MEDWAVE
Peer Reviewed Medical Journal

FEATURES

Comparative analysis of leukemia and risk estimation in working age population between provinces of Ecuador

Antonio Ramón Gómez-García[a*], Esteban Fernandez-Moreira[a], Xavier García-León[b], Manuel Gómez del Moral[b]

[a]*Universidad Espíritu Santo, Samborondón, Ecuador;* [b]*Universidad Complutense de Madrid, Madrid, España*

ABSTRACT

Leukemia is associated with exposure to radiation, benzene derivatives, and pesticides. Previous research has documented an increase in work-related leukemia in the Latin American Andean region. To date, there are only few studies in Ecuador on the impact of oil exploitation on adjacent indigenous communities. Our study aims to show the impact of leukemia on the working-age population. For the calculation of morbidity and mortality rates, we used hospital discharge and death records from the National Institute of Statistics of Ecuador. These data were collected and adjusted to the corresponding province's population for further analysis. Large differences were observed between provinces in adjusted rates of leukemia mortality and morbidity in the working-age population. The variations in altitude among different areas in Ecuador give the provinces a distinct geographic identity. Likewise, the provinces with the highest morbidity and mortality rankings, such as Azuay, Loja, Imbabura, and Tungurahua, have an average altitude above 2000 meters. As a result, there are variations in the average temperature, exposure to solar and cosmic radiation, and mining and farming methods. The observed differences warrant the future collection of geolocation data for affected individuals. This could help to better understand how leukemia cases have demogrpahic hotspots in the country, identify possible risk factors associated with the disease in each region, and design more effective prevention and control strategies.

KEYWORDS Leukemia, Working-age population, heterogeneity, regions, Ecuador

INTRODUCTION

Work-related leukemia in 2019 was estimated to represent a disease burden worldwide of 1.4 years of life adjusted for disability, higher in men than in women. Moreover, evidence shows an increase in work-related leukemia in the Andean region of Latin America [1].

According to administrative records provided by the General Workers' Risk Insurance, seven cases of work-related leukemia have been recognized in the Ecuador between 2019 and 2020. Only 2 of the 24 provinces that make up the national territory registered cases. The qualified cases fell among workers in agriculture, manufacturing industries, and health services.

The available information indicates an under-reporting and under-recognition of work-related leukemias worldwide and particularly in Ecuador [2,3]. Unfortunately, the actual number of cases may differ from official records. In many cases, this situation may be due to the lack of knowledge of occupational exposure.

Although it cannot be conclusively confirmed that outcomes are due to the work enviorment, these data could be used to estimate the burden represented by leukemias for the population in working ages, as well as for those territories most affected.

The purpose of this brief report is to present the morbidity and mortality rates for leukemias in working ages in the Ecuadorian provinces with data from official records in Ecuador. In this way, we could counteract the existing gap on this issue and provide guidance on epidemiological surveillance for certain economic activities in some provinces of the country.

METHODS

For the calculation of morbidity and mortality rates (age-standardized) and confidence intervals (95% CI), administrative records of hospital discharges and deaths with codes

* **Corresponding author** agomezg@uees.edu.ec
Citation Gómez-García AR, Fernandez-Moreira E, García-León X, Gómez del Moral M. Comparative analysis of leukemia and risk estimation in working age population between provinces of Ecuador. Medwave 2024;24(6):e2903
DOI 10.5867/medwave.2024.06.2903
Submitted Dec 23, 2023, **Accepted** Jul 19, 2024,
Published Jul 26, 2024
Postal address Escuela de Postgrado Universidad Espíritu Santo, Samborondón, Ecuador

C91 (lymphoid leukemia), C92 (myeloid leukemia), and C93 (monocytic leukemia) were used for the most recent year available in the country (2021). The age range between 15 and 69 years was considered as the working age population. The information was obtained from the website of the National Institute of Statistics and Census (https://www.ecuadorencifras.gob.ec).

RESULTS

For 2021, 1745 patients were treated for leukemias: 60.1% for C91, 39.5% for C92, and 0.3% (6 patients) for C93. Figure 1 represents 3.4% of the 50 595 cases registered for neoplasms. Regarding mortality, 4.3% (265 deaths) of the total deaths from neoplasms (6184 deaths), 57.7% corresponded for C91, 41.9% for C92, and 0.4% (1 death) for C93.

