

# The proportion of thyroid cancer and other cancers in the Democratic Republic of Congo.

**John Bukasa Kakamba**

University of Kinshasa: Universite de Kinshasa

**Pascal Bayauli**

University of Kinshasa: Universite de Kinshasa

**Ayrton Bangolo** (✉ [ayrtonbangolo@yahoo.com](mailto:ayrtonbangolo@yahoo.com))

Palisades Medical Center <https://orcid.org/0000-0002-2133-2480>

**Branly Mbunga**

University of Kinshasa: Universite de Kinshasa

**Francis Iyese**

University of Kinshasa: Universite de Kinshasa

**Aliocha Nkodila**

Universite Protestante du Congo

**Ali Atoot**

Palisades Medical Center

**Gaurav Anand**

Palisades Medical Center

**Maimona Chaudhary**

Palisades Medical Center

**Pamela Q. Fernandes**

Palisades Medical Center

**Hari PSS. Mannam**

Palisades Medical Center

**Adithya Polavarapu**

Palisades Medical Center

**Mera Junnissa**

Palisades Medical Center

**Abdullah Azhar**

Palisades Medical Center

**Mohan N. Alichetty**

Palisades Medical Center

**Gauravdeep Singh**

Palisades Medical Center

**Georgemar V. Arana**

Palisades Medical Center

**Manbir Singh**

Palisades Medical Center

**José D. Rodriguez-Castro**

Palisades Medical Center

**Adam Atoot**

Palisades Medical Center

**Simcha Weissman**

Palisades Medical Center

**Jean Rene M'buyamba**

Palisades Medical Center

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## Research Article

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# Abstract

**Background:** Cancer diagnosis is increasing around the world and in the Democratic Republic of the Congo (DRC). The frequency of thyroid cancer has increased over the past three decades. There are very few studies on cancer epidemiology, and in particular on thyroid cancer in the DRC. This study aims to establish the most recent frequency and proportion of thyroid cancer in the DRC compared to other cancers.

**Methods:** This is a retrospective and descriptive study of 6,106 consecutive cancer cases listed in the pathological registers of 4 laboratories in the city of Kinshasa. This study included all cancer cases recorded in the registers between 2005 and 2019.

**Results:** From a sample of 6,106 patients, including all cancer types, 68.2% cases were female and 31.2% were male. Breast and cervical cancer were the most common types of cancer in women and, prostate and skin cancer were the most common types in men. Thyroid cancer was sixth in frequency in women and eleventh in men compared to all cancers. Papillary carcinoma was the most common of thyroid cancers. Rare cancers such as anaplastic and medullary thyroid carcinomas had a frequency of 7% and 2%, respectively.

**Conclusion:** Newer diagnostic tools led to a surge in cancer diagnoses in the DRC. Thyroid cancer has more than doubled its frequency over the last several decades in the country.

**Trial registration:** Our research protocol has obtained the approval of the national health ethics committee of the DRC, number 197/CNES/BN/PMMF/2020.

## Background

Thyroid pathology is the most common endocrinopathy worldwide [1] and is mostly represented by goiters and nodules [2, 3]. Five to ten percent of thyroid nodules are malignant [3–6]. Thyroid cancer only represents 1% of all cancers worldwide [7, 8] but has occupied the fifth position among all cancers in France and Canada in women in terms of incidence and twentieth in terms of mortality in 2005 [9–11]. The improvement of diagnostic techniques by means of thyroid ultrasound, fine needle aspiration, Computed Tomography scan and detailed histopathological analyses partly explains the increase in incidence of thyroid cancer [12, 13]. Despite this increase in incidence, the mortality curve has remained stable over time [10, 14].

The Democratic Republic of the Congo (DRC) is a low-income country where there are only 7 pathology laboratories for more than 80 million citizens. Five of these laboratories are located in the capital city of Kinshasa. The typical Congolese meals have been characterized with a low iodine content for decades. Iodine deficiency is a well-known risk factor for thyroid cancer [14, 15]. We thus hypothesize that thyroid cancer may be frequent in the DRC but reliable data on cancers in general and thyroid cancer in particular is scarce. The first study addressing thyroid cancer prevalence in the DRC was conducted by Mashinda et

al and it revealed, in women, a thyroid cancer frequency of 0.5% out of all cancers found in the anatomopathological records between 1969 and 2008 [16]. Although epidemiologic trend changes are expected to be gradual, the available data now seems dated. The objective of this study is thus to provide more recent thyroid cancer frequency data using the largest series analyzed so far in the DRC.

