



Where does Hispanic Latin America stand in biomedical and life sciences literature production compared with other countries?

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ABSTRACT

Objectives: to provide objective quantitative data about medical-related scientific production in Hispanic Latin America compared to different regions and identify demographic and political variables that could improve research.

Study design: This is an analytical, observational, cross-section bibliometric study about all fields of medical-related scientific production over five years in different regions and its relationship with demographic and political variables that could impact research and the health system quality.

Methods: Data on the total scientific production of all Hispanic Latin American countries and other countries representing almost 90% of mundial publications between 2017 and 2021 were retrieved from the PubMed database. Demographic and political data were obtained from open online databases. Counts of publications were rationed to population and analyzed with all other demographic, region, and language variables, using univariate Poisson regression and negative binomial regression (for over-disperse variables) analysis. Multivariate negative binomial regression was used to analyze the combined effect of variables related to the healthcare and research Sectors.

Results: Hispanic Latin America increased yearly from 29,445 publications in 2017 to 47,053 in 2021. This cumulative growth of almost 60% exceeded the 36% increment in all countries' publications and was only below that of Russia and China, which grew 92% and 87%, respectively. Negative binomial regression showed that the percentage of gross income dedicated to research (IRR 2.036, 95% CI: 1.624, 2.553, $p < .001$), life expectancy at birth (IRR 1.444, 95% CI: 1.338, 1.558, $p < .001$), and the number of medical doctors per inhabitant (IRR 1.581, 95% CI: 1.17, 2.13, $p = .003$) positively impacted scientific production. A higher mortality associated with chronic diseases between ages 30 and 70 (IRR 0.782, 95% CI: 0.743 0.822, $p < .001$) and a lower population with access to medicine (IRR 0.960, 95% CI: 0.933, 0.967, $p < .001$) were found to impact scientific production negatively. Hispanic Latin American countries published less than 20% of those with English as their native language ($p < .001$).

Conclusion: Hispanic Latin America has increased the gross number of publications by almost 60 % from 2017 to 2021. However, the number of publications per 100,000 inhabitants is still low compared to other countries. Our analysis highlights that this may be related to lower GDP, research investment, and less healthcare system quality.

1. Key findings

- The present study considered publications from 32 nations from 2017 to 2021 and represented almost 90% of publications indexed in Pubmed during that period. The gross number of publications from

Hispanic Latin America grew by 60%, above the 36% increase of publications from all other countries considered in this study.

- In 2021, the number of publications per 100,000 people in all included countries was 25.36. It showed a significant disparity

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between nations, with 271.78 in Australia, 11.17 in Hispanic Latin America, and 5.13 in India.

- Multivariate analysis of data from all included nations showed that better life expectancy at birth, current health expenditure per capita expressed in American Dollars, number of Medical Doctors per 1000 population, and quality of health care perception as “very good” increases the number of publications per 100,000 inhabitants by 34%.

2. Introduction

Peer-reviewed scientific publications are essential to communicating research results and disseminating information that can impact clinical practice globally, being the basis for scientific development [1].

Bibliometric analysis is a standardized method of quantifying research, extracting measurable data through statistical analysis of published research studies [1]. Bibliometrics owes its systematic development mainly to D.J.D. Price and Eugene Garfield, who contributed to the advancement of psychology by the middle of the last century [2].

Biomedical and life sciences literature production has been studied in different fields of medicine, such as cardiovascular diseases [3], respiratory medicine [4], virology [5], parasitology [6], and vascular surgery [7]. In most of them, scientific production in Latin America remains low compared to leading regions, such as the United States of America (USA) and Western Europe. Notwithstanding, increasing output from Latin American countries has been observed [8]. All of them considered Latin America to be a geographic region. Of the 42 nations the World Bank considers Latin America, only 17 have Spanish as their official language. That group of countries (listed in Appendix 1) conforms to Hispanic Latin America. In this paper, we only regarded Hispanic Latina-American countries as a region. Brazil was isolated from its neighbors because of its language, its largest population, and its largest GDP. Besides, it is part of the BRICS emerging economies.

