# The burden disease of Chagas in Colombia from 2010 to 2020

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## Abstract

Objective: To estimate the morbimortality and burden of Chagas disease in Colombia during the period 2010 to 2020.

Methods: Incidence and mortality were estimated with data obtained from Sispro and Dane cubes according to CIE 10 codes, and indicators using the methodology of Lopez and Murray where DALYs were estimated by department, sex, and age groups.

Results:

At the national level during the period from 2010 to 2020 the incidence rate was increasing reaching the 2019 rate of 2.99 per 1,000 inhabitants, the mortality rate until 2014 was 0.5 per 100,000 inhabitants and began to decline from 2016. Regarding the burden of disease, the years of life lost due to premature death reached a rate of 3.46 per 1,000 inhabitants being higher loss in men than in women, contrary to what happened in years lived with a disability where it is women who contribute more years, the overall rate of YLD was 29.38 per 1,000 inhabitants. Finally, the DALYs at the national level were 16.39 per 1,000 inhabitants with a greater burden in the Orinoquia, Andina, and Amazonica regions.

Conclusions:

Colombia is in the fight to control Chagas disease through vector eradication and timely identification of acute cases. For this reason, these results provide important and relevant information on the characterization and trends of regional and national disease burden, which could be used to direct and prioritize the formulation of health policies and strategies that give continuity to the early detection and timely management of the disease.

Chagas disease is caused by the parasite Trypanosoma cruzi, discovered in 1906 by the Brazilian physician Carlos Chagas, who while researching malaria, detected insects with the particularity of being flagellated protozoa similar to trypanosomes, Later when analyzing the blood smear of a 2-year-old girl who presented fever, he found protozoa similar to the one he had found in the insect. This is how the first case of trypanosomiasis was described since it could be reproduced in animals and the epidemiological and clinical characteristics and the way of transmission of the disease were known. (1)

This disease can go unnoticed for many years and only until complications at the cardiac or digestive level (esophagus and liver) can clinical manifestations occur. Symptoms are progressive until they cause disability or premature death; in the chronic phase, it can lead to disability, and job desertion in useful ages for society, which generates great costs for families and the health system. (2)

Once the parasite is transmitted via the bloodstream, two clinical forms may occur: Acute Chagas, where the symptoms are minor (fever, redness, and inflammation in the area of the bite (the sign of the blister)) this phase is treated with nifurtimox and benznidazole, but the chronic phase, in which heart failure occurs due to dilation of the heart ventricles decreasing the ejection force, also with failure of the megacolon and megaesophagus, treatment is based on the management of these complications such as pacemaker implantation; therefore, there is no cure for the disease. (2)

Globally, the World Health Organization (WHO) estimates that between 6 and 7 million people are infected with Trypanosoma cruzi, and Chagas disease is endemic in 21 Latin American countries, where socio-demographic factors such as low

strata, poor housing cracks, rural areas, among others, are common, However, the mode of transmission is the same; the vector (triatomine bugs (pitos in Colombia) bites in uncovered areas of the skin and then defecates in the bite, the person smears the feces on the mucous membranes allowing the entry of the parasite through blood, consumption of food contaminated with the feces of the vector. Other forms of infection are blood donation, organ donation, and vertical transmission (mother to child). (2)

Recently, new cases have been documented in other regions of the world. Before it had only been found in South America: Chagas disease has reached Canada, the USA, European countries, African countries, Eastern Mediterranean and Western Pacific, therefore, this disease has gone from being rural to urban and this is due to population mobilization, migration, and urbanization, added to the fact that many people are still in the asymptomatic phase without a diagnosis, therefore WHO estimates that 75 million people areat risk of infection. (3).

It is estimated that approximately 6 million people have Chagas disease in Latin America. (4), 30,000 new cases per year have been registered, 12,000 deaths, and 8,000 newborns with Chagas disease who were infected during gestation; additionally, around 70 million people are at risk of contracting the disease. (3)

It is estimated that the disability-adjusted life years per individual with chronic disease of 0 - 51 (range 0-38 - 0 -60) and the cost of medical care for a person with trypanosomiasis was US$2,600[1] (range $1,966 - $3,034) in Latin America, on the other hand, Brazil is one of the countries with the highest health cost followed by Argentina, similarly, the highest DALYs are also in Brazil (196,206) which is

equivalent to a quarter of the total global burden of disease, which is US$627.5 million in care costs, and 806,170 DALYs (5)