## Methods

This is a retrospective and descriptive study of thyroid cancers and of all types of cancer retrieved from the records of 4 anatomopathological laboratories including that of Kinshasa University Clinics, National Institute of Biomedical Research (INRB), Kinshasa General Hospital (HGRK) and LEBOMA laboratory. All these laboratories are located in the capital city of Kinshasa, a city of nearly 12 million inhabitants. This study included cancers diagnosed in those centers between 2005 and 2019, except for the data obtained from LEBOMA laboratory, which covered from 2015 to 2019. The choice of these centers was governed by the fact that they are the only pathology laboratories in the town of Kinshasa with available data over the period of the study. We calculated the relative frequency of thyroid cancer by dividing the number of thyroid cancers by the number of all types of cancer. It's important to report that calcitonin was not measured preoperatively in patients with thyroid cancer.

The study took into account the following socio-demographic characteristics: age, gender, year of diagnosis and histopathological diagnosis.

The following types of cancer were taken into account: breast cancer, cervical cancer, prostate cancer, skin cancer, hematologic cancers, uterine cancer, colon cancer, lung cancer, stomach cancer, bone cancer, thyroid cancer, anorectal cancer, Kaposi sarcoma, soft tissue cancers, eye cancers, ovarian cancer, mouth cancer, vaginal cancer, urinary bladder cancer, laryngeal cancer, nose cancer, peritoneal cancer, liver cancer, renal cancer, vulva cancer, ureteral cancer, nasopharyngeal cancer, intestinal cancer, pancreatic cancer, greater omentum cancer, esophageal cancer, penile cancer, testicular cancer, tonsillar cancer, brain cancer, coecum cancer, vocal cords cancer, ear cancer, parotid glands cancer, duodenal cancer, cancer of the palate, forehead cancer, glottis cancer, trachea cancer, sweat glands cancer, maxillary cancer and splenic cancer.

Data was entered into Excel and transported to Statistical Package for the Social Sciences (SPSS) version 21. Quantitative variables were expressed as mean (+/- standard deviation) or median (+/- interquartile range) for variables that did not have a normal distribution. Qualitative variables were expressed as proportions. Student's t-test was used for comparing averages between men and women. Chi-square test or Fisher's exact test was used to compare the difference in proportions between the 2 groups regarding qualitative variables. A p value < 0.05 was of statistical significance.

## Results

6,106 cancer cases were included in this study. A female predominance was observed with 68.2% of cases versus 32.8% for men with a female/male ratio of 4. We noted 106 cases of thyroid cancer, representing 1.7% of the total number of cancer cases. The frequency of all types of cancer according to their location and gender, are grouped together in Table 1.

Table 1  
Cancer distribution by affected organs and gender.

	<b>All</b> <b>n = 6106</b>	<b>Females</b> <b>n = 4169 (68,3%)</b>	<b>Males</b> <b>n = 1937 (31,7%)</b>
Breast	1631 (26,7)	1560 (37,4)	71 (3,7)
Cervix	1138 (18,6)	1138 (27,3)	-
Prostate	678 (11,1)	-	678 (35)
Skin	356 (5,8)	186 (4,5)	170 (8,8)
Blood and LO	206 (3,4)	95 (2,3)	111 (5,7)
Uterus	196 (3,2)	196 (4,7)	-
Colon	173 (2,8)	92 (2,2)	81 (4,2)
Lungs	161 (2,6)	60 (1,4)	101 (5,2)
Stomach	112 (1,8)	45 (1,1)	67 (3,5)
Bone	110 (1,8)	58 (1,4)	52 (2,7)
Thyroid	106 (1,7)	84 (2)	22 (1,1)
Anus / rectum	97 (1,6)	51 (1,2)	46 (2,4)
KS	87 (1,4)	22 (0,5)	65 (3,4)
Soft tissue	87 (1,4)	52 (1,2)	35 (1,8)
Eye	77 (1,3)	35 (0,8)	42 (2,2)
Ovary	77 (1,3)	77 (1,8)	-
Mouth	76 (1,2)	44 (1,1)	32 (1,7)
Vagina	75 (1,2)	75 (1,8)	-
Urinary bladder	73 (1,2)	32 (0,8)	41 (2,1)
Larynx	65 (1,1)	11 (0,3)	54 (2,8)
Nose	62 (1,0)	28 (0,7)	34 (1,8)
Peritoneum	51 (0,8)	24 (0,6)	27 (1,4)
Liver	49 (0,8)	24 (0,6)	25 (1,3)
Kidneys	41 (0,7)	21 (0,5)	20 (1)
Vulva	41 (0,7)	41 (1)	-
Ureter	33 (0,5)	14 (0,3)	19 (1)

