



Evolution of the Hospitalization Burden of Cleft Lip and Palate in Chile: A Nationwide Population-Based Study (2001–2019)

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Objective: To characterize the evolution of the hospitalization burden associated with cleft lip and palate (CLP) in Chile between 2001 and 2019, analyzing demographic, geographic, and treatment-related patterns at the national level.

Methods: This observational, descriptive, and retrospective study analyzed nationwide hospital discharge data from the Department of Statistics and Health Information of the Chilean Ministry of Health. Hospitalizations with a primary diagnosis of CLP were identified using ICD-10 codes (Q35, Q36, Q37). Variables included sex, age, region of residence, hospital location, health care system (public or private), type of hospitalization, length of hospital stay, and surgical procedures. Temporal trends were assessed using descriptive statistics and linear regression analysis.

Results: A total of 23,883 CLP-related hospital discharges were recorded. Hospitalizations were predominantly concentrated in early childhood, with 46.5% occurring in patients under one year of age. The male-to-female ratio was 1.23:1 and remained stable over time. Geographically, 38.4% of discharges occurred in the Metropolitan Region followed by Biobío (10.4%) and La Araucanía (6.9%). Most hospitalizations took place in public health care facilities (69.7%), although a temporary increase in nonpublic discharges was observed. Surgical procedures were

performed in 72.1% of hospitalizations, most frequently hard palate closure and/or oronasal fistula repair (14.1%) and unilateral primary cheiloplasty (9.5%). The medial length of hospital stay was 1 day. A decreasing trend in annual hospitalizations was observed but it was not statistically significant.

Conclusion: The hospitalization burden of CLP in Chile remains concentrated in early infancy and in specific geographic regions, highlighting persistent regional inequalities and the need for decentralized, equitable, and interdisciplinary care strategies.

Key Words: Cleft lip and palate, epidemiology, health care survey

(*J Craniofac Surg* ;00: 000–000)

In Chile, cleft lip and palate (CLP) is the third most common congenital craniofacial anomaly, following Down syndrome and polydactyly. The incidence is 1.21 per 1000 live births for cleft lip with or without palatal involvement, and 0.6 per 1000 live births for isolated cleft palate.¹ A higher prevalence has been observed in males (56.8%) compared with females (43.2%).²

The figures reported in Chile are notably higher than recent global averages, which estimate a prevalence of 0.3 per 1000 live births for cleft lip and 0.45 per 1000 for cleft lip and palate.³ In this context, hospital discharge data collected in Chile by the Department of Health Statistics and Information (DEIS) of the Ministry of Health represent an important resource for assessing the hospitalization burden associated with CLP and other craniofacial anomalies. Such data enable the analysis of epidemiological trends and key variables, including sex, age, geographic distribution, length of hospital stay, type of health care facility, and surgical interventions.^{4–6} This approach has proven particularly useful for the assessment of chronic and high-complexity conditions.

Individuals with CLP face multiple functional and psychosocial challenges that significantly affect their daily lives. These include hearing impairment,^{7,8} speech disorders,⁹ language and communication difficulties,⁸ feeding difficulties,¹⁰ socioemotional issues,¹¹ and maxillofacial growth deficiencies.¹² Together, these factors can substantially impact the quality of life of patients¹³ and their families,¹⁴ underscoring the need for coordinated, multidisciplinary care.

In Chile, CLP is one of 87 conditions covered by the Explicit Health Guarantees (GES) system, also known as Plan AUGE. This legally mandated program applies to both public (Fonasa)

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Received August 18, 2025.

Accepted for publication February 15, 2026.

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The authors report no conflicts of interest.

Supplemental Digital Content is available for this article. Direct URL citations are provided in the HTML and PDF versions of this article on the journal's website, www.jcraniofacialsurgery.com.

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ISSN: 1536-3732

DOI: 10.1097/SCS.00000000000012584

and private (Isapre) health care systems and aims to ensure access, quality, timeliness, and financial protection for high-priority health conditions. Since 2005, GES Guarantee No. 13 has ensured access to comprehensive CLP treatment delivered through a multidisciplinary model involving surgery, dentistry, speech therapy, nutrition, psychology, social work, pediatrics, and related specialties. Subsequent updates in 2009 and 2015 incorporated evidence-based recommendations, broadening the scope of rehabilitation services and enhancing the quality of care.^{15–17} This model has been associated with improvements in functional outcomes and quality of life.^{13,18} Nevertheless, disparities in access to specialized care persist across regions, highlighting the need for continued evaluation of public health policies.