In Colombia, Chagas disease is considered an event of public health interest; therefore, notification of new cases is mandatory; however, acute cases are immediately notifiable, and chronic cases are only reported weekly to SIVIGILA (Public Health Surveillance System) inpriority groups such as children under 18 years of age, pregnant women, indigenous women and women of childbearing age, to prevent vertical and gestational transmission. (6)

In 2018, up to the 40th epidemiological week, 102 probable cases of acute Chagas disease were reported of which 10.8% (11) were confirmed, as for chronic cases to week 43, 616 cases were reported of which 347 (56.3%) were confirmed, the departments with the highest number of cases were: Santander (226), Arauca (44), Casanare (44) and Boyacá (10) (5). In epidemiological period VI of 2021, 67 chronic cases were reported, of which 31 are confirmed, 23 are probable and 13 have been discarded. (7)

Recently, the National Institute of Health (INS) in conjunction with the National University of Colombia and the Institute of Cardiology, published a study of mortality related to Chagasdisease in Colombia from 1979 to 2018: temporal and spatial trends, in which it reports that there were 7,287,461 deaths registered in Colombia during the period 1979-2018; 3,276 (0.04%) were related to Chagas disease, 2,827 (86.3%) as an underlying cause and 449 (13.7%) as an associated cause. The average mean age- and the sex-standardized mean annual mortality rate was 0.211 (95% confidence interval [CI] (0.170-0.252) deaths/100,000 population,

with a significant upward trend (CPA = 6.60%; 95% CI: 5.9-7.3) (8)

Considering that Colombia continues to be an endemic country for Chagas disease and that strategies for interrupting vector transmission have been implemented in 66 municipalities (9)In addition to the fact that the WHO estimates that many people are asymptomatic and undiagnosed and that the total number of people are not reported to the surveillance system,it is necessary to estimate the burden of Chagas disease to identify and define priority strategies that will allow directing and prioritizing decision making to improve the health status of the Colombian population, This is done by estimating the DALYs that measure the losses caused by the fatal and non-fatal consequences of diseases and injuries in a population.

**Materials and methods**

An exploratory ecological study that estimates the burden of disease associated with Chagas disease in Colombia from 2010 to 2020, using the methodology by Murray estimating the proposed DALYs by estimating multimorbidity using years as the unit of measurement that defines the disease and its consequences in the health model through the synthetic health indicators (years of life lost due to premature death, years of life lived with disability and Disability-adjusted life years). (10). [2]

**Morbidity**

Incidence data were obtained from individual service delivery records stored in the SISPRO cubes of the Ministry of Health and Social Protection with newly confirmed diagnoses according to the International Classification of Diseases in its tenth version, from which codes B570 to B575 were taken into account, which

includes acute and chronic Chagas disease in its different forms of clinical development; these data were classified by sex, age group, and department.

**Mortality:**

Mortality data was obtained from the National Department of Statistics (DANE) and were classified according to basic cause or related diagnosis of death with diagnoses B570 to B575according to the International Classification of Diseases (ICD 10).

**Disease burden:**

The burden was estimated using disability-adjusted life years (DALYs) resulting from the sum of years of life potentially lost (YPLL) plus years lived with disability (YLD), adjusted by standard life expectancy per 1000 population (16), disease duration of 40 years with a discount rate of 3% using the 2020 reference population.

