the disease. Rare types of sarcoma subtypes can have an incidence of ≤1 per 1,000,000 population, making it very challenging for doctors to both diagnose and manage the disease with these subtypes. In addition, this result is also in line with the high incidence of cancer-based on location, one of which is in the breast organ, where more than 85% of cancer cases in the breast are carcinoma.[28]

5. Conclusion

Most cancers were diagnosed in the age group 41-60 years for both sexes. The incidence is more common in women and breast. On the other hand, cancers of the colon, lung, pharynx, hematopoietic and RES systems, and lymph nodes are the most common cancers in men. Carcinoma is still the most common cancer to be found.

Data quality plays a major role in the cancer registry. Therefore, every clinician, pathologist, registrar, and hospital management has to ensure comparability, validity, timeliness, and completeness of the cancer registry data.

6. References

1. Kumar V, Abbas A, Aster J, Turner J. Cancer. In: Robbins & Cotran Pathologic Basis of Disease 10th rev. ed. Philadelpia: Elsevier. 2021. p268–316.
2. Hanahan D. Hallmarks of cancer: New dimensions. Canc Discov 2022;12(1):31–46.
3. Kobayashi H. Cancer registry. Teikyo Med J 2019;6(42):205–7.
4. Djiauw D, Bens P, Evlina S. Pengembangan sistem registrasi kanker Indonesia. Indones J Cancer 2012;6(2):61–6.
5. Montanino A, Manzo A, Carillio G, Palumbo G, Esposito G, Sforza V, et al. Angiogenesis inhibitors in small cell lung cancer. Front Oncol 2021;5(11):222-33.
6. Sung H, Ferlay J, Siegel R, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin 2021;71(3):209–49.
7. Parkin D. The evolution of the population-

based cancer registry. Nat Rev Cancer 2006;6(8):603–12.
8. Robert T. Surveillance, epidemiology, and results (SEER). J Epid 2021;7(1):1-4.
9. Skeet R. Cancer registration: principles and methods. IARC Sci Publ 1991;(95):101–7.
10. Steeg P. Targeting metastasis. Nat Rev Cancer 2016;16(4):201–18.
11. Patterson A, Gonzalez F, Perdew G, Peters J. Molecular regulation of carcinogenesis: Friend and foe. Toxicol Sci 2018;165(2):277–83.
12. Nissen N, Karsdal M, Willumsen N. Collagens and cancer-associated fibroblasts in the reactive stroma and its relation to cancer biology. J Exp Clin Cancer Res 2019;38(1):1–12.
13. Arem H, Loftfield E. Cancer epidemiology: A survey of modifiable risk factors for prevention and survivorship. Am J Lifestyle Med 2018;12(3):200–10.
14. Tran K, Lang J, Compton K, Xu R, Acheson A, Henrikson H, et al. The global burden of cancer attributable to risk factors, 2010–19: a systematic analysis for the Global Burden of Disease Study 2019. Lancet 2022;400(10352):563–91.
15. White M, Holman D, Boehm J, Peipins L, Grossman M, Jane Henley S. Age and cancer risk: A potentially modifiable relationship. Am J Prev Med 2014;3(46):1–16.
16. Siegel R, Miller K, Jemal A. Cancer statistics, 2016. CA Cancer J Clin 2016;66(1):7–30.
17. Haug U, Riedel O, Cholmakow C, Olsson L. First-degree relatives of cancer patients: A target group for primary prevention? A cross-sectional study. Br J Cancer 2018;118(9):1255–61.
18. Gupta P, Pastushenko I, Skibinski A, Blanpain C, Kuperwasser C. Phenotypic plasticity: Driver of cancer initiation, progression, and therapy resistance. Cell Stem Cell 2019;24(1):65–78.
19. Lugano R, Ramachandran M, Dimberg A. Tumor angiogenesis: causes, consequences, challenges, and opportunities. Cell Mol Life Sci 2020;77(9):1745–70.
20. Prior I, Hood F, Hartley J. The frequency of ras mutations in cancer. Cancer Res 2020;80(14):2669–974.
21. Gondhowiardjo S, Brohet K, Nugroho C, Panigoro S, Adham M, Prajogi G, et al. Research article cancer epidemiology based on hospital-based cancer registry at national referral hospital of Indonesia. CA Epid Nat Ref Hosp eJKI 2021;9(1):36-43.
22. Tim Registrasi Kanker RSUP. Dr. Sardjito. Distribusi Kasus Kanker RSUP Dr. Sardjito/ FK-KMK UGM 2008-2019 [Internet]. Yogyakarta: Jogja Can; 2022. Available from: https://canreg.fk.ugm.ac.id/laporan-data/registrasi-kanker-berbasis -rumah-sakit-dr-sardjito-fkkmk-ugm/rkbr-maret-2022/
23. Kim H, Lim H, Moon A. Sex differences in cancer: Epidemiology, genetics and therapy. Biomol Ther 2018;26(4):335–42.
24. Adamo M, Groves C, Dickie L, Ruhl J. SEER program coding and staging manual 2021. Nat CA Inst 2021;1(9):1–271.
25. Chang J, Poppe M, Hua C, Marcus K, Esiashvili N. Acute lymphoblastic leukemia. Pediatr Blood Cancer 2021;68(52):1–7.
26. Huang Z, Hu C, Liu K, Yuan L, Li Y, Zhao C, et al. Risk factors, prognostic factors, and nomograms for bone metastasis in patients with newly diagnosed infiltrating duct carcinoma of the breast: a population-based study. BMC Cancer 2020;20(1):1–17.
27. Wismayer R, Kiwanuka J, Wabinga H, Odida M. Colorectal adenocarcinoma in Uganda: are right-sided and left-sided colon cancers