Considering recent demographic trends in Chile, including declining birth rate,¹⁹ this study aims to characterize the evolution of the hospitalization burden among individuals with CLP between 2001 and 2019. Using national hospital discharge data, we analyzed demographic variables (sex and age), geographic variables (region of residence and hospital location), and treatment-related variables (health system, type of hospitalization, surgical procedures, and length of hospital stay) to assess changes in hospitalization patterns at the national level.

METHODS

Study Design

This observational, descriptive, and retrospective study used secondary data to analyze the hospitalization burden associated with CLP in Chile between 2001 and 2019. Data were obtained from the national hospital discharge (HD) databases maintained by the Department of Health Statistics and Information (DEIS) of the Chilean Ministry of Health (MINSAL). These publicly available datasets were retrieved from the DEIS-MINSAL website (<https://deis.minsal.cl/#datosabiertos>) and used to examine the temporal trends in CLP-related hospitalizations.

The hospital discharge database includes all hospitalizations nationwide, encompassing both inpatient admissions and ambulatory surgical procedures. The unit of analysis was the hospitalization event. An encrypted patient identifier allows linkage of multiple hospitalizations belonging to the same individual.

Although the database covers the period from 2001 to 2023, only data up to 2019 were included. This restriction was due to the unavailability of hospital identifiers and encrypted patient IDs in the datasets from 2020 to 2023, which are required to distinguish multiple events from the same patient.

Participants

The study population included all hospital discharge records with a primary diagnosis of CLP, classified according to the International Classification of Diseases, 10th Revision (ICD-10). The following ICD-10 codes were included: Q35 (cleft palate), Q36 (cleft lip), Q37 (cleft lip and palate). Discharges without one of these codes listed as the primary diagnosis were excluded. All data were anonymized and complied with Chilean ethical and legal regulations. Because the study used secondary data without personally identifiable information, informed consent was not required.

Data Collection

Data were obtained from the DEIS database, which compiles standardized information from both public and private

hospitals nationwide. The dataset included anonymized, individual-level records containing demographic variables (sex and age), geographic variables (region of residence and region of the health care facility), and hospitalization-related variables, including health care system (public or private), length of hospital stay, type of hospitalization, and surgical procedures performed.

Data Analysis

Absolute and relative frequencies were calculated using SPSS software, version 26. The year of hospital discharge was used as the independent variable. Dependent variables included the number of discharges stratified by sex, age, health care system, length of hospital stay, type of hospitalization (surgical or nonsurgical), and surgical interventions. Hospital discharge rates by age group were calculated per 1000 inhabitants using official population projections from the National Institute of Statistics (INE) for the corresponding years.

Temporal trends in CLP-related hospital discharges were evaluated using linear regression analysis in SPSS version 26. The model included year of discharge as the independent variable and annual number of hospital discharges as the dependent variable. The slope coefficient and its 95% confidence interval (95% CI) were calculated to estimate the annual change, the coefficient of determination (R^2) to assess model fit, and the P -value, with statistical significance defined as $P < 0.05$.

RESULTS

Evolution of the Hospitalization Burden According to Demographic Variables

Between 2001 and 2019, a total of 31,059,859 hospital events were recorded in Chile, of which 23,880 were hospital discharges (HDs) related to CLP, representing 0.08% of the total hospitalization burden (see Supplemental Table 1, Supplemental Digital Content 1, <http://links.lww.com/SCS/J503>). The highest number of CLP-related HDs occurred in 2001 (1437 events), whereas the lowest was recorded in 2019 (1069 events) (Fig. 1).

When analyzed by sex, the overall male-to-female ratio during the study period was 1.23:1. The association between sex and year of discharge, assessed using Pearson's χ^2 test, showed no statistically significant differences ($P = 0.274$). Similarly, both the likelihood ratio and the linear-by-linear association indicated no significant temporal trend ($P > 0.05$), demonstrating stability in the male-to-female distribution of CLP-related HDs over time.