Several bibliometric analyses of specific fields or regions have studied the relationship between scientific output and political, economic, and health system variables [9–12]. Some have found a strong association between the number of publications and a high gross domestic product (GDP) due to increased human and economic resources destined for research [13]. We hypothesized that some other variables related to education, healthcare system quality, and native language could also influence the quantity of scientific production.

This bibliometric analysis aims to provide objective quantitative data about medical-related scientific production in Hispanic Latin America over five years compared with countries worldwide, representing 90% of Pubmed indexed publications. It also aims to identify demographic and political variables that could improve research.

2.1. Study Design

This is an analytical, observational, cross-section bibliometric study about all fields of medical-related scientific production over five years in different regions and its relationship with demographic and political variables that could impact research and the health system quality.

3. Methods

Using the National Center for Biotechnology Information (NCBI Bethesda (MD) and the National Library of Medicine (US) database, we retrieved information with the PubMed Advanced Search Builder by selecting the Date of Publication from the first to the last day of 2017, 2018, 2019, 2020, and 2021. (“2021/01/01”[Date - Publication]: “2021/12/31”[Date - Publication]). The total number of publications was obtained. Then, the retrieval was done for the same years, adding the country’s name in the “affiliation” field. Example: (2021/01/01:2021/12/31[Date - Publication] AND “Argentina”[Affiliation]) OR

“Argentina”[Affiliation]). We obtained the number of publications per year, per country, from 2017 to 2021 in any language. This action was repeated, spelling their names in English and their native languages with all Hispanic Latin American countries, Australia, Brazil, Canada, China, Spain, France, Germany, India, Israel, Italy, Japan, Portugal, Russia, South Korea, United Kingdom, and the United States. All these countries were selected because, all together, they represented almost 90% of indexed publications in PubMed. All Hispanic Latin-American countries were considered as a single region. Brazil was excluded due to its difference in language, its largest population, and its largest GDP. Besides, it is part of the BRICS emerging economies.

Population, GDP per capita, life expectancy at birth, current health expenditure per capita, and expenditure in Research (GDI) were obtained from the open online databases of World Bank Open Data (WB) [14]; Number of Medical Doctors (MD) per 1000 population, mortality from chronic-degenerative diseases, number of research trials, annual grants to research (U\$S millions), and current government expenditure on medical research per capita (U\$S) from World Health Organization (WHO)[15]; number of top-200 universities from QS World University Rankings [16]; researchers engaged in research and development from UNESCO; and quality of health care perception as very good, and percentage of people who cannot afford good healthcare from The Ipsos Global Health Service Monitor [17].(Table 1)

The number of publications was rationalized per 100.000 inhabitants for each country; then, all countries were ranked based on this ratio. Hispanic Latin American countries (HLATAM) were analyzed together as a region. Region and language classifications were established based on each country’s demographics and official language.

Counts of publications were analyzed with all other demographic, region, and language variables using univariate Poisson regression and negative binomial regression (for over-disperse variables) analysis. Multivariate negative binomial regression was used to analyze the combined effect of variables related to the healthcare and research sectors.

4. Results

A total of 7,489,809 publications were analyzed in this study. In 2017, 1,303,913 publications were indexed in PubMed, 1,351,533 in 2018, 1,417,136 in 2019, 1,637,588 in 2020, and 1,779,639 in 2021. The selected countries represented 81.71%, 83.34%, 84.86%, 87.50%,

Table 1
Variables analyzed.

Variable	Year	Source
Population	2017–2021	WB
GDP per capita	2017–2021	WB
Life expectancy at birth, total (years)	2020	WB
Current health expenditure per capita (U\$S)	2019	WB
Number of MD per 1000 population	2017 or the last reported	WHO
Expenditure in Research (% GDP)	2017–2020	WB
Mortality from CVD, cancer, diabetes, or CRD between exact ages 30 and 70 (%)	2017–2019	WHO
Number of Trials	2015–2019	WHO
Number of Universities ranked top200 per Country	2017–2021	QS
Quality of Health care perception as very good (%)	2021	Ipsos
People who cannot afford good healthcare (%)	2021	Ipsos
Researchers engaged in research and development (per million people)	2017–2020	UNESCO
Annual grants to research (U\$S millions)	2019	WHO
Current Government expenditure on Medical Research per capita (U\$S)	2020	WHO

GDP: gross domestic product, MD: Doctor of Medicine, CVD: Cardiovascular diseases, CRD: Cronic Renal Disease, WB: World Bank, WHO: World Health Organization 15.

and 89.09% of all indexed publications in PubMed in 2017, 2018, 2019, 2020, and 2021, respectively.

