Clinico-Pathological Findings and Spatial Distributions of Esophageal Cancer in Arsi Zone, Central Ethiopia

Haji Aman Deybasso (hajia.aman9@gmail.com)
Jimma University https://orcid.org/0000-0003-1441-3300
Kedir Teji Roba
Haramaya University College of Health Sciences: Haramaya University College of Health and Medical Sciences
Berhanu Nega
Addis Ababa University College of Health Sciences
Tefera Belachew
Jimma University College of Public Health and Medical Sciences

Research

Keywords: Esophageal cancer, clinical pattern, geographical distribution, Arsi, Ethiopia

Posted Date: September 23rd, 2020

DOI: https://doi.org/10.21203/rs.3.rs-78101/v1

Abstract

Background: Arsi Zone is one of the esophageal cancer endemic areas and reported to have high incidence of esophageal cancer in Ethiopia. This study assessed clinico-pathological patterns and spatial distributions of esophageal cancer in Arsi Zone, Oromia, Central Ethiopia.

Methods: A cross sectional study design was carried out by abstracting data from 403 patients` records that were treated from January 2015 to January 2019. Data were collected by using structured data collection form and Geographical Positioning System software. The collected data were summarized in the form of tables, figures, means and standard deviations. Statistical data analysis was done using SPSS software version 21.0 while geospatial analysis was conducted using the Arc-GIS 10.1 software.

Results: The disease was prominent among individuals aged 50 to 59 years. The mean age of females and males was 52.2(SD±10.41) and 56.94(SD ±12.27) years respectively. The vast majority (98.3%) of the cases had squamous cell carcinoma. Dysphagia with weight loss accounted for 87.6 percent of the presenting symptoms. The tumor was located at the lower thorax of 42.9% of the patients. Majority (62%) of the patients were from the eastern and north-eastern parts of the Arsi zone. Overwhelming majorities of the patients were from the Robe, Jaju, Disksis and Sude districts.

Conclusion: Dysphagia with weight loss was the major symptom during first visit. Squamous cell carcinoma was the predominant histopathological type. Eastern and the northeastern parts of the Zone are the most affected regions. Future studies should focus on the determinants of EC and precise areas with high incidence by using prospective studies through the population and/or facility-based cancer registry systems

Introduction

Esophageal cancer (EC) is the malignant tumor that develops inside the esophagus as the result of alteration in epithelial linings(1) It is 7th cancer in incidences and the 6th causes of cancer mortality in the world(2). World Health Organization (WHO) identified Squamous Cell Carcinoma (SCC) and Adenocarcinoma (AC) as the major tissue types of esophageal cancer (3). Adenocarcinoma is more prevalent in developed countries such as in the United States, United Kingdom, Scandinavia, France, Switzerland, Denmark, Italy, Slovakia, Netherlands, Australia, and New Zealand(4).

Esophageal cancer has distinct geographical distributions within the country and across the globe(5). In Canada, rural parts of the Quebec region has higher incidences of EC than other parts (6). Similarly, considerable geographical variations were seen in the northeast and Midwest regions of America (7). Corresponding variations were observed in different regions of France, Denmark, and the Netherlands(8). Squamous cell carcinoma is the predominant type of EC in developing countries (9). Eastern Turkey, northeastern Iran, Kazakhstan, and northern and central China are the hot spot areas in Asia`s EC belt (10).

Projection of cancer in Africa anticipated staggering increases in cancer corresponding to 1.27 million new cases and 0.97 million deaths in 2030(11). The incidences of EC were rare until the 1930s in East, Central, and Southern Africa(12). With gradual increases over time, the eastern and southern Africa became the epicenter of esophageal carcinoma (5,13–15). Concentrations of EC cases were notably observed in rural and Eastern Cape provinces of South Africa (16), western parts of Kenya (17,18), among Darfurian tribes in Sudan (19) and populations living in Kilimanjaro areas in Tanzania (20). Arsi Zone was one of the EC endemic areas in Africa`s esophageal cancer belt for years (21) and a constantly reported high incidence area of EC in Ethiopia(22–24).

Identifying a cluster of cases of EC within the endemic area highlights high-risk populations and helps in generating hypothesis about the potential risk factors associated with that disease [23–25]. Yet, except few observational studies at a country and regional levels (23,28,29), no study has ever been conducted to assess the clinico-pathological patterns and spatial distributions of esophageal cancer in esophageal cancer endemic areas in Ethiopia.

Therefore, this study was conducted to determine the clinico-pathological patterns and spatial distributions of esophageal cancer in Arsi Zone, Oromia, Central Ethiopia.

Methods

Study setting and period

Arsi Zone is found in the central part of the Oromia Regional State in central Ethiopia. Asella is the capital city located 175 Kilo meters South East of Addis Ababa, the capital city of Ethiopia. A cross sectional study design was carried out by retrospectively abstracting data from the patients` records treated at multiple health facilities over five years period. Data were collected from seven referral hospitals and four clinics which render diagnostic services, consultations, and cancer treatments in Asella, Adama, and Addis Ababa (**additional file1).** All EC patients from Arsi Zone who visited the selected health facilities during the study period were considered as source population. The study populations constituted radiographically diagnosed and pathologically confirmed EC patients from Arsi Zone. Endoscopy and pathologically confirmed esophageal cancer patients with complete data were included. Records of eight five patients were excluded from the study because of incomplete demographic and clinical data. The data collection period covers from January 2015 to January 2019.