Linear regression analysis performed to evaluate temporal trends in CLP-related HDs between 2002 and 2019 demonstrated a negative slope of -7.142 (95% CI: -16.186 to 1.902), indicating an average annual decrease in hospital discharges. However, this trend was not statistically significant ($P = 0.114$), and the model explained 14% of the variance in annual discharges ($R^2 = 0.14$). As shown in Figure 2, hospitalizations were predominantly concentrated in children younger than 1 year of age (18.2%) (see Supplemental Tables 2, 3, and 4, Supplemental Digital Content 2–4, <http://links.lww.com/SCS/J504>, <http://links.lww.com/SCS/J505>, <http://links.lww.com/SCS/J506>), with a progressive decline across older age groups. The median age at discharge was 2 years. Overall, 46.8% of HDs occurred in patients aged 1 year or younger, and 90.3% occurred in individuals aged 18 years or younger. The average annual HD rate was highest in the population under

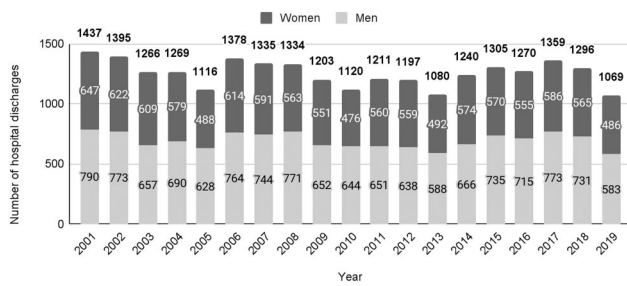


FIGURE 1. Annual number of hospital discharges for cleft lip and palate between 2001 and 2019.

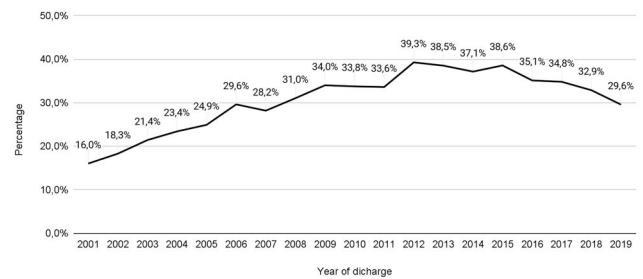


FIGURE 3. Annual percentage of hospital discharges for cleft lip and palate in facilities not belonging to the National Health Services System of Chile.

1 year of age (1.6 per 1000 inhabitants), reflecting a greater hospitalization burden in this age group (see Supplemental Table 5, Supplemental Digital Content 5, <http://links.lww.com/SCS/J507>).

Evolution of the Hospitalization Burden According to Geographic Variables

Geographic analysis revealed a marked concentration of CLP-related HDS in the Metropolitan Region of Santiago (38.4%), followed by Biobío Region (10.4%) and La Araucanía (6.9%). Together, these 3 regions accounted for 55.7% of all HDs during the study period (see Supplemental Table 6, Supplemental Digital Content 6, <http://links.lww.com/SCS/J508>).

Evolution of the Hospitalization Burden According to Treatment Variables

Most CLP-related HDs occurred in facilities belonging to the National Health Services System (69.7%). Nevertheless, a progressive increase in HDs in facilities outside this system (private hospitals, armed forces hospitals) was observed, peaking at 39.3% in 2012, followed by a decline to 29.6% in 2019 (Fig. 3) (see Supplemental Table 7, Supplemental Digital Content 7, <http://links.lww.com/SCS/J509>).

Within the public health care system, the highest numbers of HDs were recorded in the Metropolitan Health Services, particularly Metropolitan Oriente (2564 events) and Metropolitan Norte (1886 events), followed by Araucanía Sur (1972 events) and Concepción (1705 events) (see Supplemental Table 8, Supplemental Digital Content 8, <http://links.lww.com/SCS/J510>).

In the private sector, HDs were predominantly concentrated in the Metropolitan Region of Santiago (6538 events), accounting for over 90% of discharges in this category. Other regions with notable numbers of private-sector HDs included

Antofagasta (166 events), La Araucanía (151 events), and Valparaíso (121 events) (see Supplemental Table 9, Supplemental Digital Content 9, <http://links.lww.com/SCS/J511>).

Analysis of hospitalization characteristics showed a median length of stay of 1 day (see Supplemental Tables 10 and 11, Supplemental Digital Content 10–11, <http://links.lww.com/SCS/J512>, <http://links.lww.com/SCS/J513>), as shown in Figure 4. Overall, 91.5% of HDs lasted 5 days or fewer, and 58.9% consisted of a single day of hospitalization. This distribution remained consistent over time, as demonstrated by the proportion of 1-day stay HDs (Fig. 5). Between 2001 and 2019, surgical interventions were performed in 72.1% of CLP-related HDs (n = 17,212). The absolute number of surgical procedures increased over time, peaking at 1208 in 2017, and remained above 60% annually since 2011 onward (Fig. 6). In contrast, HDs without surgical intervention accounted for 27.9% of cases (n = 6671) and demonstrated a decreasing trend toward the end of the study period (see Supplemental Table 12, Supplemental Digital Content 12, <http://links.lww.com/SCS/J514>). Among the ten most frequently performed surgical procedures, hard palate closure and/or closure of oronasal fistulas was the most common, accounting for 14.1% of all procedures, followed by unilateral primary cheiloplasty (9.5%) and veloplasty (7.6%).