	<b>All</b> <b>n = 6106</b>	<b>Females</b> <b>n = 4169 (68,3%)</b>	<b>Males</b> <b>n = 1937 (31,7%)</b>
Pharynx/nasopharynx	33 (0,5)	19 (0,4)	14 (0,7)
Intestines	29 (0,5)	16 (0,4)	13 (0,7)
Pancreas	29 (0,5)	13 (0,3)	16 (0,8)
Greater omentum	22 (0,4)	15 (0,4)	7 (0,4)
Esophagus	21 (0,3)	8 (0,2)	13 (0,7)
Penis	20 (0,3)	-	20 (1)
Testicles	20 (0,3)	-	20 (1)
Tonsils	13 (0,2)	5 (0,1)	8 (0,4)
Brain	10 (0,2)	6 (0,1)	4 (0,2)
Coecum	10 (0,2)	4 (0,1)	6 (0,3)
Vocal cords	8 (0,1)	1 (0,0)	7 (0,4)
Ears	7 (0,1)	5 (0,1)	2 (0,1)
Parotid glands	7 (0,1)	2 (0,0)	5 (0,3)
Duodenum	6 (0,1)	2 (0,0)	4 (0,2)
Palate	4 (0,1)	4 (0,1)	0 (0,0)
Forehead	2 (0,0)	1 (0,0)	1 (0,1)
Glottis	2 (0,0)	0 (0,0)	2 (0,1)
Trachea	2 (0,0)	1 (0,0)	1 (0,1)
Sweat glands	1 (0,0)	1 (0,0)	0 (0,0)
Maxillary	1 (0,0)	1 (0,0)	0 (0,0)
Spleen	1 (0,0)	0 (0,0)	1 (0,1)

The most common types of cancer, in decreasing order of frequency were breast cancer, cervical cancer, prostate cancer, skin cancer and lymphoid cancers. Thyroid cancer ranked eleventh in frequency for all cancer types.

The five most common types of cancer in women were breast cancer, cervical cancer, uterine cancer, skin cancer and lymphoid organ (LO) cancer. Thyroid cancer was ranked Sixth with a frequency of 2%.

The five most common types of cancer in men were prostate cancer, skin cancer, LO cancer, lung cancer and colon cancer. For men, thyroid cancer was ranked eleventh (1.1% of all types of cancer).

The male gender was more represented in the age groups  $\leq 30$  and  $> 60$ , while the female gender was more represented in the age groups between 30 and 60 years old. Most cases of cancer in women occur between the ages of 40 and 60 and in men over 50. The number of patients diagnosed with cancer increases with age in both genders.

In the age group up to 40 years old and between 41 and 60 years old, breast cancer was the most common type of cancer. In the age group of over 61, prostate cancer was the most common. Thyroid cancer occupied the sixth position in the age group under 41 years, the tenth in the age group between 41 years and 60 years and the sixteenth in the age group over 60 years old. Figure 1 represents cancer cases' distribution based on age and gender.

The frequencies of cancer cases according to age groups are found in Table 2.



Table 2  
Cancer distribution by age group.

Cancers	≤ 40 y.o		41–60 y.o		≥ 61 y.o	
	N (1409)	23%	N (2689)	44%	N (2008)	33%
Prostate	25	1,8	122	4,5	531	26,4
Cervical	156	11,1	611	22,7	371	18,5
Breast	403	28,6	895	33,3	333	16,6
Skin	141	10,0	133	4,9	82	4
Uterus	22	1,6	107	4,0	67	3,3
Lungs	30	2,1	64	2,4	67	3,3
Blood and LO	106	7,5	48	1,8	52	2,6
Colon	37	2,6	92	3,4	44	2,2
Stomach	19	1,3	60	2,2	33	1,6
K S	32	2,3	24	0,9	31	1,5
Soft tissue	27	1,9	30	1,1	30	1,5
Vessels	13	0,9	32	1,2	28	1,4
Bones	51	3,6	33	1,2	26	1,3
Vagina	16	1,1	33	1,2	26	1,3
Larynx	18	1,3	21	0,8	26	1,3
Anus-rectum	27	1,9	45	1,7	25	1,2
Thyroid	37	2,6	45	1,7	24	1,2
Mouth	28	2,0	24	0,9	24	1,2
Liver	12	0,9	19	0,7	18	0,9
Ureter	3	0,2	12	0,4	18	0,9
Vulva	4	0,3	20	0,7	17	0,8
Ovary	25	1,8	36	1,3	16	0,8
Peritoneum	12	0,9	23	0,9	16	0,8
Nose	26	1,8	23	0,9	13	0,6
Eye	35	2,5	30	1,1	12	0,6
Esophagus	5	0,4	6	0,2	10	0,5