Data collection tool

Nine trained BSc Nurses have participated in the data collection process. The questionnaires (checklists) were developed by the research team and tested to make the required adjustments and familiarize data collectors with data collection tools. The data were retrieved from patients` registration books and charts from the surgical, oncology, endoscopy, and pathology clinics. Data were collected on demographic characteristics (age, sex and residence), clinical, histopathological type of cancer, tumor location, degree of tumor differentiation, cancer stages and the primary residences of the patientsThe

severity of dysphagia was graded as follows: grade 1: normal swallowing; grade 2: difficulty in swallowing solids; grade 3: difficulty in swallowing semisolids; grade 4: difficulty in swallowing liquids; grade 5: difficulty in swallowing own saliva. The clinical staging was performed using TNM (American Joint Committee on Cancer (AJCC) cancer staging manual); this is a staging system that is an expression of the anatomical extent of the disease based on the extent of the primary tumor (T), absence or presence of and extent of regional lymph node metastasis (N) and absence or presence of distant metastasis (M) (30). The administrative units, geographical locations, and agro-climatic divisions were gathered from the Arsi Zone finance and economic development office while the topologies of the study area were collected by using Geographical Information System (GIS) obtained from the agriculture departments of Arsi Zone **(additional file1 2).**

Data processing and analysis

Questionnaires were checked daily for accuracy, consistency, and completeness by supervisors. Furthermore, the supervisor and the principal investigator gave feedback and correction on daily bases. Patients were categorized into highland, midland, and lowland agro-climatic divisions (**Supplementary file 3).** The information related to administrative units (Districts) was extracted from the map of Arsi Zone with the scale ratio of 1:1200. The extracted demographic information on spatial locations was geo-tagged to the database containing administrative districts from where patients came.

The categorical variables of the cases were analyzed by descriptive statistical methods and presented in the form of tables and figures. Continuous variables were summarized using means and standard deviations. The association between categorical variables was determined using the Chi-square ($\chi 2$) test. P-values <0.05 were declared as significant. Statistical data analysis was done using SPSS software version 21.0 (SPSS, Inc, Chicago, IL, USA).

Categorical attributes of the number of males and females were identified and the coordinates of the point were taken using Geographical positioning System (GPS) at the district level. The number of EC patients per district was used for delineating and mapping the distributions of EC per district in the Arsi Zone. In order to analyze the data spatially, CSI, 2013 Ethio- GIS administrative data were used as input data to automatically mark out and map the burden of cancer by using the Arc-GIS 10.1 software. Finally, different types of colors were used to indicate the burden of EC cancer per district based on the following category: Red **color** for the districts which had 31 and above patients, **Pink color** for the districts which had 21 to 30 patients **yellow color** for the districts which had 11 to 20 patients and **Green color** for the districts which have 1 to 10 patients.

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutions Research Board (IRB) of Jimma University and approval of the research was obtained from Research Ethical Committee (REC) and administrations of the selected health facilities. Personally identifiable information was not taken from patients records to keep anonymity.

Results

Patients` characteristics

Out of 403 patients` whose cards reviewed, 388(96.3%) of them were rural residents. Two hundred nine (51.8%) of the patients were females. The male to female ratio was 0.93:1.0 with no statistically significant difference. The majority of patients (72.2% females vs. 50.5% males) were below the age of 60 years. The overall mean age was 54.5(SD ± 11.6) years. The mean age of female patients was 52.2(SD ± 10.41) years which ranging from 25 to 85 years. The corresponding mean age for males was 56.94(SD ± 12.27) years with the age ranging from 19 to 88 years **(**Table 1**).**

Table 1
Socio-demographic characteristics of EC patients in Arsi Zone (N = 403)

Variables	**Sex of the participants**		**Total**
	Male	**Female**	
Residence of the participants	No.(%)	No.(%)	No.(%)
Urban	8(4.1)	7(3.3)	15(3.7)
Rural	186(95.9)	202(96.7)	388(96.3)
Total	194(100)	209(100)	403(100)
Age at diagnose			
<=19 years	1(0.5)	0(0)	1(0.2)
20–29 years	2(1.0)	3(1.43)	5(1.2)
30–39 years	8(4.12)	15(7.2)	23(5.7)
40–49 years	31(16.0)	49(23.4)	80(20.0)
50–59 years	56(28.9)	84(40.2)	140(34.7)
60–69 years	60(30.9)	46(22)	106(26.3)
70–79 years	30(15.5)	9(4.3)	39(9.7)
>=80 years	6(3.1)	3(1.4)	9(2.2)
Total	194(100)	209(100)	430(100)

Clinico-pathological characteristics

With regard to histopathological subtype, 396 (98.3%) of the cases had squamous cell carcinoma. The tumor was located at the lower thorax, mid thorax, and Gastroesophageal Junction (GEJ) among 42.9%, 26.1%, and 23.8% of the patients, respectively. Furthermore, 168(41.7%) of the tumor was moderately differentiated while there were no conclusive reports on the degree of tumor differentiation for 47(11.7%)

of the cases. A greater number of patients (87.6%) had dysphagia and weight loss during the first visit. The majority (42.4%) of patients were at the third stage of cancer while cancer staging was not determined for 76(18.9%) of patients (Table 2).