DISCUSSION

This nationwide study provides an updated analysis of the hospitalization burden associated with CLP in Chile between 2001 and 2019. The main findings include a marked concentration of hospitalizations in children younger than one year, a stable male-to-female ratio over time, substantial geographic concentration in the Metropolitan Region, and a high proportion of hospitalizations involving surgical intervention, particularly hard palate closure and unilateral primary cheiloplasty. Although a modest decline in the annual hospital discharges was observed, this trend did not reach statistical significance.

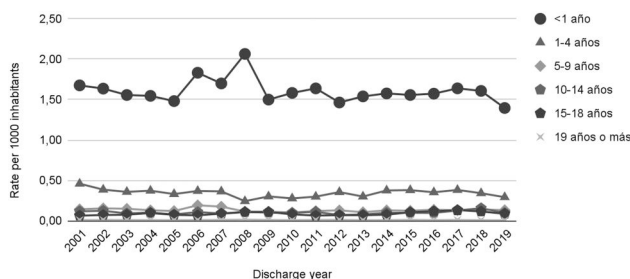


FIGURE 2. Hospital discharge rate for cleft lip and palate per 1000 inhabitants in Chile, by age group, between 2001 and 2019.

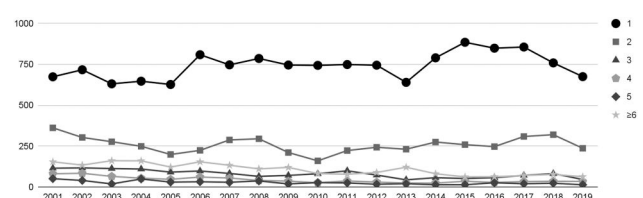


FIGURE 4. Annual number of hospital discharges for cleft lip and palate by length of hospital stay (in days) between 2001 and 2019.

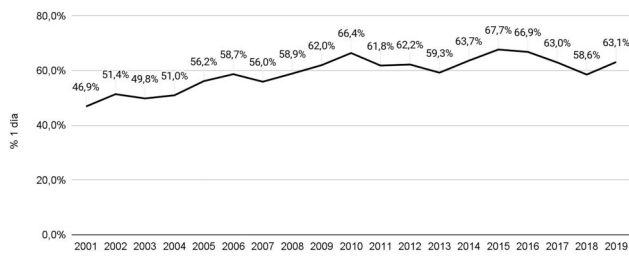


FIGURE 5. Annual percentage of hospital discharges for cleft lip and palate with a hospital stay of only 1 day.

From a demographic perspective, the predominance of hospitalizations in infants reflects current clinical practice favoring early surgical intervention to optimize outcomes related to speech, feeding, and maxillofacial growth.^{13,20} The observed male-to-female ratio (1.23:1) is consistent with international reports demonstrating a slight male predominance in CLP incidence.^{3,21}

Geographic analysis revealed a pronounced concentration of HDs in the Metropolitan Region, followed by Biobío and La Araucanía. Similar patterns of centralization have been reported for other high-complexity chronic conditions in Chile, including stroke and inflammatory bowel disease, where hospitalization volumes and improved outcomes are often observed in densely populated urban areas with greater availability of specialized infrastructure and health care professionals.^{4,5}

International studies have likewise documented unequal geographic distribution of specialized services for craniofacial anomalies. In United States, for example, a geospatial analysis indicates that more than 27% of children with CLP reside over an hour from a specialized care center, highlighting persistent disparities between urban and rural regions.²² Such inequalities increase travel burden for families, delay surgical intervention, and restrict access to comprehensive interdisciplinary rehabilitation necessary for optimal functional outcomes.^{23,24}