Cancers	≤ 40 y.o		41–60 y.o		≥ 61 y.o	
	N (1409)	23%	N (2689)	44%	N (2008)	33%
Testicles	8	0,6	2	0,1	10	0,5
Pharynx	14	1,0	8	0,3	9	0,4
Pancreas	5	0,4	16	0,6	8	0,4
Intestines	7	0,5	15	0,6	7	0,3
Kidney	23	1,6	11	0,4	7	0,3
Vocal cords	1	0,1	2	0,1	5	0,2
Greater Omentum	7	0,5	11	0,4	4	0,2
Penis	5	0,4	12	0,4	3	0,1
Duodenum	1	0,1	2	0,1	3	0,1
Tonsils	4	0,3	7	0,3	2	0,1
Coecum	5	0,4	3	0,1	2	0,1
Ears	4	0,3	1	0,0	2	0,1
Palate	1	0,1	1	0,0	2	0,1
Parotid glands	3	0,2	3	0,1	1	0,0
Trachea	1	0,1	0	0,0	1	0,0
Maxillary	0	0,0	0	0,0	1	0,0
Spleen	0	0,0	0	0,0	1	0,0
Brain	6	0,4	4	0,1	0	0,0
Glottis	0	0,0	2	0,1	0	0,0
Nasopharynx	1	0,1	1	0,0	0	0,0
Forehead	2	0,1	0	0,0	0	0,0
Sweat glands	1	0,1	0	0,0	0	0,0

Papillary carcinoma was the most common type of thyroid cancer, representing 67% of all thyroid cancer cases followed by the follicular type in 21% of cases. The anaplastic type occupied the third, lymphoma the fourth and medullary cancer the fifth position.

The frequencies of the different types of thyroid cancer cases in this series are found in Table 3.

Table 3  
Frequency and distribution of the cases of thyroid cancer  
according to histological type.

Variable	Number of cases	Percentage (%)
Histology		
Papillary carcinoma	71	67,0
Follicular carcinoma	23	21,7
Anaplastic carcinoma	8	7,5
Lymphoma	3	2,8
Medullary carcinoma	1	0,9

## Discussion

The main objective of this research was to establish the frequency of thyroid cancer in the Congolese population, secondarily aiming to identify the most frequent types of cancer. Our series included 6,106 cases, of which 68.2% were female and 31.8% were male. This predominance of the female gender was also found in the series of Mashinda who studied the prevalence of cancer in the urban setting of Kinshasa [16] and it was also the case for the Lukanu series, which included cases from a rural setting of Congo in Kimpese [17]. These are the first two epidemiological studies analyzing neoplastic diseases carried out in the DRC and which preceded our research.

Female predominance in overall cancer diagnosis was observed in the DRC, a similar trend was also observed in Brazil [18]. The cascade of sexual hormone activity, in particular estrogens and the aromatization of androgens via Mitogen-activated protein kinase (MAPK), causing the decline of immune cells and promoting the proliferation of cancer cells and the inhibition of apoptotic activity can explain the female predominance [19, 20]. However, some European series have found a male predominance [21–25].

The male gender was more represented in the age groups up to 30 years and over 60 years; on the other hand, the female gender was more represented in the age groups between 30 and 60 years. Most cancers in women occurred between the ages of 40 and 60 and in men over 50. Overall, 77% of cancer patients were over 40 years of age. Most series around the world, according to which the older the age the greater the probability of developing a neoplastic disease [26, 27].