Regarding the province of residence of the person affected by leukemia, the highest percentage of treated and deceased patients were concentrated in 2 out of the 24 provinces of the country: Pichincha (21.6% and 22.3%, respectively) and Guayas (20.9% and 23.8%, respectively). However, after standardizing rates by considering the unequal age distribution of the studied population among provinces, eight provinces with the highest morbidity and mortality rates for leukemias for the population in working ages were identified in Figure 1.

In particular, the provinces of Azuay and Tungurahua stand out with the highest morbidity and mortality rates. Azuay province had 29.2 treated patients (95% CI: 29.1 to 29.3) and mortality was 3.92 (95% CI: 3.89 to 3.96) per 100,000 inhabitants. Although with mortality rates lower than 3.5, the provinces of Loja and Morona Santiago ranked second and third in the morbidity ranking. Similarly, the province of Imbabura ranked sixth in morbidity. On the other hand, the province of Pastaza ranked first in mortality with 6.21 deaths per 100 000 inhabitants (95% CI: 6.17-6.25), although with very low morbidity rates. Likewise, the provinces of Santo Domingo de los Tsáchilas and Cotopaxi followed in the third and fourth positions of the mortality ranking.

DISCUSSION

Leukemias cause significant economic and social costs due to prolonged work disability during treatment and years of life lost due to premature death in working ages [3]. For most workers, quality information on previous exposures is not always available, partly because occupational safety concern in our country is relatively recent. Secondly, it is likely that not enough attention has been paid to occupational variables, neglecting its impact.

Some studies have observed that exposure to pesticides and herbicides could be related to the risk of developing leukemia [4,5]. In our results, provinces Azuay, Cotopaxi, Imbabura, Santo Domingo de los Tsáchilas, and Tungurahua have been observed with high morbidity and mortality rates, characterized by agricultural activity. Recently, the proliferation of greenhouses in crops is increasing in the country. Another important aspect of agrochemical use has been the association between childhood leukemia and parental exposure.

The oil industry is another pillar of the Ecuadorian economy and is mainly concentrated in the provinces of the Amazon region. We are surprised by the absence of qualified cases among affiliated workers and the low morbidity and mortality rates for provinces with a higher presence of this economic activity, with the exception of Morona Santiago, Pastaza, and Zamora Chinchipe. Other studies conducted in the provinces of Napo, Orellana, and Sucumbíos have pointed out excess mortality from leukemia in communities adjacent to oil fields [6,7].

Finally, mining has increased in the country in recent years, although illegally in the provinces of Azuay, Loja, and Imbabura. Our results show that these provinces have high morbidity and mortality rates compared to other provinces. There are suspicions about the relationship between the development of leukemias among mining workers and exposure to minerals containing carcinogenic agents and radon gas [8].

The Republic of Ecuador is located on the equator line and crossed from north to south by the Andes Mountain rangeand due to its latitude, the total amount of solar radiation is higher [9]. There are several cities located on average more than 2500 meters above sea level which are in provinces of the country in the highest rankings of morbidity and mortality, such as Azuay, Loja, Imbabura, and Tungurahua.

CONCLUSION

The marked differences in morbidity and mortality of leukemias in the different provinces and regions of the country suggest triggers linked to demographics and economic activities. Our work is a first approach to this problem in Ecuador. Spatial Bayesian analysis of leukemias mortality would allow us to guide future research studies that achive more refined explanations. Ecuador, given its population distribution, has the ideal conditions for this type of study.

Contributor roles ARGG and EFM contributed to the study conception and design. Material preparation, data collection were performed by ARGG and analysis were performed by ARGG and EFM. The first draft of the manuscript was written by ARGG, EFM, XGL and MGM contributed to the proposed data analysis. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. All authors have read the latest manuscript of the article and agree to publish it.

