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Burden and disparities of hematologic malignancies in the Andean countries: a GLOBOCAN 2022 analysis of incidence, mortality, and mortality-to-incidence ratios

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Abstract

Purpose:*The Andean countries with a population of 133 million people are undergoing demographic changes that may affect the way cancer trends behave. Identifying these changes and risk factors is important for the development of programs to prevent or treat them.*

Methodology:*This is a retrospective ecological analysis of population-level data from the Andean countries analyzing data trends from Hodgkin lymphoma, non-Hodgkin lymphoma (NHL), multiple myeloma and leukemias. Primary outcomes were age-standardized ratios and mortality to incidence ratio. They were compared with socioeconomic indicators like human development index.*

Results:*In 2022, a total of 18,826 hematologic malignancy cases and 13,253 deaths were reported across the Andean region. NHL was the most common subtype, accounting for 37.82% of cases, while leukemias were the leading cause of death (39.77%). Peru exhibited the highest age-standardized incidence rate (ASIR: 28.7 per 100,000) and mortality rate (ASMR: 16.1), whereas Venezuela had the lowest mortality. Across all countries, males demonstrated higher incidence and mortality rates. Mortality-to-incidence ratios (MIR) varied substantially, with multiple myeloma showing the highest relative mortality burden.*

Discussion and conclusion: *These findings highlight marked regional disparities in hematologic malignancy burden across the Andean countries. Higher incidence in certain settings likely reflects improved diagnostic capacity, while elevated mortality and MIR in others suggest limitations in access to timely diagnosis and effective treatment. The inconsistent relationship between Human Development Index and mortality contrasts with global trends and may be driven by differences in data quality and healthcare infrastructure. Overall, these results underscore the need for strengthened cancer surveillance systems and more equitable access to oncologic care in the region.*

Introduction

The Andean countries (AC) with a total population of 133 million people have a wide variety of medical conditions that correlate with the differences in geography, income levels, healthcare access and cultural traits. Hospitals and healthcare staff that care for immigrants from Ecuador, Colombia, Venezuela and Peru usually face uncommon medical situations that may delay diagnosis and treatment of certain conditions. Many of these countries are going through demographic transitions that may change the incidence of certain diseases like cancer. For example, the AC population is currently aging more, as per the United Nations Department of Economic and Social Affairs (UN DESA) these countries' populations' median age is increasing, youth is decreasing and the portion of elderly is increasing (1). All of these changes may shift the way cancer trends behave.

Hematological malignancies represent a smaller proportion of new cancers in these regions, accounting for only 6.29% of new cancer cases in South America, but they possess an important mortality burden of 7.8% of all cancer deaths (2). They can be classified as leukemias, Hodgkin's lymphoma (HL), non-Hodgkin lymphoma (NHL) and multiple myeloma (MM). Most of these malignancies have well known

associated risk factors that may vary from country to country. To provide a non-related example, New Zealand has among the highest rates of NHL in the world, which has been associated with a high Human Development Index (HDI) (3). Properly matching these risk factors with the hematological cancer trends in this region is paramount for the development of nation-level cancer screening measures, as well as for the initiation of cancer prevention programs. This may also help promote research initiatives that might shape the way clinicians think of patients from these particular regions.

Methodology

This study is a retrospective ecological analysis of population-level data evaluating incidence and mortality of hematological malignancies in Andean countries (Ecuador, Colombia, Peru, and Venezuela) for the year 2022. Data were obtained from multiple sources, including the Global Cancer Observatory (GLOBOCAN), national cancer registries, world population review and United Nations population datasets (1,4). All available population data in the age range between 20–85 years old were included and stratified by sex.

Hematological malignancies analyzed included leukemias, Hodgkin lymphoma, non-Hodgkin lymphoma, and multiple myeloma, as defined by standard international classifications. Primary outcomes were age-standardized incidence rates (ASIR) and age-standardized mortality rates (ASMR) per 100,000 population, calculated using standard global population references. Secondary outcomes included crude incidence and mortality rates, as well as mortality-to-incidence ratios (MIR), used as a proxy for survival. The total cancer cases and deaths used on this paper exclude non-melanoma skin cancers.