In middle- and low-income settings, including South Africa and Indonesia, limited specialized infrastructure, scarcity of multidisciplinary teams, and economic barriers further compromise timely and high-quality CLP care.^{25,26} These challenges adversely affect outcomes and perpetuate social inequities, underscoring the importance of public policies aimed at decentralizing specialized craniofacial services, strengthening regional capacity, and reducing geographic and financial barriers to care.²⁷ Regarding treatment characteristics, surgical procedures were performed in 72.1% of hospitalizations, predominantly hard palate closure and unilateral primary cheiloplasty. These findings are consistent with inter-

national standards recommending primary lip repair within the first 3 months of life and palatal closure between 9 and 12 months to support normal speech development, feeding, and maxillofacial growth.^{28,29} Early palatal closure has also been associated with reduced rates of velopharyngeal insufficiency and decreased need for secondary surgical interventions.²⁹ The median hospital length of stay observed in this study parallels global trends toward shorter hospitalizations, driven by optimized perioperative protocols and resource utilization.^{30,31} Evidence suggests that early discharge, when appropriately planned, does not increase the risk of immediate postoperative complications. However, as emphasized in recent meta-analysis, ambulatory surgical management requires structured postoperative follow-up to minimize delayed complications, ensure functional outcomes, and maintain continuity of interdisciplinary care.³²

Although the regression analysis demonstrated a downward trend in CLP-related HDs, the lack of statistical significance suggests that the overall hospitalization burden has remained relatively stable. This modest decline may be partially explained by the reduction in birth rates in Chile in recent years,¹⁹ as well as improvements in prenatal diagnosis and perinatal preventive strategies. In addition, the expanded coverage under the Explicit Health Guarantee (GES) has promoted standardized care pathways, which may have contributed to more efficient hospital processes.

From a health systems perspective, the persistent concentration of hospitalizations in a limited number of regions highlights the need to advance toward a more decentralized model of care. Improving regional access to specialized surgical and interdisciplinary services is essential to ensure equitable, timely treatment and to optimize long-term functional and quality of life outcomes for individuals with CLP.^{13,22,23,25,33,34}

Limitations and Future Directions

This study presents several limitations. First, the use of secondary administrative database did not allow differentiation between primary and secondary surgical procedures, nor did it provide detailed information on type of cleft (eg, Q35.5, Q37.5, Q37.4) or severity. These factors may substantially influence hospitalization patterns and overall burden. Second, the dataset did not include information on institutional surgical protocols, such as single-stage versus two-stage palatoplasty or the use of lip adhesion. Variability in surgical approaches across institutions may therefore introduce bias when comparing institutional or regional outcomes. Third, clinical and functional outcomes, such as speech, feeding, and aesthetic results, were not available, limiting assessment of the impact of hospital care beyond length of stay and readmissions. Finally, the analysis was limited to data through 2019 and does not capture more recent changes in health care delivery, including the potential effects of the COVID-19 pandemic.

Future research should prioritize prospective, longitudinal cohort studies following individuals with CLP from birth into adolescence and adulthood. Such studies should incorporate detailed clinical, surgical, and functional outcome measures to enable analysis of surgical timing, techniques, and long-term results. Additional investigation into genetic and environmental determinants of cleft distribution and severity is warranted. Moreover, studies addressing regional disparities and evaluating strategies to expand access to specialized cleft care are essential to support health equity and inform evidence-based public health policy.

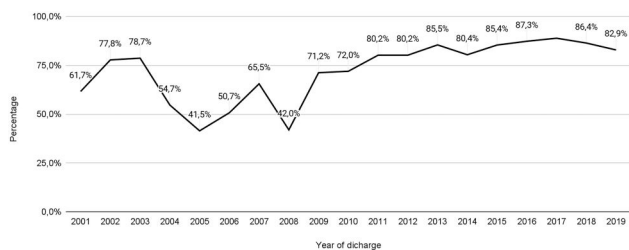


FIGURE 6. Percentage of hospital discharges for cleft lip and palate involving at least one surgical intervention in Chile between 2001 and 2019.

CONCLUSION

This nationwide study describes the evolution of the hospitalization burden associated with CLP in Chile between 2001 and 2019 and identifies persistent inequalities in access to care. Most HD occurred in infants younger than one year, with a stable male-to-female ratio over time. Hospitalizations were highly concentrated in the Metropolitan Region, reflecting geographic centralization of specialized services. With regard to treatment patterns, the majority of hospitalizations involved surgical intervention, particularly primary cheiloplasty and hard palate closure. Together, these findings provide a comprehensive national overview of hospital-based CLP care and underscore the urgent need to decentralize specialized services to ensure equitable, timely, and interdisciplinary access to care for affected individuals across all regions of the country.

ACKNOWLEDGMENTS

We acknowledge the support provided by Smile Train, which made possible the development of this research and the publication of this article.

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