Table 2
Clinic pathological characteristics of esophageal cancer cases in Arsi Zone, 2020

Variables	Sex of the participants		Total
	Male	Female	
	No.(%)	No.(%)	
Histopathological types			
Squamous cell carcinoma	191(98.5)	205(98.1)	396(98.3)
Adenocarcinoma	4(1.9)	3(1.5)	7(1.7)
Tumor location			
Cervical	2(1)	0(0)	2(0.5)
Upper thorax	15(7.7)	12(5.7)	27(6.7)
Mid thorax	48 (24.7)	57(27.3)	105(26.1)
Lower thorax	89 (45.9)	84(40.2)	173(42.9)
Gastro Esophageal Junction	40 (20.6)	56(26.8)	96(23.8)
Degree of tumor differentiation			
Well differentiated	53(27.3)	47(22.5)	100(24.8)
Moderately differentiated	77(39.7)	91(43.5)	168(41.7)
Poorly differentiated	44(22.7)	44(21.1)	88(21.8)
Report not conclusive	20(10.3)	27(12.9)	47(11.7)
Presenting symptoms			
Dysphagia and weight loss	171(88.1)	182(87.1)	353 (87.6)
Vomiting	23(11.9)	27(12.9)	50(12.4)
Cancer stage			
Stage 1	7(3.6)	7(3.3)	14(3.5)
Stage 2	17(8.8)	28(13.4)	45(11.2)
Stage 3	81(41.8)	90(43.1)	171(42.4)
Stage 4	48(24.7)	49(23.4)	97(24.1)
Not graded	41(21.1)	35(16.7)	76(18.9)

Magnitude of esophageal cancer in Arsi zone

Cases of EC were recorded from 25 (96.2%) of the existing 26 districts of Arsi Zone. Majority of the of the patients were from Robe (53), Jaju(37) and Diksis(34) districts followed by 21 to 30 of patients being from Doddota, Sude, Zuway-dugda, Lode-hetosa and Shirka districts. Seven districts (Amigna, Sire, Munessa, Merti, Chole, Lemu-bilbilo, and Tiyo) accounted for 11 to 20 cases during the study period. The remaining ten districts (Bale, Guna, Gololcha, Honkolowabe, Hetosa, Seru, Tena, Aseko, Bekoji, and Digalu-Tijo) contributed one to 10 patients (Fig. 1).

Spatial distribution of oesophageal cancer

In this study, 141 (35%) of the patients were from the eastern parts of the zone. The northeast, southeast, and northern parts of the zone had a total of 108 (26.8%), 47(11.7%) and 31(7.7%) of patients, respectively. Additionally, the zonal capital and surrounding districts (Asella &Tiyo) contributed to a total of 30(7.4%) patients while 27(6.7%) and 17(4.2%) of the cases were found to be the residents of the western and southwest parts, in that order. Out of the total cases, 178(44.2%), 137(34.0%) and 88(21.8%) of the patients were from the districts located in the highland, midland and lowland agro-climatic divisions, respectively (Fig. 2).

Discussion

In this study, we attempted to review the clinico-pathological patterns and spatial distributions of esophageal cancer in Arsi Zone. Accordingly, vast proportions of the patients were rural residents similar to the preceding studies that reported predominance of EC in rural areas (16,28,31,32). A high proportion of EC among rural residents may be attributed to exposure to various environmental and occupational carcinogens(33–35). Furthermore, Patel K. et.al.[2013] argued that the predominance of EC among rural populations is linked to infection from fungi and bacteria that replicate in grass-thatched houses (35). Moreover, inadequate nutrient intake and lower socioeconomic status could be another risk factors associated with increased incidences of EC among the rural populations (36,37).

In the present study, 7.1% of patients were ≤ 39 years of age and the youngest male and female patients were diagnosed at the age of 19 and 25 years, respectively. This is contradictory to the pathogenesis of EC that usually increases with age and attaining a climax after 70 years(1). Some studies in Africa also found increasing in the proportion of young patients as early as 12 years of age (38,39). The proportion of youngest patients in this study is greater than the findings in Ethiopia (29) and Kenya(39). Observing EC among younger populations may indicate early childhood exposure to the carcinogens that may alter the natural pathogenesis of the disease.

Dysphagia with weight loss accounted for 87.6 percent of the presenting symptoms. Besides, the majority of the patients were at advanced stages of cancer. Dysphagia and late presentations became the cardinal presentations of EC patients in Ethiopia (23,28,29), Africa(16,33,35,40–42) and elsewhere(43–46). The reason could be because of the fact that esophagus has a remarkable capability to stretch until significantly blocked by the tumor(47).In addition, presenting at a late stage of cancer with

dysphagia could be linked to failure to understand the early symptoms associated with esophageal carcinoma.

Squamous cell carcinoma was the dominant (98.3%) histo-pathological type similar to previous studies in Ethiopia(23,28,29,48). The finding is very conceivable since squamous cell carcinoma is the leading histo-pathological type of EC in developing countries(1,49,50).