Descriptive analyses were performed to compare incidence and mortality across countries, malignancy subtypes, and sex. Comparative analyses were conducted using relative differences between countries. Epidemiologic patterns were further evaluated in the context of demographic aging, socioeconomic indicators, and healthcare access metrics obtained from international datasets like Human Development Index (HDI) and Healthcare Spending by Capita (HSC). Elderly population was considered the segment of each country's population older than 65 years old. Pearson's correlation was calculated to compare quantitative variables using Google Sheets.

Given known variability in cancer registry completeness across countries, particularly in low-resource settings, results were interpreted with consideration of potential underreporting and modeled estimates. This study utilized publicly available, de-identified data and did not require institutional review board approval.

Results

In 2022, a total of 18,826 hematological malignancies were reported in the Andean countries in 2022, representing 7.07% of all new cancer diagnoses in the region (excluding non-melanoma skin cancer). In the same year, these malignancies accounted for 13,253 deaths, comprising 9.73% of all cancer-related

mortality. Among these, NHL had the highest proportion of cases (37.82%), while the leukemias contributed the most to mortality (39.77%).

As seen in Table 1, Peru was found to be the country with the highest ASIR of hematological malignancies (28.7 per 100,000), followed by Venezuela and Ecuador tied (22.2 per 100,000), leaving Colombia with the lowest incidence rates (21 per 100,000). ASMR also varied across different countries, with Peru demonstrating the highest mortality (16.1 per 100,000), followed by Ecuador (14 per 100,000), then Colombia (12.7 per 100,000) and Venezuela being the country with the least hematological malignancy deaths (10.9 per 100,000).

Table 1
ASIR and ASMR by country and malignancy in 2022

		Ecuador	Colombia	Venezuela	Peru
ASIR	**HL**	**1.5**	**1.6**	**3.1**	**1.5**
	NHL	**11.7**	**9.5**	**9.7**	**15.3**
	MM	**2.3**	**3.4**	**2.3**	**3.6**
	Leukemia	**6.7**	**6.5**	**7.1**	**8.3**
TOTAL PER COUNTRY		22.2	21	22.2	28.7
ASMR	**HL**	0.55	0.56	0.82	0.54
	NHL	5.8	4.5	3.8	6.6
	MM	2	2.5	1.9	2.7
	Leukemia	5.6	5.1	4.4	6.3
TOTAL PER COUNTRY		14	12.7	10.9	16.1
MIR		0.63	0.6	0.49	0.56

Note: *HL, Hodgkin lymphoma; NHL, non-Hodgkin lymphoma; MM, multiple myeloma; ASIR, age-standardized incidence rate; ASMR, age-standardized mortality rate; MIR, mortality-to-incidence ratio.*

Across all countries, NHL had the highest incidence, particularly in Peru. In contrast, HL showed the lowest incidence across the region. Mortality patterns were slightly different, with leukemias accounting for the highest death rates, also in Peru. In both sexes NHL was found to be the most incident and leukemias the most fatal. After calculating M/F incidence and mortality, it was found that in every country studied, males had more incidence and mortality in every of these malignancies than women.

MIR was similar between countries, with the highest ratio observed in Ecuador (MIR 0.63) indicating a higher mortality burden relative to incidence while Venezuela demonstrated the lowest ratio of the region (MIR 0.49). From all of the hematological malignancies MM had the highest mortality-incidence ratio

(MIR 0.78), closely followed by leukemias (MIR 0.75), leaving NHL (MIR 0.45) and HL (MIR 0.32) on the bottom (Table 2).