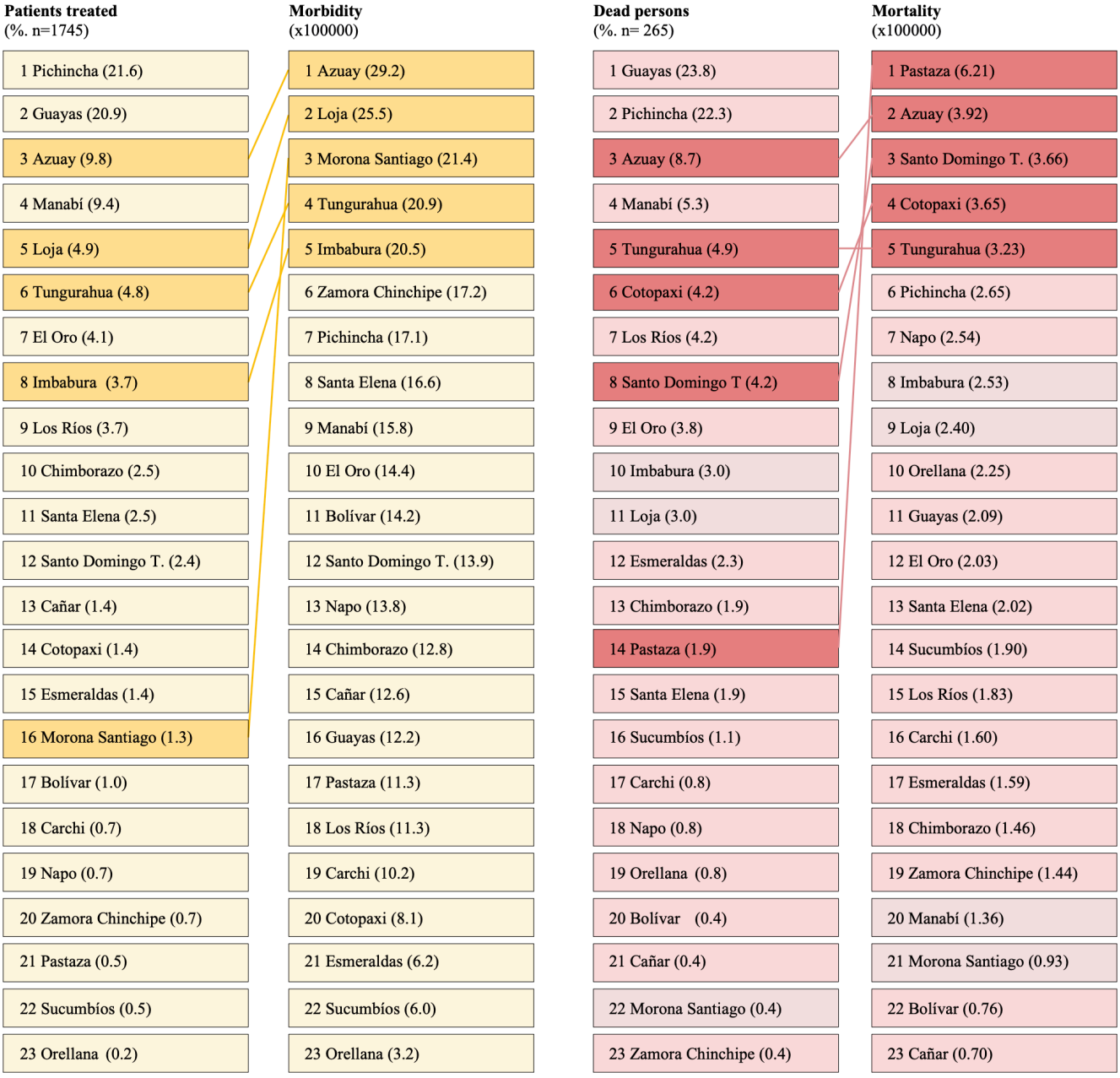
Competing interests The authors declare no competing interests with this work.

Funding

Language of submission English.

Peer review and provenance Not commissioned. Externally peer-reviewed by three reviewers, double-blind.

Figure 1. Distribution of morbidity and mortality rates for leukemias by provinces in the Republic of Ecuador, 2021.



Source: Prepared by the authors of this study.