In our series, breast cancer occupies the first position in terms of frequency of cancer in women and cervical cancer occupies the second position. However, in the series published by Mashinda et al., cervical cancer was the most frequent followed by breast cancer [16]. This difference can be explained by the methodology, the study period, the progress of the national policy on cancer screening in women and by the development of diagnostic means. Mashinda studied the records of two pathology laboratories, while

we researched the records of 4 pathology laboratories. Mashinda analyzed results from 1965 to 2008, while we studied data between 2005 and 2019. We must consider that the means of raising awareness have evolved and the educational level of the population has increased over time. All these parameters can explain this difference. The findings of our study are similar to the Lukanu series; breast cancer was the most frequent followed by cervical cancer [17]. Our results also mirrored those found in several African and worldwide series [28–31].

When we consider both sexes, breast cancer was the most frequent type of cancer in our series, this result being similar to those in the literature [29].

Regarding cancer in male patients, prostate cancer was the most frequent in our series. This result was similar to the series of Lukanu [17]. On the other hand, Mashinda found lymphoid organ cancer as the most frequent followed by prostate cancer [16]. Our results are similar to those found in the literature [29]. There has been an improvement in the awareness of the Congolese population regarding prostate cancer over the past two decades.

Thyroid cancer is the most common type of cancer of the endocrine system [32]. Our series found a frequency of 1.7%. In women, the frequency is 2% and it is 1.1% in men, with a female/male ratio of 4. The series described by Mashinda et al found a thyroid cancer frequency of 0.5% in women [16]. The frequency of thyroid cancer in women in our series compared to that of Mashinda's is multiplied by 4, a female predominance that is confirmed in the literature [33, 34]. Thyroid cancer occupied the sixth position of all listed cancers among women in our series, whereas it is the 5th most frequent cancer in women worldwide [35].

The increase in thyroid cancer frequency has also been observed in several studies around the world over the past three decades [10]. The mechanisms underlying this increase have not yet been elucidated. However, nutritional, hormonal, anthropometric, environmental, and other factors are suspected. Many authors also consider that excessive iodine intake, and the development and accessibility of diagnostic tools participate to the increase in diagnosis [36, 37].

Our study found that nearly 7% of thyroid cancers were anaplastic and 1% were medullary, while these cancers are rare in the literature [38]. This can be considered as a particularity of the DRC regarding thyroid cancer, especially since calcitonin is not generally measured in the assessment of thyroid nodules or preceding thyroidectomy.

It is known that 90% of thyroid cancers are differentiated and have good prognosis and that only 5 to 10% are undifferentiated and have therefore a bad prognosis [39, 40]. This high prevalence of undifferentiated cancers in our series constitutes a particularity of the Congo. This can be explained by the fact that, undifferentiated thyroid cancers, given their aggressive behavior, are more likely to warrant a surgical evaluation. Thyroid cancers in our study originated from surgical pathology reports. Nevertheless, this particularity requires more in-depth studies to better understand the causes and mechanisms.

Since iodine deficiency in the soil is considered a risk factor for anaplastic cancer [41], the question to be raised is whether iodine deficiency could be responsible for this higher frequency of undifferentiated cancers. knowing that iodine saturation in the Congo was only obtained in 1993 [42]. Another potential mechanism is that initially differentiated cancers have lost differentiation over time [43] due to late diagnosis.

This work has the limitations of retrospective studies. In addition, it is biased due to the fact that we only took into consideration the patients who had carried out the anatomopathology while those who had not carried out one, were not included in this study, this may have influenced a high frequency of cancers and certain histological types. Finally, limitation in diagnostic facilities in data reporting in a resource-poor health care facility are also potentially limiting.

Despite these limitations, this work gives a scoping vision of cancer in the DRC and in particular of thyroid cancer. It has established the frequencies of different forms of cancer in a country where cancer data are rare.

## Conclusions

Cancer diagnosis is on the rise in the DRC and the frequency of thyroid cancer as compared to total number of cancers has doubled over the period from 2005 to 2019. A marked female predominance was observed. Papillary thyroid cancer is the most frequent type of thyroid cancer followed by follicular carcinoma. There is a high frequency of undifferentiated thyroid cancers such as anaplastic carcinomas, long recognized as rare carcinomas. Breast cancer is the most common of all types of cancer, followed by cervical cancer. Prostate cancer is the most common type of cancer in men. Thyroid cancer ranked sixth most common cancer in women and eleventh most common in men. This study establishes the most recent and updated frequency of thyroid cancer in the second largest African country.

## Abbreviations

DRC

Democratic Republic of the Congo

INRB

Biomedical Research

HGRK

Kinshasa general hospital

SPSS

Statistical Package for the social sciences

LO

lymphoid organ

MAPK

Mitogen-activated protein kinase

YO  
years old  
KS  
Kaposi sarcoma

## Declarations

### **Ethics approval and consent to participate:**

This study protocol was reviewed and approved by the national health ethics committee of the DRC, number 197/CNES/BN/PMMF/2020.