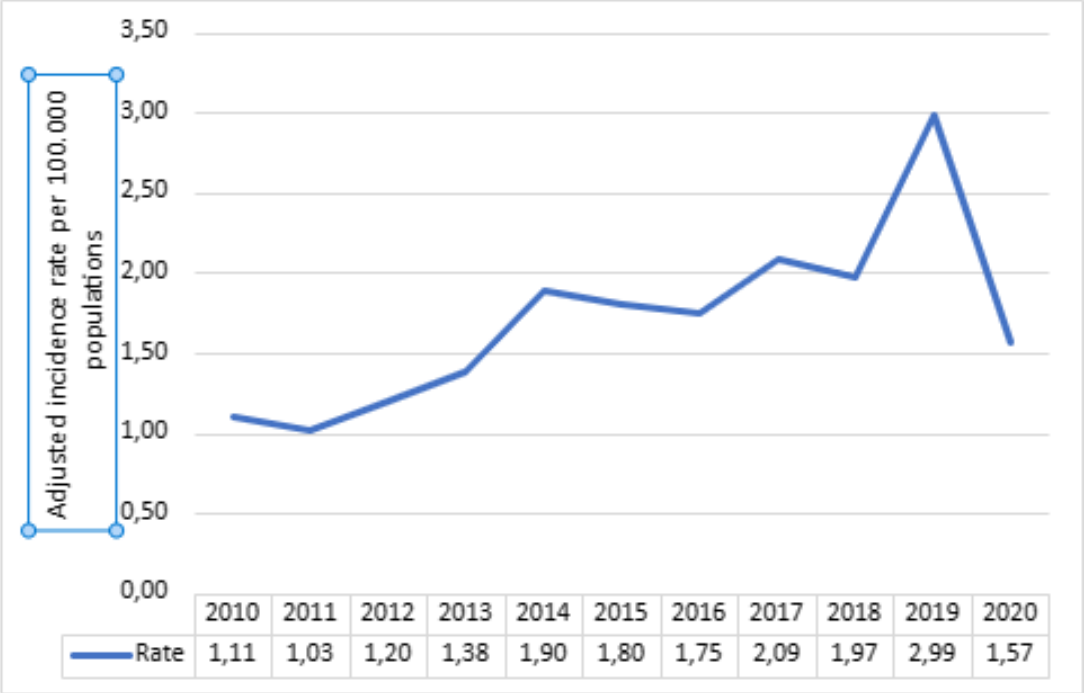
**Information Analysis**

Morbidity and mortality results were presented in raw data and adjusted rates per 100,000 inhabitants by department and age group standardized to the total population for the year 2020. The results of DALYs, DALYs, and DALYs were presented in absolute numbers and rates per 1,000 population by department, sex, and age group; Microsoft Excel was used for these analyses.

**Results Morbimortality**

During the period from 2010 to 2020, there were 8,505 new cases of Chagas disease in Colombia, from these data the incidence rates per 100,000 inhabitants were adjusted with the reference population of the year 2020. It is important to note that since 2011 this disease began to have a sustained increase in cases until 2014 reaching a rate of 1.90 per 100,000 inhabitants, had another peak increase in 2017 with a rate of 2.09 and again in 2019 had a significant increase to 2.99, and by 2020 had a significant decrease in cases (Figure 1).

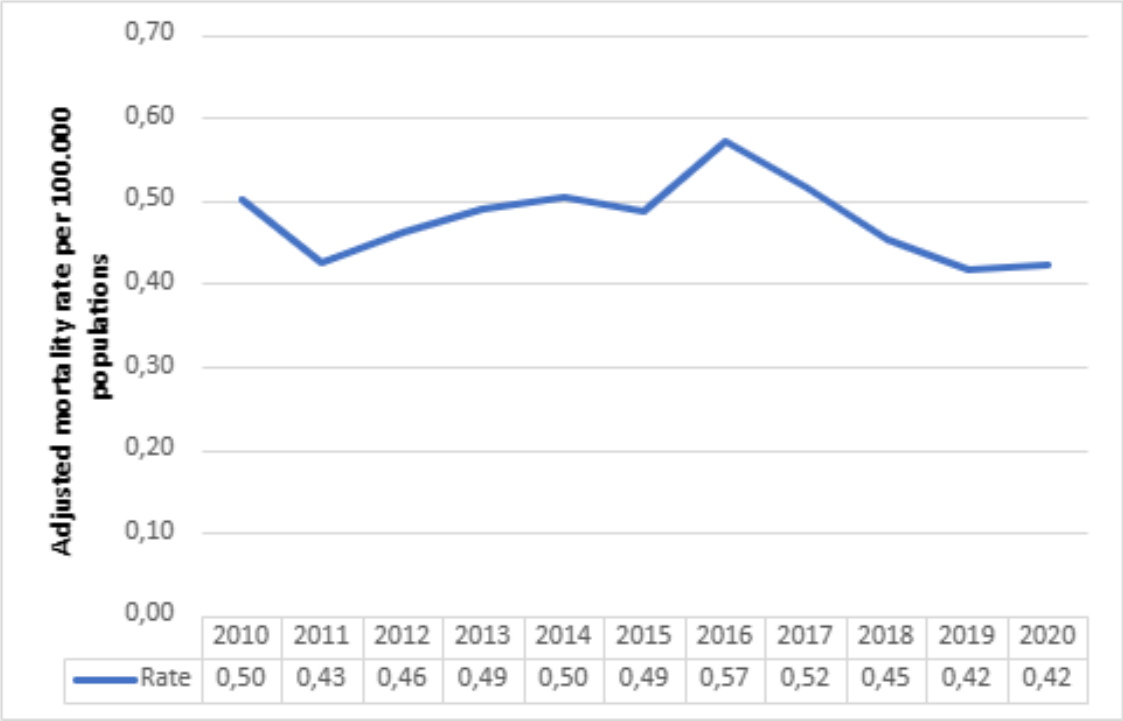
*Illustration 1 Adjusted incidence rate per 100,000 population.*