REFERENCES

1. Shi Y, Chen C, Huang Y, Xu Y, Xu D, Shen H, et al. Global disease burden and trends of leukemia attributable to occupational risk from 1990 to 2019: An observational trend study. Front Public Health. 2022;10: 1015861. https://doi.org/10.3389/fpubh.2022.1015861
2. Yi M, Li A, Zhou L, Chu Q, Song Y, Wu K. The global burden and attributable risk factor analysis of acute myeloid leukemia in 195 countries and territories from 1990 to 2017: estimates based on the global burden of disease study 2017. J Hematol Oncol. 2020;13: 72. https://doi.org/10.1186/s13045-020-00908-z
3. Dong Y, Shi O, Zeng Q, Lu X, Wang W, Li Y, et al. Leukemia incidence trends at the global, regional, and national level between 1990 and 2017. Exp Hematol Oncol. 2020;9: 14. https://doi.org/10.1186/s40164-020-00170-6
4. Breilh J, Pagliccia N, Yassi A. Chronic pesticide poisoning from persistent low-dose exposures in Ecuadorean floriculture workers: toward validating a low-cost test battery. Int J Occup Environ Health. 2012;18: 7–21. https://doi.org/10.1179/1077352512Z.0000000002

5. Zúñiga-Venegas LA, Hyland C, Muñoz-Quezada MT, Quirós-Alcalá L, Butinof M, Buralli R, et al. Health Effects of Pesticide Exposure in Latin American and the Caribbean Populations: A Scoping Review. Environ Health Perspect. 2022;130: 96002. https://doi.org/10.1289/EHP9934
6. Hurtig AK, San Sebastián M. Geographical differences in cancer incidence in the Amazon basin of Ecuador in relation to residence near oil fields. Int J Epidemiol. 2002;31: 1021–7. https://doi.org/10.1093/ije/31.5.1021
7. Onyije FM, Hosseini B, Togawa K, Schüz J, Olsson A. Cancer Incidence and Mortality among Petroleum Industry Workers and Residents Living in Oil Producing Communities: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2021;18. https://doi.org/10.3390/ijerph18084343
8. Cortes-Ramirez J, Naish S, Sly PD, Jagals P. Mortality and morbidity in populations in the vicinity of coal mining: a systematic review. BMC Public Health. 2018;18. https://doi.org/10.1186/s12889-018-5505-7
9. Lombardi C, Heck JE, Cockburn M, Ritz B. Solar UV radiation and cancer in young children. Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research. cosponsored by the American Society of Preventive Oncology. 2013;22: 1118–1128. https://doi.org/10.1158/1055-9965.EPI-12-1316

Análisis comparativo de leucemia y estimación del riesgo en la población en edad laboral entre provincias del Ecuador

RESUMEN

La leucemia es una enfermedad a consecuencia, además de factores genéticos, de la exposición a radiaciones, derivados del benceno y pesticidas. Investigaciones anteriores han documentado un aumento de la leucemia ocupacional en la región andina de América Latina. Hasta la fecha, existen sólo unos pocos estudios en Ecuador sobre el impacto de la explotación petrolera en las comunidades indígenas. Nuestro objetivo es mostrar el impacto de la leucemia en la población en edad de trabajar. Para el cálculo de las tasas de morbimortalidad se utilizaron los registros de altas hospitalarias y defunciones del Instituto Nacional de Estadística del Ecuador. Estos datos fueron recopilados y estimadas las tasas ajustadas. Se observaron grandes diferencias entre provincias en las tasas ajustadas de mortalidad y morbilidad por leucemia en la población en edad de trabajar. Asimismo, las provincias con mayor ranking de morbilidad y mortalidad, como Azuay, Loja, Imbabura y Tungurahua, coinciden en tener una altitud promedio superior a los 2000 metros. Hay provincias de baja altitud en la costa y provincias por encima de los 2000 metros en la sierra, lo que le da a las provincias del Ecuador una identidad geográfica distintiva. Como resultado, existen variaciones en la temperatura promedio, la exposición a la radiación solar y cósmica, y actividades de minería y agricultura. Las diferencias observadas, recomiendan la recopilación futura de datos de geolocalización de las personas afectadas. Esto podría ayudarnos a comprender mejor cómo se distribuyen los casos de leucemia, identificar posibles factores de riesgo asociados a la enfermedad en cada región y diseñar estrategias de prevención y control más efectivas.