Table 2
Male to female ratio on incidence and mortality in the Andean countries on 2022

		Ecuador	Colombia	Venezuela	Peru
SEX M/F RATIO INCIDENCE	**HL**	1.01	1.12	1.24	1.28
	NHL	1.08	1.34	1.28	1.27
	MM	1.33	1.47	1.14	1.71
	Leukemia	1.04	1.11	1.23	1.29
SEX M/F RATIO MORTALITY	**HL**	1.03	1.14	1.26	1.4
	NHL	1.06	1.31	1.21	1.42
	MM	1.3	1.44	1.09	1.43
	Leukemia	1.04	1.11	1.22	1.29

Note: *HL, Hodgkin lymphoma; NHL, non-Hodgkin lymphoma; MM, multiple myeloma.*

Other indicators like human development index (HDI), median age, elderly population and healthcare spending per capita (HSC) were obtained for each country. Peru had the highest HDI (0.76) while Venezuela had the lowest one (0.69). The median age varied across countries being Ecuador the country with the lowest median age (28) while Colombia was the country with highest median age (31.2). The country that had the highest percentage of elderly population was Colombia (9.02%) while Ecuador was the country with the lowest amount of elderly population (7.9%). Colombia also had the highest HSC while Venezuela had the lowest HSC (Table 3). A positive correlation was observed between HDI and both ASIR (r = 0.391) and ASMR (r = 0.847)

Table 3
Demographic and socioeconomic characteristics of Andean countries

HDI	**Ecuador**	**Colombia**	**Venezuela**	**Peru**
	0.75	**0.75**	**0.69**	**0.76**
MEDIAN AGE	28	31.2	28.8	29.1
ELDERLY POPULATION > 65 YEARS OLD	7.90%	9.02%	8.98%	8.81%
HEALTHCARE SPENDING PER CAPITA	1,157.054 USD	1,570.884 USD	135.854 USD	1,006.934 USD

Note: *HDI, Human Development Index*

Discussion

This study provides a comparative overview of the burden of hematological malignancies across Andean countries. Incidence and mortality rates varied across malignancy subtypes, countries, and sex. The highest age-standardized incidence and mortality rates were observed in Peru, the country with the highest Human Development Index (HDI), likely reflecting differences in diagnostic capacity and cancer registration. Notably, Peru also exhibited the lowest mortality-to-incidence ratio (MIR), despite intermediate levels of healthcare expenditure, which may suggest comparatively more favorable outcomes. In contrast, other countries did not demonstrate consistent associations between epidemiological indicators and socioeconomic variables.

Age-standardized incidence rates (ASIR) are often influenced by differences in diagnostic capacity and cancer registration rather than true variation in disease frequency (5,6). In this study, Peru demonstrated both the highest ASIR and the highest HDI; however, the correlation between these variables was only moderate ($r = 0.391$), suggesting that additional factors contribute to the observed incidence patterns. While improved detection likely plays a role, the concurrent elevation in both ASIR and age-standardized mortality rates (ASMR) raises the possibility of a genuinely higher disease burden.

Traditionally, ASMR is expected to correlate inversely with HDI, reflecting improved access to early diagnosis and treatment in more developed settings (7). In contrast, the present analysis demonstrated a positive association between ASMR and HDI, indicating a deviation from expected global patterns. This finding may reflect differences in death certification practices, reporting accuracy, or healthcare system performance across countries, rather than a true increase in mortality risk in higher-HDI settings (8).

The mortality-to-incidence ratio (MIR) further highlights disparities in cancer outcomes across the Andean region. Higher MIR values are generally associated with poorer survival relative to incidence and may reflect limitations in access to timely diagnosis and effective treatment, whereas lower MIR values suggest comparatively better outcomes(9,10). In this analysis, Venezuela demonstrated the lowest MIR (0.49) in the region. However, this finding should be interpreted with caution, as variations in cancer registration, diagnostic capacity, and mortality reporting may influence MIR estimates, particularly in settings with constrained health information systems. Therefore, the observed pattern may not necessarily reflect superior treatment outcomes but could also be influenced by differences in data completeness and reporting practices (9).