two distinct disease entities? World J Surg Oncol 2023;21(1):1–13.

28. Gondhowiardjo S, Ekaputra E, Randi A, Jayalie V. The challenge of the implementation and evaluation of hospital-based cancer registry in Indonesia's national referral hospital. Med J Indones 2020;29(4):431–5.
29. Barta J, Powell C, Wisnivesky J. Global epidemiology of lung cancer. Ann Glob Heal 2019;85(1):1–16.
30. Nagtegaal I, Arends M, Salto-Tellex M. Colorectal adenocarcinoma. In: WHO classification of tumors digestive 5th rev. ed. France: IARC. 2019. p177–87.
31. Gondhowiardjo S, Nurhidayat W, Zhafirah NF, Jayalie V, Sekarutami S, Koesmedi Priharto R, et al. Cancer profile in Jakarta: A 5-year descriptive study. Maced J Med Sci 2023;11(5):17-22.
32. Dong Y, Shi O, Zeng Q, Lu X, Wang W, Li Y, et al. Leukemia incidence trends at the global, regional, and national levels between 1990 and 2017. Exp Hematol Oncol 2020;9(1):1–11.
33. Adham M, Kurniawan A, Muhtadi AI, Roezin A, Hermani B, Gondhowiardjo S, et al. Nasopharyngeal carcinoma in Indonesia: Epidemiology, incidence, signs, and symptoms at presentation. Chin J Cancer 2012;31(4):185–96.
34. Chamani G, Zarei M, Rad M, Hashemipoor M, Haghdoost A. Epidemiological aspects of oral and pharyngeal cancer in Kerman Province, South Eastern Iran. Iran J Public Health 2009;38(2):90–7.
35. Belisario J. Melanoma. In: Skin cancer in Australia. Canberra: AIHW.2016. p5–12.
36. Ogata D, Namikawa K, Nakano E, Fujimori M, Uchitomi Y, Higashi T, et al. Epidemiology of skin cancer based on Japan's National Cancer Registry 2016–2017. Cancer Sci 2023;114(7):2986–92.
37. Fritz A, Percy C, Jack A, Shanmugaratnam K, Sobin L, Parkin M, et al. Coding guidelines for topography and morphology. In: International Classification of Diseases for Oncology 3rd ed. Edition. Switzerland: WHO. 2020. p14-93
38. Saggioro M, D'Angelo E, Bisogno G, Agostini M, Pozzobon M. Carcinoma and Sarcoma Microenvironment at a Glance: Where we are. Front Oncol 2020;10(3):1–9.