Source: Own elaboration based on SISPRO 2010-2020 data.

Regarding mortality there were 2,307 deaths with the basic or related cause of Chagas disease, with which the mortality rate is estimated for the entire period with the population of 2020 as standardization, a rate of 0.5 per 100,000 inhabitants was evidenced in 2014, subsequently, it presented an increase to 0.57 in 2016. Since then and until 2020 a sustained decrease in the rate has been evidenced.

*Illustration 2 Adjusted mortality rate per 100,000 inhabitants*




Source: Own elaboration based on data from Dane 2010 to 2020.

**Synthetic indicators**

**Years of life lost due to premature death (YLL)**

During the evaluated period from 2010 to 2020, there were 1,903 years lost due to premature death representing a rate of 3.46% per 1,000 inhabitants of DALYs where the male sex represents 59.16% of the total compared to women; on the other hand, the departments with the highest number of DALYs were Bogotá DC (427), Santander (419), Norte de Santander(188), Casanare (179), Boyacá (178) and Meta (145).

**Years lived with disability (DALYs)**

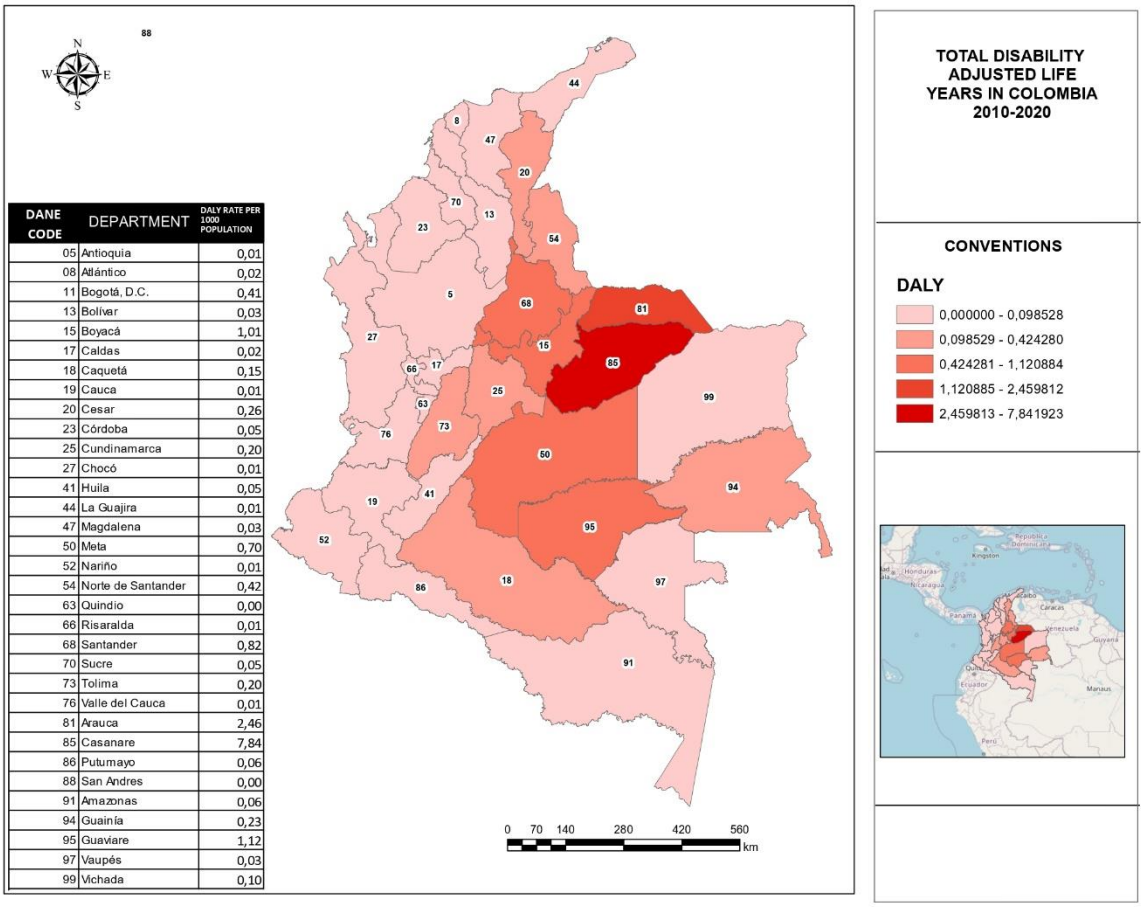
In the period evaluated, a total of 11,518 years lived with disability were recorded throughout Colombia with a rate of 29.38 per 1.000 inhabitants, women lived more years with disability with 59.83% of all DALYs and 19.67% more than men (complementary table 1), on the other hand, the regions with the highest rate of years lived with a disability were the Orinoquia with a rate of 20.51 per thousand inhabitants of DALYs and Casanare (14,81) followed by Arauca (4.39) and Meta (1.12), next the Andean region with 4.98 per thousand inhabitants with the departments of Boyacá (1.74) and Santander (1.24), followed by the Amazon region with 2.57 per thousand inhabitants with the department of Guaviare (2.09) having the highest rate of DALYs.