The lower thorax was the commonest anatomical site for a tumor followed by mid thorax and GEJ with no significant differences between male and female patients. The finding is similar with the studies that found lower thorax as the commonest anatomical sites of esophageal cancer(40,48) but contrary to the studies that identified middle thorax as major cancer location in Ethiopia (23,28), Uganda (40), Tanzania(31), Ghana(51) and Pakistan(52). The inconsistencies in tumor locations can be explained by differences in the classification of the anatomic sites. In this study, tumor locations were based on Watanabe N.et.al, five (Cervical, upper, mid, lower, and GEJ) anatomical sites for the carcinogenesis of EC (3) contrary to other studies that used upper, mid, and lower anatomical classifications.

The majority of the patients in this study had a moderately differentiated tumor differently to studies that found well-differentiated tumors among EC patients [23, 38]. The disparities might be because of lower inconclusive results in this study (11.7%) than the rate of undetermined pathological results (62.7%) in the aforementioned studies.

The geographical distribution of EC in the Arsi Zone showed asymmetrical patterns. About 62% of the patients were from the eastern and north-eastern parts. The majority of the patients were from the Robe district followed by Jaju, Disksis and Sude districts. Additionally, Doddota, Zuway-dugda,Lode-hetosa, and Shirka were succeeding districts in an increased number of cases. Besides, 44.2% of the cases were from the highland agro-climatic zone. The finding is in agreement with the study that reported high altitude areas as the main location of EC in Arsi Zone(42). The predominance of EC in those areas seems to be related to the population sizes because the eastern, north-eastern, and highland agro-ecological zone are the most populated areas in Arsi Zone (53,54). In stratified analysis though, the effect of population sizes was not observed. For instance, Robe district which had the highest number of cases encompasses equivalent population size (6.2% of the zonal population) to Munessa district that had only 4.2% of the total cases. Whereas, Jaju and Diksis districts have lower populations than Munessa district. Conversely, the 6th populated Digalu-tijo district contributed to a single esophageal cancer patient.

Remarkably, greater numbers of patients were from contiguous districts and located farther from the main referral hospital in the Zone. The clustering of EC at demarcated areas and the disparities between and within geographical locations are the peculiar characteristics of EC in Africa, Asia, and elsewhere(10,21,55,56). High prevalence of EC in geographically adjacent areas may signal the existence of potentially harmful factors at high burden areas than areas with lower prevalence of esophageal cancer. Nevertheless, there are no established evidences whether the routinely reported “hot wheat porridge consumption” is widely practiced in higher burden districts of Arsi Zone. Hence, similar to multiple studies (57–62), the discrepancies in the geographical distribution of EC in the Arsi Zone may be

primarily linked to differences in dietary practices, lifestyles, genetics and exposure to environmental carcinogens.

In the wake of increasing chronic diseases in developing countries like Ethiopia(63), the identified clinic-pathological findings and high-risk geographical areas can be used as the baseline for exploring the potential risk factors and designing preventive strategies.

Limitations

Being the retrospective study and absence of proper cancer registry systems influenced retrieving of important socio-demographic and clinical information which might provide better perspectives to our study. Besides, identification of the patients $resntsatthedistrict \leq velmay \neg exactlylocatepatients$ exact agro-climatic areas due to existing overlapping in agro-ecological zones within the districts.

Conclusion

Dysphagia with weight loss was the major symptom during first visit. Squamous cell carcinoma was the predominant histopathological type. Eastern and the northeastern parts of the Zone are the most affected regions. Education on early symptoms associated with EC and benefit of timely seeking health care should be provided using various education channels. Future studies should focus on the determinants of EC and precise areas with high incidence by using prospective studies through the population and/or facility-based cancer registry systems.

Declarations

Ethics approval and consent to participate

Ethical permission was obtained from the Institutions Research Board (IRB) of Jimma University and approval of the research activity was sought from each health facility administration offices before the study was carried out. Confidentiality of the data was maintained by avoiding names and other personal identifiers known or written in the questionnaires.

Consent for publication

Not applicable

Availability of data and material

All data generated or analysed during this study are included in this published article [and its supplementary information files].

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Acknowledgement

The authors are very grateful to the members of staff in the medical records, surgery and pathology departments of each health institution for their support and cooperation during data collection.

Authors' Contributions

HA designed the research conception, conducted the research, analysed the data and wrote the final report. KT, VM and TB have provided advisory support during the whole research processes, edited and critically evaluated the final report. All authors have read and approved the manuscript.

Authors' information

[1, 4] Adama Hospital Medical College and PhD candidate in Human nutrition at Jimma University, Ethiopia

[2] Haramaya University, College of Health and Medical Sciences, Ethiopia

[3] Addis Ababa University, College of health science, Ethiopia

[4] Jimma University, Department of Human Nutrition and Dietetics, Jimma, Ethiopia

References

1. Napier KJ. Esophageal cancer: A Review of epidemiology, pathogenesis, staging workup and treatment modalities. World J Gastrointest Oncol. 2014;6(5):112.
2. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68(6):394–424.
3. Watanabe N, Shimizu M, Kochi T, Shirakami Y, Tanaka T. Esophageal Carcinogenesis. Open J Pathol. 2014;04(04):151–70.
4. Siersema PD. Esophageal Cancer. Gastroenterol Clin North Am. 2008 ;37(4):943–64.