Increasing age is a well-established risk factor for both the incidence and mortality of hematological malignancies (11,12). However, this expected pattern was not consistently observed in the Andean region. In this analysis, Colombia demonstrated the highest median age among the included countries but exhibited comparatively lower ASIR. This finding suggests that population age structure alone may not fully account for differences in hematological malignancy burden across countries. Other factors, including diagnostic capacity, healthcare access, and registry completeness, likely play a more prominent role in shaping observed incidence patterns.

Consistent with global epidemiologic patterns, non-Hodgkin lymphoma NHL was the most common hematologic malignancy in this cohort, occurring at approximately twice the frequency of leukemias, which ranked second. This distribution is expected, as NHL comprises a highly heterogeneous group of disorders with diverse clinical presentations and risk factors, allowing it to arise across a broad range of settings (13). Despite its higher incidence, NHL demonstrated a substantially lower MIR compared to leukemias (0.45 vs 0.75, respectively), indicating relatively better survival outcomes. In contrast, leukemias, although less frequent, are associated with a disproportionately higher mortality burden, underscoring their more aggressive clinical course at the population level.

Overall, the findings of this study highlight the complex and non-linear relationship between socioeconomic development and the burden of hematological malignancies. While higher HDI has traditionally been associated with increased incidence and lower mortality, this pattern was not consistently observed across the Andean region. These results suggest that HDI alone may not fully capture the heterogeneity of cancer burden and outcomes within this regional context.

This study has several limitations. First, the use of GLOBOCAN data relies partially on modeled estimates, particularly in countries with limited cancer registry coverage. Second, the ecological design precludes causal inference at the individual level. Third, variations in data quality across countries may affect comparability (14). Finally, the analysis is based on 2022 data, which may not fully reflect current trends in the region.

Conclusion

Hematological malignancies in the Andean region demonstrate substantial heterogeneity in incidence, mortality, and outcomes across countries. While socioeconomic development, as measured by HDI, provides a useful framework for understanding cancer burden, the relationships observed in this study were not uniform and suggest the influence of additional factors, including healthcare infrastructure, diagnostic capacity, and data quality. These findings underscore the importance of strengthening cancer surveillance systems and improving access to timely diagnosis and treatment to reduce regional disparities. Future studies incorporating longitudinal data and more granular health system indicators are needed to better characterize the drivers of these differences and inform targeted public health strategies.

Declarations

Competing interests:

I declare that the authors have no competing interests as defined by Springer, or other interests that might be perceived to influence the results and/or discussion reported in this paper.

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Author Contribution

E.A.P wrote the main manuscript text and V.R.V prepared all the figures. All authors reviewed the manuscript