The overall gross number of publications increased in most countries selected during the study period, sharing the leadership of the USA and China (Fig. 1). Hispanic Latin America was not the exception; it increased yearly by 8.5%, 8.5%, 22.8%, and 10.3% from 2017 to 2021, respectively, starting with 29,445 publications in 2017 and rising to 47,053 in 2021. This cumulative growth of almost 60% exceeded the 36% increment in all countries' publications and was only below that of Russia and China, which grew 92% and 87%, respectively. When the number is adjusted to a 100,000 population, the overall ratio in 2021 was 25.36. Australia was the top country, followed by Israel, Canada, and Portugal. The USA and China dropped to the 11th and 13th positions, respectively. Hispanic Latin America as a unit (HLATAM) appeared in the 14th position, above Russia and India (Table 2).

Negative binomial regression showed that the percentage of gross income dedicated to research (IRR 2.036, 95% CI:1.624, 2.553, $p < .001$), life expectancy at birth (IRR 1.444, 95% CI:1.338, 1.558, $p < .001$), and number of medical doctors per inhabitant (IRR 1.581, 95% CI:1.172, 2.132, $p = .003$) positively impact scientific production. A similar beneficial effect was seen related to the number of trials per 100.000 inhabitants and the positive perception of health by the population.

A higher mortality associated with chronic diseases between the ages of 30 and 70 years (IRR 0.782, 95% CI:0.743 0.822, $p < .001$) and a lower population with access to medicine (IRR 0.960, 95% CI:0.933, 0.967, $p < .001$) were found to impact scientific production negatively. (Table 3).

Regarding native-language effects in scientific production, Hispanic Latin American countries published less than 20% of those with English as their native language ($p < .001$). Nevertheless, Spain published 11

Table 2
Number of publications per 100000 population.

Country	Number of Publications per 100000 population
Australia	271.78
Israel	220.42
Canada	196.77
Portugal	161.52
United Kingdom	158.97
Italy	148.60
Spain	129.16
Germany	120.85
South Korea	100.05
France	94.30
USA	90.04
Japan	68.68
China	22.72
HLATAM	11.17
Russia	10.10
India	5.13

folds more than Hispanic Latin American countries. Furthermore, Brazil published twice as many articles as other Hispanic Latin American countries (Table 4).

Similarly, Chinese, Indian, Portuguese, Russian, and Japanese native languages hurt the number of publications per 100,000 inhabitants compared with English as a native language. Still, Hebrew and Italian appeared to be positive.

The yearly increase in publications per 100,000 inhabitants, with an increase in the percentage of gross income dedicated to research, correlates in some countries, such as China, South Korea, Israel, Italy, and the USA. (Table 5)