**Disability-adjusted life years (DALY)**

Between 2010 and 2020 there were 13,431 disability-adjusted life years in Colombia associated with Chagas disease with a rate of 16.39 disability-adjusted life years (DALYs) per 1,000 inhabitants, with the departments of Casanare, Arauca, Guaviare, Boyacá and Santander having the highest number of years, meaning that the greatest burden of Chagas disease is located in the Orinoco and Andean regions (Figure 3). It is important to mention that women live more years with a disability, representing 60%, but men contribute with more "years potentially

lost" in the statistics; however, in DALYs, women represent 56%of the total years of life adjusted for a disability during the period evaluated (see complementary figure 2, complementary table 1).

*Illustration 3 Map of DALYs in Colombia associated with Chagas disease 2010 to 2020.*




| DANE CODE | DEPARTMENT | DALY RATE PER 1000 POPULATION |
|---|---|---|
| 05 | Antioquia | 0,01 |
| 08 | Atlántico | 0,02 |
| 11 | Bogotá, D.C. | 0,41 |
| 13 | Bolívar | 0,03 |
| 15 | Boyacá | 1,01 |
| 17 | Caldas | 0,02 |
| 18 | Caquetá | 0,15 |
| 19 | Cauca | 0,01 |
| 20 | Cesar | 0,26 |
| 23 | Córdoba | 0,05 |
| 25 | Cundinamarca | 0,20 |
| 27 | Chocó | 0,01 |
| 41 | Huila | 0,05 |
| 44 | La Guajira | 0,01 |
| 47 | Magdalena | 0,03 |
| 50 | Meta | 0,70 |
| 52 | Nariño | 0,01 |
| 54 | Norte de Santander | 0,42 |
| 63 | Quindío | 0,00 |
| 66 | Risaralda | 0,01 |
| 68 | Santander | 0,82 |
| 70 | Sucre | 0,05 |
| 73 | Tolima | 0,20 |
| 76 | Valle del Cauca | 0,01 |
| 81 | Arauca | 2,46 |
| 85 | Casanare | 7,84 |
| 86 | Putumayo | 0,06 |
| 88 | San Andres | 0,00 |
| 91 | Amazonas | 0,06 |
| 94 | Guainía | 0,23 |
| 95 | Guaviare | 1,12 |
| 97 | Vaupés | 0,03 |
| 99 | Vichada | 0,10 |

Source: Own elaboration

During the period from 2010 to 2020.

The result of the estimation of the synthetic indicators by department expressed in rate per 1,000 inhabitants can be observed in this table, which shows departments that do not contribute years potentially lost due to Chagas diseases, such as Quindío, Chocó, San Andrés, Magdalena, and Vaupés, as well as those that presented the highest DALYs during the periodfrom 2010 to 2020.