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Figures

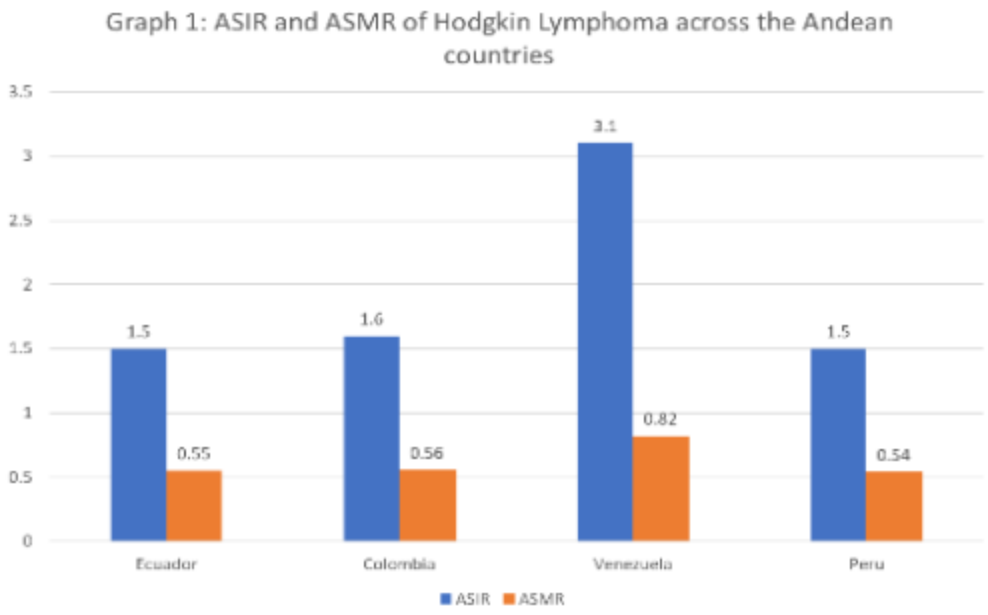


Figure 1

Note: *ASIR, Age Standardized Incidence Ratio; ASMR, Age Standardized Mortality Ratio*

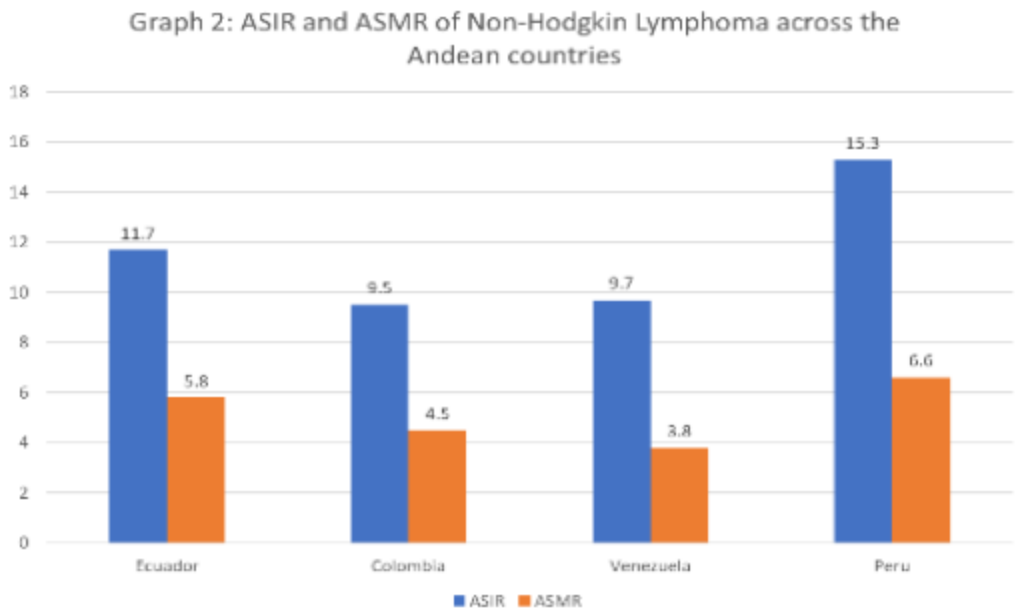


Figure 2

Note: *ASIR, Age Standardized Incidence Ratio; ASMR, Age Standardized Mortality Ratio*