Multivariate analysis of better health systems variables (life

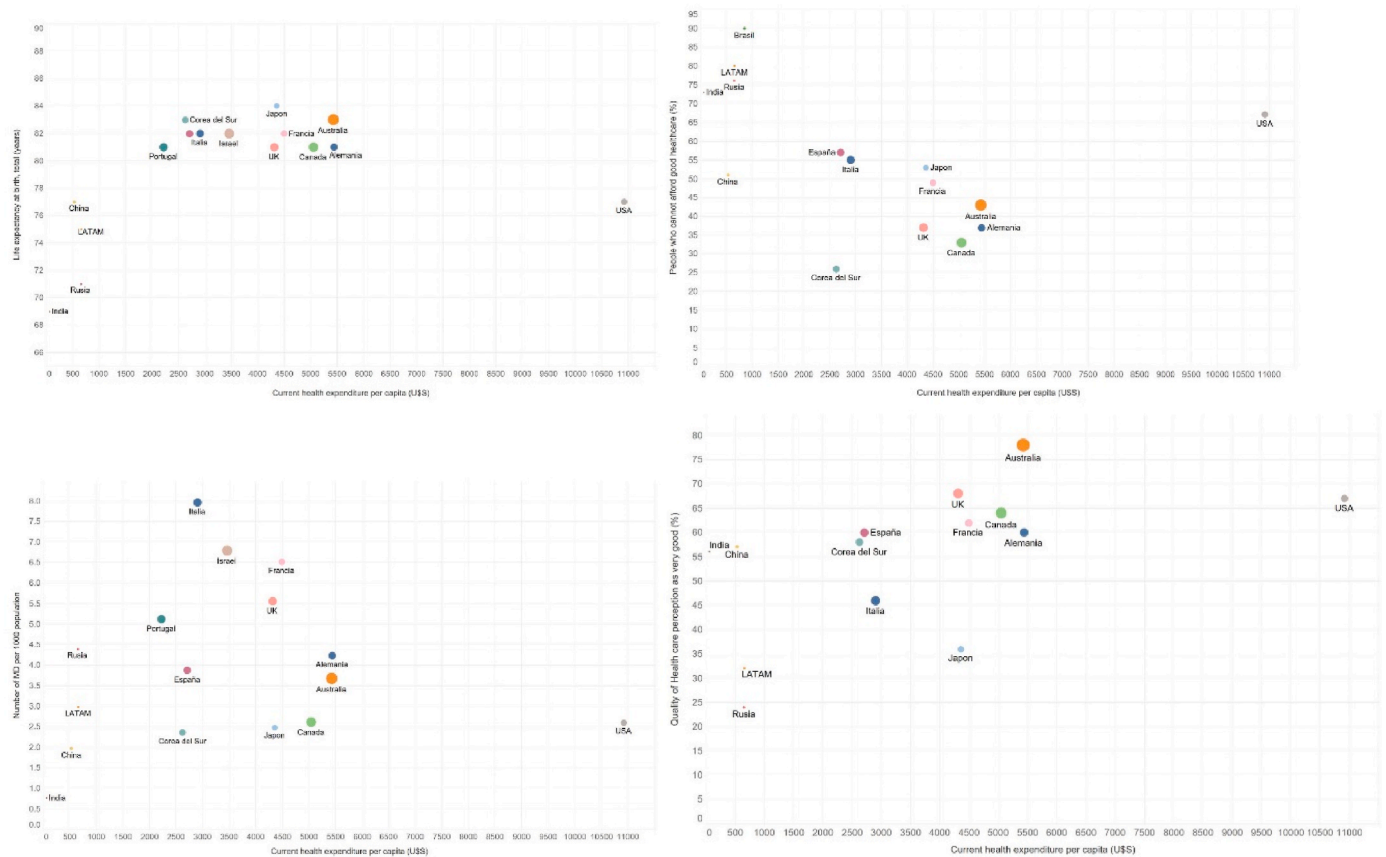


Fig. 1. Visualization of the relationship between healthcare spending and life expectancy, people unable to afford good healthcare, member of MDs and Quality healthcare perception and the scientific production. Dot sized by number of publications per 100k people.

Table 3
Negative binomial regression.

Variable	IRR	95% CI	p =
Life expectancy at birth	1.444	1.338, 1.558	< .001
Current health expenditure per capita	1.0007	1.0005, 1.0009	< .001
Number of MD per 1000 population	1.581	1.172, 2.132	.003
Mortality from CVD, cancer, diabetes, or CRD between exact ages 30 and 70	0.782	0.743, 0.822	< .001
Number of Trials	1.107	1.082, 1.133	< .001
Number of trials per 100,000 population	1.000	0.999, 1	.397
Number of Universities ranked 200 in 2021	1.088	0.99, 1.185	0.054
Quality of Health Care perception as very good (%)	1.054	1.031, 1.077	< .001
% of People who cannot afford good healthcare	0.950	.933, .967	< .001
Researchers engaged in research and development (per million people)	1.0004	1.0003, 1.0005	< .001
Annual grants to research	1.000	.999, 1	.085
Current Government expenditure on Medical Research per capita (US\$)	2.776	0.973, 7.92	.056
GDP per capita	1.00008	1.00007, 1.00009	< .001
Expenditure in Research (% GDP)	2.036	1.624, 2.553	< .001

Table 4
Publications regarding the native language.