5. Mudan SS, Kang J-Y. Epidemiology and Clinical Presentation in Esophageal Cancer. In: Rankin SC, editor. Carcinoma of the Esophagus [Internet]. Cambridge: Cambridge University Press; 2007 [cited 2020 Apr 11]. p. 1–13. Available from: https://www.cambridge.org/core/product/identifier/CBO9780511545443A008/type/book_part
6. Cattelan L, Ghazawi FM, Le M, Lagacé F, Savin E, Zubarev A, et al. Epidemiologic trends and geographic distribution of esophageal cancer in Canada: A national population-based study. Cancer Med. 2020;9(1):401–17.
7. Drahos J, Wu M, Anderson WF, Trivers KF, King J, Rosenberg PS, et al. Regional Variations in Esophageal Cancer Rates by Census Region in the United States, 1999–2008. Phillips WA, editor. PLoS ONE. 2013;8(7):e67913.
8. Melhado RE, Alderson D, Tucker O. The Changing Face of Esophageal Cancer. Cancers. 2010 ;2(3):1379–404.
9. Kamangar F, Dores GM, Anderson WF. Patterns of Cancer Incidence, Mortality, and Prevalence Across Five Continents: Defining Priorities to Reduce Cancer Disparities in Different Geographic Regions of the World. J Clin Oncol. 2006;24(14):2137–50.
10. Zhang H-Z, Jin G-F, Shen H-B. Epidemiologic differences in esophageal cancer between Asian and Western populations. Chin J Cancer. 2012;31(6):281–6.
11. Sylla BS, Wild CP. A million africans a year dying from cancer by 2030: What can cancer research and control offer to the continent? Int J Cancer. 2012;130(2):245–50.
12. Sammon AM, scoafrica.org (Organization). Squamous cancer of the oesophagus in Africa. Place of publication not identified: Scoafrica.org; 2009.
13. Munishi MO, Hanisch R, Mapunda O, Ndyetabura T, Ndaro A, Schüz J, et al. Africa's oesophageal cancer corridor: Do hot beverages contribute? Cancer Causes Control. 2015;26(10):1477–86.
14. Parkin DM, Bray F, Ferlay J, Jemal A. Cancer in Africa 2012. Cancer Epidemiol Biomarkers Prev. 2014 Jun 1;23(6):953–66.
15. Middleton DRS, Bouaoun L, Hanisch R, Bray F, Dzamalala C, Chasimpha S, et al. Esophageal cancer male to female incidence ratios in Africa: A systematic review and meta-analysis of geographic, time and age trends. Cancer Epidemiol. 2018;53:119–28.
16. Alaouna M, Hull R, Penny C, Dlamini Z. Esophageal cancer genetics in South Africa. Clin Exp Gastroenterol. 2019 Apr;Volume 12:157–77.
17. Patel K, Wakhisi J, Mining S, Mwangi A, Patel R. Esophageal Cancer, the Topmost Cancer at MTRH in the Rift Valley, Kenya, and Its Potential Risk Factors. ISRN Oncol. 2013;2013:1–9.
18. Parker RK, Dawsey SM, Abnet CC, White RE. Frequent occurrence of esophageal cancer in young people in western Kenya. Dis Esophagus. 2010;23(2):128–35.
19. Gasmelseed N, Abudris D, Elhaj A, Eltayeb EA, Elmadani A, Elhassan MM, et al. Patterns of Esophageal Cancer in the National Cancer Institute at the University of Gezira, in Gezira State, Sudan, in 1999-2012. Asian Pac J Cancer Prev. 2015;16(15):6481–90.

20. Gabel JV, Chamberlain RM, Ngoma T, Mwaiselage J, Schmid KK, Kahesa C, et al. Clinical and epidemiologic variations of esophageal cancer in Tanzania. World J Gastrointest Oncol. 2016;8(3):314.
21. Schaafsma T, Wakefield J, Hanisch R, Bray F, Schüz J, Joy EJM, et al. Africa's Oesophageal Cancer Corridor: Geographic Variations in Incidence Correlate with Certain Micronutrient Deficiencies. Meliker J, editor. PLOS ONE. 2015;10(10):e0140107.
22. Shewaye AB, Seme A. Risk factors associated with oesophageal malignancy among Ethiopian patients: a case control study. East Cent Afr J Surg. 2016;21(2):33.
23. Wondimagegnehu A, Hirpa S, Abaya SW, Gizaw M, Getachew S, Ayele W, et al. Oesophageal Cancer Magnitude and Presentation in Ethiopia [Internet]. In Review; 2019 Aug [cited 2020 Apr 11]. Available from: https://www.researchsquare.com/article/rs-4421/v1
24. Alebachew Woldu M, Legese DA, Abamecha FE, Beyene Berha A. The Prevalence of Cancer and its Associated Risk Factors among Patients Visiting Oncology Unit, Tikur Anbessa Specialized Hospital, Addis Ababa- Ethiopia. J Cancer Sci Ther [Internet]. 2017 ;09(04). Available from: https://www.omicsonline.org/open-access/the-prevalence-of-cancer-and-its-associated-risk-factors-among-patientsvisiting-oncology-unit-tikur-anbessa-specialized-hospital-a-1948-5956-1000452.php?aid=88787
25. Hutt MSR, Burkitt D. Geographical Distribution of Cancer in East Africa: A New Clinicopathological Approach. BMJ. 1965 ;2(5464):719–22.
26. Kou K, Guo X, Baade P, Lu Z, Fu Z, Chu J, et al. Spatial Analysis of Esophageal Cancer Mortality in a High-risk Population in China: Consistent Clustering Pattern in 1970-74 and 2011-13. Asian Pac J Cancer Prev. 2018 Nov 1;19(11):3161–6.
27. Klingelhöfer D, Zhu Y, Braun M, Brüggmann D, Schöffel N, Groneberg DA. A world map of esophagus cancer research: a critical accounting. J Transl Med. 2019;17(1):150.
28. Shewaye AB, Seme A. Risk factors associated with oesophageal malignancy among Ethiopian patients: a case control study. East Cent Afr J Surg. 2016;21(2):33.
29. Bulcha G g., Leon M e., Gwen M, Abnet C c., Sime A, Pritchett N r., et al. Epidemiology of Esophageal Cancer (EC) In Oromia Region, Ethiopia 2016: A 4-Year Medical Record Review. J Glob Oncol. 2018;4(Supplement 2):14s–14s.
30. Mchembe MD, Rambau PF, Chalya PL, Jaka H, Koy M, Mahalu W. Endoscopic and clinicopathological patterns of esophageal cancer in Tanzania: experiences from two tertiary health institutions. World J Surg Oncol. 2013;11(1):257.
31. Mchembe MD, Rambau PF, Chalya PL, Jaka H, Koy M, Mahalu W. Endoscopic and clinicopathological patterns of esophageal cancer in Tanzania: experiences from two tertiary health institutions. World J Surg Oncol. 2013;11(1):257.
32. Al-abed AAA, Tamil AM, Al-Dubai SAR. Case control study on risk factors associated with esophageal cancer in Yemen. BMC Public Health. 2012 Nov;12(S2):A11, 1471-2458-12-S2-A11.