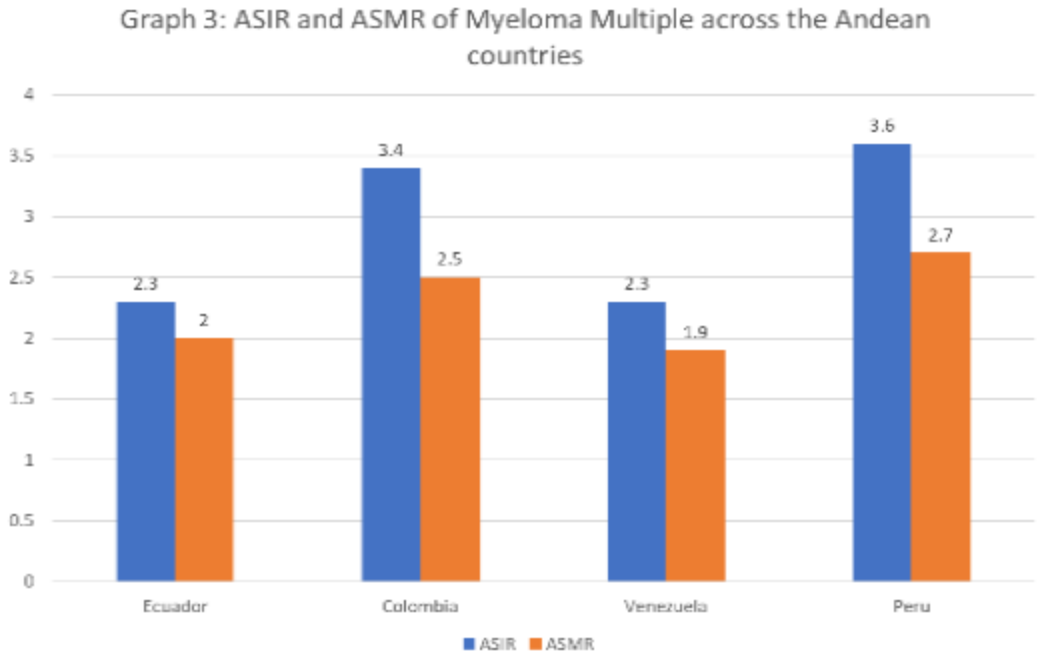


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Note: *ASIR, Age Standardized Incidence Ratio; ASMR, Age Standardized Mortality Ratio*

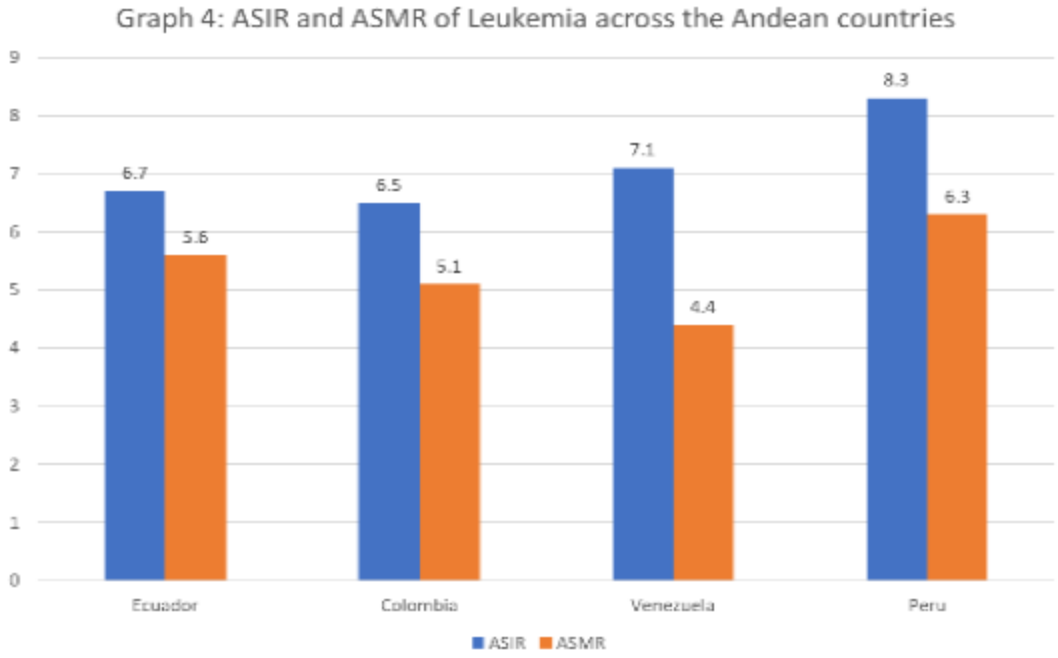


Figure 4

Note: *ASIR, Age Standardized Incidence Ratio; ASMR, Age Standardized Mortality Ratio*