Language	IRR	95% CI	p =
English	Reference		
German	1.035	0.89, 1.202	.646
Chinese	0.173	0.135, 0.220	<.001
Korean	0.868	0.744, 1.01	.073
Spanish	0.186	0.147, 0.236	<.001
French	0.837	0.731, 0.978	.026
Indian	0.039	0.025, 0.062	<.001
Israel	1.907	1.661, 2.188	<.001
Italian	1.192	1.029, 1.379	.019
Japanese	0.584	0.494, 0.691	<.001
Portuguese	0.230	0.185, 0.287	<.001
Russian	0.073	0.052, 0.104	<.001

expectancy at birth, total (years), current health expenditure per capita (US\$), number of MDs per 1000 population, and quality of health care perception as very good increases the population-pondered number of publications by 34% (95% CI: 23%, 47%, $p < .001$). The same behavior is observed with an increase in research resources (Fig. 1). Multivariate analysis of the number of researchers and trials showed a 13% increase in publications per 100,000 people (95% CI: 6%, 20%, $p < .001$).

5. Discussion

Hispanic Latin America, with a total population of 654,981,699, represents 8.30 % of the 7,888,408,690 inhabitants of the world in 2021, as reported by the World Bank Open Data [14]. The same year, PubMed indexed 47,053 publications affiliated with Hispanic Latin American countries, representing 2.64% of the 1,779,639 publications indexed that year.

This dystopic relationship has been described previously, representing 1.3% of all publications in 1995 and 1.8% in 2000. Only Africa was below Latin America, accounting for 0.9% of all publications [18]. In this publication, the authors adjusted the number of publications per million population per year, and Latin America got closer to Asia but still only above Africa.

Similarly, a bibliometric analysis of global research production in respiratory medicine showed an average of 0.8% of publications from Latin America from 1995 to 2003, only above Africa [4]. Likewise,

Table 5
Correlation between the yearly increase in the number of publications per 100,000 people and the annual increase of expenditure in research (% of GDP).

Variation of the number of publications per 100000 population per year	IRR	95% CI	p =	Variation of the Expenditure in Research (% GDP)per year: p =
Germany	1.072	1.008, 1.140	.025**	.137
Australia	1.068	1.025, 1.112	.001**	NA
Canada	1.068	1.018, 1.120	.006**	.860
China	1.169	1.005, 1.361	.043**	.044**
South Korea	1.071	1.002, 1.145	.044**	.008**
Spain	1.120	1.053, 1.192	<.001**	.120
France	1.062	0.993, 1.137	.079	.249
India	1.130	0.824, 1.550	.447	NA
Israel	1.071	1.025, 1.121	0.003**	.013**
Italy	1.132	1.069, 1.199	< .001**	.007**
Japan	1.079	0.995, 1.171	.065	.151
HLATAM	1.120	0.909, 1.380	.284	.234
Portugal	1.124	1.063, 1.1890	<.001**	.101
Russia	1.191	.943, 1.503	.142	.968
United Kingdom	1.077	1.02, 1.136	.006**	.297
USA	1.094	1.017, 1.176	.015**	.024**

another study analyzed publications from 1995 to 2002 in the cardiovascular field, finding Latin American publications to represent 1.1%, being only more productive than Africa [3]. The same phenomenon was observed in virology, where Latin American scientific production represented 1.4% of the world’s scientific production on that topic in the same period [5]. Only in the field of Parasitology do Latin American countries get closer to Western Europe and the USA, representing 17.2% of the total publications [6]. Most of these publications concluded by urging the WHO, the WB, national governments, and different institutions to increase research support for developing countries.