33. Mlombe Y, Rosenberg N, Wolf L, Dzamalala C, Challulu K, Chisi J, et al. Environmental risk factors for oesophageal cancer in Malawi: A case-control study. Malawi Med J. 2015;27(3):88.
34. Zhang X, Zhuang D, Ma X, Jiang D. Esophageal cancer spatial and correlation analyses: Water pollution, mortality rates, and safe buffer distances in China. J Geogr Sci. 2014;24(1):46–58.
35. Patel K, Wakhisi J, Mining S, Mwangi A, Patel R. Esophageal Cancer, the Topmost Cancer at MTRH in the Rift Valley, Kenya, and Its Potential Risk Factors. ISRN Oncol. 2013;2013:1–9.
36. Samarasam I. Esophageal cancer in India: Current status and future perspectives. Int J Adv Med Health Res. 2017;4(1):5.
37. Goodarzi E, Sohrabivafa M, Haddad MHF, Naemi H, Khazaei Z. Esophagus cancer geographical distribution, incidence, mortality and their world Human Development Index (HDI) relationship: World cancer research Journal. 2019; 6: e1386.
38. Dawsey SP, Tonui S, Parker RK, Fitzwater JW, Dawsey SM, White RE, et al. Esophageal Cancer in Young People: A Case Series of 109 Cases and Review of the Literature. Ng IOL, editor. PLoS ONE. 2010;5(11):e14080.
39. Parker RK, Dawsey SM, Abnet CC, White RE. Frequent occurrence of esophageal cancer in young people in western Kenya. Dis Esophagus. 2010;23(2):128–35.
40. Alema O, Iva B. Cancer of the esophagus; histopathological sub-types in northern Uganda. Afr Health Sci. 2014 14(1):17.
41. Mwachiro MM, Burgert SL, Lando J, Chepkwony R, Bett C, Bosire C, et al. Esophageal Squamous Dysplasia is Common in Asymptomatic Kenyans: A Prospective, Community-Based, Cross-Sectional Study: Am J Gastroenterol. 2016;111(4):500–7.
42. McCormack V, Menya D, Munishi M, Dzamalala C, Gasmelseed N, Roux ML, et al. Informing aetiologic research priorities for squamous cell oesophageal cancer in Africa: A review of setting-specific exposures to known and putative risk factors. IARC:29.
43. Huang S-H, Wu I-C, Wu D-C, Wu C-C, Yang J-F, Chen Y-K, et al. Occupational risks of esophageal cancer in Taiwanese men. Kaohsiung J Med Sci. 2012;28(12):654–9.
44. Xie S-H, Lagergren J. Social group disparities in the incidence and prognosis of oesophageal cancer. United Eur Gastroenterol J. 2018;6(3):343–8.
45. Cavallin F, Scarpa M, Cagol M, Alfieri R, Ruol A, Chiarion Sileni V, et al. Time to diagnosis in esophageal cancer: a cohort study. Acta Oncol. 2018 ;57(9):1179–84.
46. Hong SJ, Kim TJ, Nam KB, Lee IS, Yang HC, Cho S, et al. New TNM Staging System for Esophageal Cancer: What Chest Radiologists Need to Know. RadioGraphics. 2014 Oct;34(6):1722–40.
47. Schlansky B, Dimarino AJ Jr, Loren D, Infantolino A, Kowalski T, Cohen S: A survey of esophageal cancer: pathology, stage and clinical presentation. Alimen Phamacol Ther 2006, 23:587–593.
48. Ahmed M. ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE SCHOOL PUBLIC HEALTH. 2018;57.