### **Consent for publication:**

Written informed consent was obtained from the patients for publication of this study.

### **Availability of data and materials:**

All data generated or analyzed during this study are included in this published article or uploaded as supplementary information.

### **Competing interests:**

Not applicable.

### **Funding:**

Not applicable.

### **Authors' contributions:**

John Bukasa and Ayrton Bangolo searched the literature, wrote, and revised the manuscript. Branly Mbunga, Francis Iyese, Aliocha Nkodila, Ali Atoot, Gaurav Anand, Maimona Chaudhary, Pamela Q. Fernandes, Hari PSS. Mannam, Adithya Polavarapu, Merajunnissa, Abdullah Azhar, Mohan N. Aichetty, Gauravdeep singh, Georgemar V. Arana Jr., Manbir Singh, José D. Rodriguez-Castro revised and edited the manuscript. Adam Atoot, Pascal Bayauli, Simcha Weissman and Jean Rene M'Buyamba revised and approved the final version and are the article's guarantors. All authors certify that they contributed sufficiently to the intellectual content and data analysis. Each author has reviewed the final version of the manuscript and approves it for publication.

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## Figures

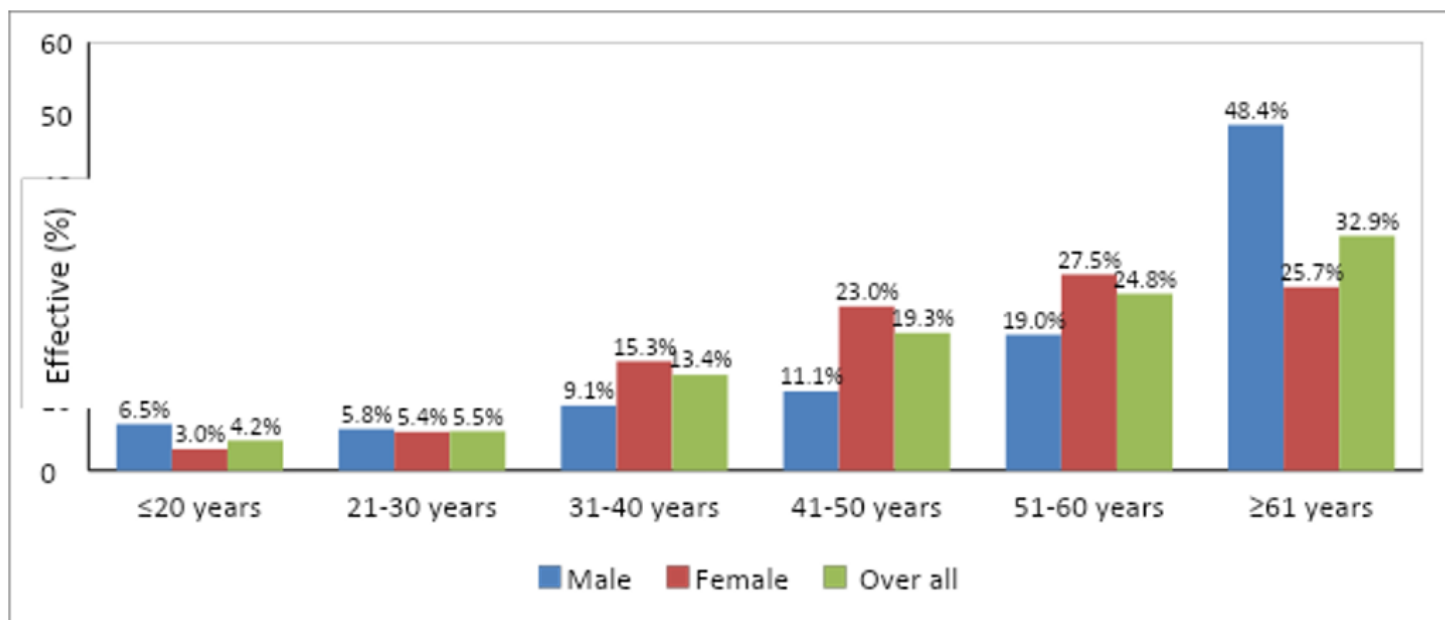


Figure 1

Cancer distribution based on age and gender