Almost 20 years later, there is a slight improvement, but the differences between regions are still enormous. When the number of publications per million people annually is adjusted, Latin America becomes closer to Asia, but it is still only above Africa [18]. We also ranked the countries after calculating the number of publications per 100,000 population per year, and we observed a clear leading trend in developed countries over Latin America. Notably, the gross number of publications from Latin America grew by almost 60% from 2017 to 2021, more significant than the increase observed in all other countries analyzed, except for Russia and China.

Observations related to GDI and the number of publications adjusted to population have been previously reported [6,19–21]. Some studies found a clear correlation, but others failed. In the present study, countries with a higher percentage of gross income dedicated to research had more publications per 100,000 population per year. Similarly, BRICS (Brazil, Russia, India, China, and South Africa) countries have found a positive correlation between gross income dedicated to research and the number of scientific publications [22]. BRICS represents 42% of the global population, and this group is emerging as a significant influencer of geopolitical changes. They also observed a positive correlation between the best-positioned universities in the Times Higher Education

global ranking when comparing the scientific output from each country of their group. We could not make a similar correlation in our study since we only considered the number of the top 200 universities ranked in the QS in each country. In addition, we focused only on the biomedical and life sciences literature. In contrast, the BRICS study included arts and humanities, business and economics, clinical, pre-clinical and health, computer science, education, engineering and technology, law, life sciences, physical sciences, psychology, and social sciences.

We also found a positive correlation with other parameters, such as the number of MDs and clinical trials per population. Moreover, total net official assistance to medical research per capita positively impacted the number of publications adjusted to people.

Poor quality of health care is a significant driver of excess mortality related to chronic conditions [23]. Access to healthcare implies the availability of relevant and effective services and providers, physical accessibility, and affordability [24]. These two variables could be considered, among others, to define the quality of a country's healthcare system. In our study, higher mortality related to chronic diseases in adults and a lower population with access to medicine correlated with significantly less scientific production.

More in-depth studies are warranted to define if more publications are the cause or the consequence of better health system parameters.

The relationship between the native language of the authors and the rejection rate has been previously studied. The journal publication acceptance rate was near 30% when authors' affiliation was UK or US, but it dropped to 20% when authors were from Spain and 10 % when authors were from Italy [25]. Another publication pointed out many language errors in manuscripts from non-native English countries [26]. Likewise, in a survey-based study, 43.5% of doctoral students responded that English grammar was the cause of at least one rejection or revision of their article [27]. Notably, in the present study, we identified fewer publications adjusted to the population from Hispanic Latin America but not from Spain. On the contrary, English-speaking countries, Italy and Israel, had more publications when adjusted to a 100,000 population.

The multivariate analysis showed an increase of 13% in publications pondered by 100,000 people with the rise in the number of researchers and clinical trials. Thus, an increase of 34% in publications per 100,000 people is seen when better health system variables are analyzed. The question is whether these findings imply that more research results in a better healthcare system or if a better health system comes with more publishing interest.

The present study has several limitations. First, we searched using only one of the multiple available engines. Although it is a popular database, it can leave out the scope of thousands of studies published in other databases. Second, we only took the total number of publications the search engine gave per country but did not perform a one-per-one verification of the affiliation country. In this way, many international collaborative studies could have been duplicated, which could have altered our results. Furthermore, PubMed sometimes counts double the same article when it appears ahead of print and in its final version. Nevertheless, this confounding factor should have occurred constantly in most publications and might not have affected the number of publications from a single country. Third, we did not quantify the impact factor of each publication because the quality of the evidence was not within this study's scope. Finally, not all variables we analyzed were available for all countries and years, so we had to select the latest data.

In conclusion, Hispanic Latin America has increased the gross number of publications by almost 60 % from 2017 to 2021. However, the number of publications per 100,000 inhabitants is still low compared to other countries. Our analysis highlights that this may be related to lower GDP, research investment, and less healthcare system quality.

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Ethical approval

As this is a bibliometric analysis and data was obtained from PubMed and other open databases, no ethical approval was required.

Declaration of competing interest

None.

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None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2024.100474>.

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