*Table 1 Estimation of synthetic indicators associated with Chagas disease in Colombia 2010 to 2020*

| DEPARTMENT | YEARS LIVED WITH DISABILITY YLD / 1000 INHABITANTS | YEARS POTENTIALLY LOST YLL / 1000 INHABITANTS | DALYS PERSONS / 1000 INHABITANTS |
|---|---|---|---|
| Antioquia | 0,00207553 | 0,00207553 | 0,00714133 |
| Atlantic | 0,02118698 | 0,00897023 | 0,01500553 |
| Bogotá, D.C. | 0,71754363 | 0,10186505 | 0,41223687 |
| Bolivar | 0,04685852 | 0,0079036 | 0,0273808 |
| Boyacá | 1,74052936 | 0,27630954 | 1,0078898 |
| Caldas | 0,03552648 | 0,01037414 | 0,01970081 |
| Caquetá | 0,22729032 | 0,07558227 | 0,15133868 |
| Cauca | 0,01603135 | 0,00178565 | 0,00892172 |
| Cesar | 0,4002722 | 0,11696056 | 0,25858969 |
| Córdoba | 0,09427346 | 0,00282154 | 0,0485473 |
| Cundinamarca | 0,35885842 | 0,05019756 | 0,2046592 |
| Chocó | 0,02198618 | 0 | 0,01099284 |
| Huila | 0,07547699 | 0,02603233 | 0,05073892 |
| La Guajira | 0,0185667 | 0,00925582 | 0,01385378 |
| Magdalena | 0,05231472 | 0 | 0,026129 |
| Goal | 1,12608832 | 0,27647664 | 0,70126779 |
| Nariño | 0,01717936 | 0,00417065 | 0,01066406 |
| Norte de Santander | 0,58282802 | 0,26741265 | 0,42428046 |
| Quindío | 0,01011414 | 0 | 0,00496671 |
| Risaralda | 0,01485279 | 0,00537826 | 0,01000009 |
| Santander | 1,24324126 | 0,3983299 | 0,82141834 |
| Sucre | 0,07691018 | 0,01864786 | 0,04803509 |
| Tolima | 0,33783086 | 0,06879055 | 0,20332451 |
| Cauca Valley | 0,01679519 | 0,0047819 | 0,01067726 |
| Arauca | 4,39850105 | 0,52113384 | 2,45981235 |

| | | | |
|---|---|---|---|
| Casanare | 14,814936 | 0,92140543 | 7,84192323 |
| Putumayo | 0,11774456 | 0 | 0,05865449 |
| San Andres Archipelago | 0 | 0 | 0 |
| Amazon | 0,07827776 | 0,03484708 | 0,05995435 |
| Guainía | 0,38669034 | 0,08250691 | 0,23385758 |
| Guaviare | 2,09284902 | 0,15522179 | 1,12088412 |
| Vaupés | 0,06287325 | 0 | 0,03151758 |
| Vichada | 0,17792751 | 0,01872158 | 0,0985279 |
| National Total | 29,3823549 | 3,46588333 | 16,3957508 |

Source: Own elaboration

## Discussion

The study of global and regional disease burden trends from 1999 to 2019 based on the results of the Global Burden of Diseases, injuries, and Risk Factors Study (GBD) shows the trend of decreasing prevalence, mortality, and DALYs in Latin America and according to the ranking of countries with prevalence rate per 100,000 live births per year show that Colombia was ranked 17th in 1990 and in 2019 without apparent changes remaining in the same position. (11).

However, this study shows that in Colombia during the period from 2010 to 2020, there was a progressive increase in the incidence rate from 2013 with 1.38 per 100,000 inhabitants until 2019 reaching a rate of 2.99 per 100,000 inhabitants. In 2020, there was a decrease in the rate to 1.57, which could be inferred by the arrival of COVID-19 in the country, which could have influenced the health system where care for other diseases was paralyzed and the diagnosis and reporting of new cases of Chagas disease decreased.

On the other hand, during those 10 years the mortality rate that averaged 0.48 per 100,000 inhabitants was almost linear; in 2010 it started with a rate of 0.50 per

100,000,arriving in 2020 with 0.42 per 100.000 inhabitants, with a difference of 0.08, which can be attributed to the arrival of new technologies for the management of Chagas disease in its chronic phase, increasing survival with the insertion of pacemakers and cardio defibrillatorsand management with beta-blockers. According to a retrospective descriptive study published in 2014 that evaluated mortality in ICD therapy in primary prevention in patients with Chagasic cardiomyopathy concludes that survival in the first year of cardio-defibrillator implantation in patients with Chagas disease is equal to that in patients with dilated cardiomyopathy (12).