49. Rastgar Jazii F, editor. Esophageal Cancer - Cell and Molecular Biology, Biomarkers, Nutrition and Treatment [Internet]. InTech; 2012 [cited 2020 Apr 12]. Available from: http://www.intechopen.com/books/esophageal-cancer-cell-and-molecular-biology-biomarkers-nutrition-and-treatment
50. Jackson L, Evers BM. Chronic Inflammation and Pathogenesis of GI and Pancreatic Cancers. In: Dalgleish AG, Haefner B, editors. The Link Between Inflammation and Cancer [Internet]. Boston, MA: Springer US; 2006 [cited 2020 Apr 12]. p. 39–65. (Rosen ST, editor. Cancer Treatment and Research; vol. 130). Available from: http://link.springer.com/10.1007/0-387-26283-0_2
51. Tettey M, Edwin F, Aniteye E, Sereboe L, Tamatey M, Ofosu-Appiah E, et al. The changing epidemiology of esophageal cancer in sub-Saharan Africa – the case of Ghana. Pan African Medical Journal. 2012; 13:6.
52. Mustafa SA, Banday SZ, Bhat MA, Patigaroo AR, Mir AW, Bhau KS. Clinico-Epidemiological Profile of Esophageal Cancer in Kashmir. 2016;3(11):6.
53. Etefa Y, Dibaba K. BUREAU OF FINANCE AND D ECONOMIC DEVELOPMANT – REGIONAL DATA AND INFORMATIONCORE PROCESS.PHYSICAL AND SOCIO ECONOMIC PROFILE OF ARSI ZONE AND DISTRICTS. FINFINNE, JUANARY, 2011. :496.
54. CSA, Federal democratic republic of Ethiopia. Central Statistical Agency: Population Projection of Ethiopia for all Regions at Woreda level from 2014-2017. Ethiopia: Central Statistical Agency; 2013. p. 118.
55. Kollarova H, Machova L, Horakova D, Janoutova G, Janout V. Epidemiology of esophageal cancer - an overview article. Biomed Pap. 2007 Jun 1;151(1):17–28.
56. Lamine DM. Esophageal and Gastric Cancers in Sub-Saharan Africa, Epidemiological and Clinical Review. J Gastrointest Dig Syst [Internet]. 2011 [cited 2020 Apr 11]; Available from: https://www.omicsonline.org/esophageal-and-gastric-cancers-in-sub-saharan-africa-epidemiological-and-clinical-review-2161-069X.S6-007.php?aid=12643
57. Munishi MO, Hanisch R, Mapunda O, Ndyetabura T, Ndaro A, Schüz J, et al. Africa's oesophageal cancer corridor: Do hot beverages contribute? Cancer Causes Control. 2015;26(10):1477–86.
58. Chen Y, Tong Y, Yang C, Gan Y, Sun H, Bi H, et al. Consumption of hot beverages and foods and the risk of esophageal cancer: a meta-analysis of observational studies. BMC Cancer. 2015;15(1):449.
59. Patel K, Wakhisi J, Mining S, Mwangi A, Patel R. Esophageal Cancer, the Topmost Cancer at MTRH in the Rift Valley, Kenya, and Its Potential Risk Factors. ISRN Oncol. 2013;2013:1–9.
60. Shewaye AB, Seme A. Risk factors associated with oesophageal malignancy among Ethiopian patients: a case control study. East Cent Afr J Surg. 2016;21(2):33.
61. Van Rensburg S, Van Rensburg S. Esophageal squamous cell cancer susceptibility: Environmental and nutritional associations reveal a universally applicable pathogenesis scenario (Review). World Acad Sci J [Internet]. 2019 Sep 27 [cited 2020 Apr 20]; Available from: http://www.spandidos-publications.com/10.3892/wasj.2019.24

62. Kou K, Guo X, Baade P, Lu Z, Fu Z, Chu J, et al. Spatial Analysis of Esophageal Cancer Mortality in a High-risk Population in China: Consistent Clustering Pattern in 1970-74 and 2011-13. Asian Pac J Cancer Prev. 2018 Nov 1;19(11):3161–6.
63. Sylla BS, Wild CP. A million africans a year dying from cancer by 2030: What can cancer research and control offer to the continent? Int J Cancer. 2012;130(2):245–50.