Regarding the burden of disease, according to DALYs, Colombia is among the 10 countries with the highest rate of disability-adjusted life years per 100,000 inhabitants in 2019 according to the Comprehensive Analysis of the Global Burden of Disease Study of Chagasdisease where a rate of 10.34/100,000 inhabitants was identified in 2019. (11) which is confirmed by the results of the present study where a high DALY rate is evident for the entire period from 2010 to 2020 which obtained a national rate of 16.39/1000 inhabitants; however, these results differ from those discriminated by sex; in 2019 standardized DALY rates were higher in men than in women with a ratio of 1.6:1 with estimated rates for men 4.17 DALYs/100,000 inhabitants and women 2.59 DALYs/100. However, the present study shows a different trend in the country where women have higher DALYs than men with a ratio of 1.3:1 showing rates of women 18.95/1,000 DALYs/inhabitant versus men 13.88 DALYs/1,000 inhabitants (Supplementary Figure 2); however, it should be taken into account that the authors of the mentioned study do not show the specific

ratio of men/womenin Colombia but express it globally.

Finally, there are no studies in the literature that show the burden of disease associated with Chagas disease at the national level, but a study of disease burden in the department of Boyacá in the years 2014 to 2016 was found. (12) where 91 DALYs expressed in rates of 3.2/1,000 inhabitants are shown, but they did not find deaths due to that event during that period; therefore, they attributed the loss of healthy years to a disability, which differs in the result since Boyacá according to the results of this research presents 178 years lost due to premature death with a rate of 0.27 DALYs/1.000 inhabitants, a rate of 1.74 DALY/1,000 inhabitants, and a rate of 1 DALY/1,000 inhabitants during the entire period, in terms of sex, the data coincide since the study in question coincides with the results of the present investigation since the female sex is the one that contributes the most DALYs.

At the national level, the departments with the highest DALY rate are represented by Casanare (7.84 DALY/1,000 inhabitants), Arauca (2.46 DALY/1,000 inhabitants), Guaviare (1.12 DALY/1,000 inhabitants), Boyacá (1.01 DALY/1,000 inhabitants), Santander (0.82 DALY/1,000 inhabitants) and Meta (0.70 DALY/1,000 inhabitants). This is related to the results of the entomological survey, which show that the geographical areas most affected by the presence of the American trypanosomiasis vector are Arauca, Boyacá, Cundinamarca, Norte de Santander, Casanare, and Meta. (13).

On the other hand, a disease burden study of the Orinoquia region in 2017 classified the causes of disease into three major groups, where Chagas disease was included in group 1: transmissible diseases. Group one had the second highest DALY rate in

the Orinoquia and for every DALY from transmissible diseases there were approximately 4.7 DALYs from no transmissible diseases (14) but it is not possible to make a comparison since it does not specify the event of Chagas disease individually by synthetic indicators, however in our results the Orinoquia region is the most affected; from 2010 to 2020 it presented 11 DALYs/1000 inhabitants and the departments with the highest burden of disease where Casanare, Arauca, and Meta with the female sex being the most affected in the three synthetic indicators DALYs, DALYs, and DALYs (Supplementary Figure 1, 2) [8].

## Conclusions

The burden of Chagas disease has been decreasing in recent decades; however, Colombia is one of the Latin American countries with the highest DALYs associated with the disease, which is why it is in the struggle to control Chagas disease through vector eradication and timely identification of acute cases. It is for this reason that these results provide important and relevant information on the characterization and trends of regional and national disease burdens where the formulation of health policies and strategies that give continuity to the early detection and timely management of the disease could be directed and prioritized, as well as contribute to the sustained reduction of DALYs, DALYs, and DALYs. On the other hand, it is important to continue with pharmacoeconomics studies that allow visualizing and broadening the panorama of the economic burden and quality of life Concerning this disease.

## Limitations

Among the limitations of the study was the under-recording or quality of the records of the data sources, since 423 new cases with an undefined department were found, which could not be included in the measurement of the synthetic indicators; however, few studies on the burden of disease-specific to Chagas were included in the standardized incidence and mortality rates, which does not allow comparison of the results obtained.

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