Figures

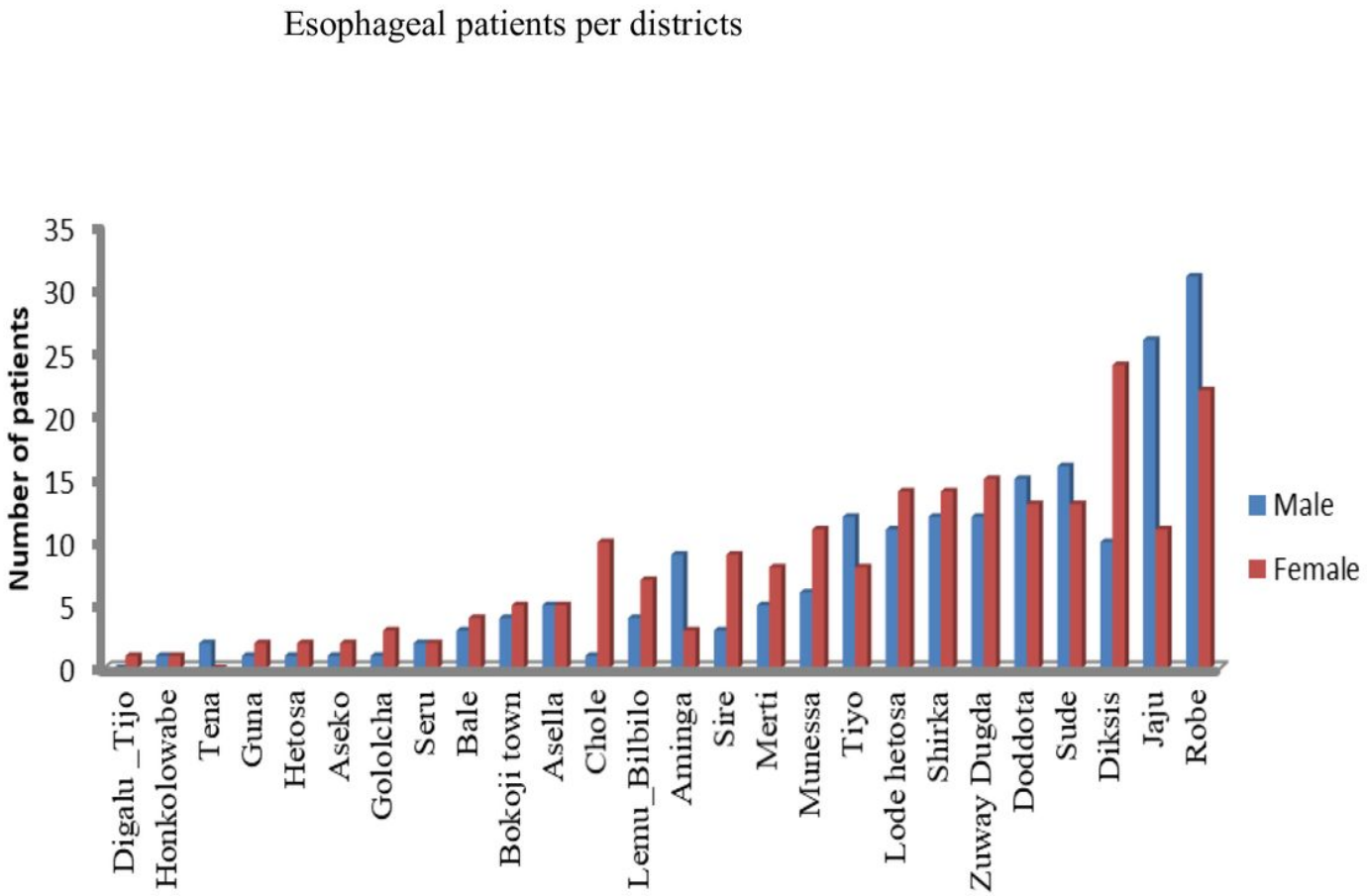

Figure 1

Total cases of esophageal cancer per districts in Arsi Zone, central Ethiopia

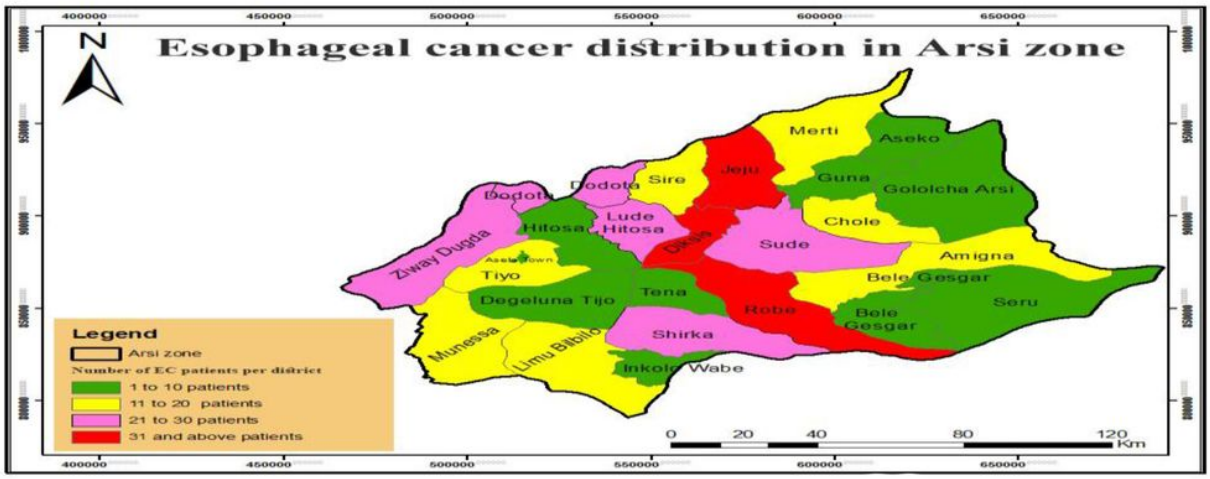

Figure 2

Map showing spatial distribution of esophageal cancer in Arsi Zone, central Ethiopia, 2020

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile2.docx
- Additionalfile3.docx
- Additionalfile1.docx