Publicación Científica de la Universidad de Ciencias Médicas de Ciego de Ávila
Editorial Ciencias Médicas
REVISTA MÉDICA ELECTRÓNICA DE CIEGO DE ÁVILA
2025;31: e4132
ISSN: 1029-3035
RNPS: 1821

Original article

# Incidence and characteristics of strabismus in patients from the Ecuadorian province of Tungurahua

# Incidencia y características del estrabismo en pacientes de la provincia ecuatoriana de Tungurahua

Carlos Alberto Pérez-Padilla[1*] https://orcid.org/0000-0002-2873-9291
Zaihrys del Carmen Herrera-Lazo[2] https://orcid.org/0000-0002-8015-0724
María del Carmen Yabor-Labrada[3] https://orcid.org/0000-0001-5391-7224
Symone Shyram Villacrés-Moya[4] https://orcid.org/0009-0004-2587-9274

[1]Master's Degree in Comprehensive Child Care. First-Level Specialist in Ophthalmology. Subspecialist in Pediatric Ophthalmology. Full Professor. Regional Autonomous University of Los Andes. Ambato General Teaching Hospital. Ambato, Tungurahua, Ecuador.
[2]Master's Degrees in Comprehensive Child Care. First-Level Specialist in Pediatrics. Full Professor. Autonomous Regional University of Los Andes. Ambato General Teaching Hospital. Ambato, Tungurahua, Ecuador.
[3]Eleventh-year medical student. Regional Autonomous University of the Andes. Ambato, Tungurahua, Ecuador.
[4]Seventh-year medical student. Regional Autonomous University of the Andes. Ambato, Tungurahua, Ecuador.

*Corresponding author. Email: makinario2013@gmail.com

## ABSTRACT

**Introduction:** strabismus is an ocular disorder characterized by binocular misalignment. Its global prevalence in infants is estimated between 2%-4% of the world's population. In Ecuador, updated information on its incidence in local populations is insufficient. Hence, the importance of conducting studies focused on specific regions.

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ISSN: 1029-3035
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**Objective:** to describe some epidemiological characteristics of strabismus in patients treated at the Ambato General Teaching Hospital.

**Methods:** an observational, descriptive, and retrospective study; 103 medical records were reviewed. The variables analyzed were age, sex, and type of strabismus. Descriptive statistics and Pearson correlation analysis were used. Established ethical principles were adhered to.

**Results:** 103 patients were diagnosed with strabismus; the cumulative incidence was 1.4%. Esotropia was most common (32.1-50.2%), followed by exotropia (21.4-45.1%); vertical strabismus was less common (4.3-13.7%). The relative incidence between men (r = 0,915; p = 0,005) and women (r = 0,892; p = 0,013) was not statistically significant (r = 0,723; p = 0,087).

**Conclusions:** the cumulative incidence of strabismus was below the figures reported in the international literature. The slight upward trend in this diagnosis among women should be investigated to identify possible predisposing factors. Although this study focused on a specific institution in the province of Tungurahua, the data it provided are relevant for future research at the national level.

**Keywords:** epidemiology; esotropia; exotropia; incidence; strabismous.

## RESUMEN

**Introducción:** el estrabismo es un trastorno ocular caracterizado por la falta de alineación binocular. Su prevalencia global en infantes se estima entre 2,00% y 4,00% de la población mundial. En Ecuador, la información actualizada sobre su incidencia en poblaciones locales es insuficiente por lo que se necesitan estudios centrados en regiones específicas.

**Objetivo:** describir algunas características epidemiológicas del estrabismo en pacientes atendidos en el Hospital General Docente de Ambato.

**Métodos:** estudio descriptivo, retrospectivo. Se revisaron 103 historias clínicas y se analizaron las variables: edad, sexo, y tipo de estrabismo. Se utilizó la estadística descriptiva y el análisis de correlación de Pearson. Se respetaron los principios éticos establecidos.

**Resultados:** se diagnosticó estrabismo a 103 pacientes; la incidencia acumulada fue de 1,40%. El tipo convergente fue más frecuente (32,10-50,20%), seguido del divergente (21,40-45,10%); el vertical tuvo menos incidencia (4,30-13,70%). La relación entre hombres (r = 0,915; p = 0,005) y mujeres (r = 0,892; p = 0,013) atendidos no tuvo significación estadística (r = 0,723; p = 0,087).

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**Conclusiones:** la incidencia acumulada de estrabismo estuvo por debajo de las cifras reportadas en la literatura internacional. Se debe investigar la tendencia ligera al incremento de este diagnóstico en mujeres, para identificar posibles factores predisponentes. Si bien este estudio se enfocó en una institución específica de la provincia de Tungurahua, los datos que aportó son relevantes para investigaciones futuras que abarquen el ámbito nacional.

**Palabras clave:** epidemiología; estrabismo; esotropía; exotropía; incidencia.

Received: 2025/03/28
Approved: 2025/04/08
Published: 2025/04/11

## INTRODUCTION

Strabismus is an eye disorder characterized by binocular misalignment. It affects a significant proportion of the world's population and involves medical, psychological, and social aspects. Its onset in childhood requires special attention due to its negative impact on children's visual development and long-term quality of life. The estimated global prevalence of strabismus in infants is between 2% and 4 %, depending on genetic, environmental, and demographic factors.[1-3]

Longitudinal studies conducted in Japan[4] and Sweden[5] found similar prevalence rates of strabismus in school-aged children. However, in Latin America, specifically in Mexico, between 3% and 5% of school-aged children suffer from this eye disorder.[6,7] This shows regional differences in the epidemiological patterns of strabismus.

Early diagnosis and proper treatment of strabismus are essential to prevent complications such as amblyopia, loss of binocular vision, and difficulties in psychomotor development in children. Recent studies have found that esotropia is more common in Western populations,[2] while exotropia is more prevalent in Asian populations. [4] Furthermore, there are specific genetic factors related to the onset of strabismus; specifically, in patients with esotropia, genetic factors are important.[8,9] In contrast, environmental factors—such as the increased incidence of childhood myopia during the COVID-19 pandemic—could have indirectly contributed to the increase in strabismus cases in some regions.[3,10]

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In Ecuador, up-to-date information on the incidence of strabismus in local populations is insufficient. Hence, it is important to conduct studies focused on specific regions—such as Ambato (a canton in the Ecuadorian province of Tungurahua)—to better understand the epidemiological characteristics of strabismus in this population. This would help guide public policies and ophthalmologic care strategies[6,7] that constitute a solid basis for medical interventions and early detection programs for this ocular disorder.[7,9,10]

The present study aims to describe some epidemiological characteristics of strabismus in patients treated at the Ambato General Teaching Hospital.

## METHODS

An observational, descriptive, and retrospective study was conducted at the Ambato General Teaching Hospital from 2020 to 2024. The population of the health area is 381,116 inhabitants according to the institution's records. The incidence and cumulative incidence of strabismus were analyzed in the 7 343 patients who were treated during the research period. Their medical records were reviewed. The study population consisted of 103 patients diagnosed with strabismus during those years.

People of any age with complete medical records and relevant demographic and medical data were included. Those with incomplete medical records, those diagnosed outside the study period, those who subsequently presented to the hospital, and those with strabismus secondary to trauma or previous surgery were excluded.

The variables analyzed were age, sex, type of strabismus, and date of diagnosis. Descriptive statistics were used to analyze the distribution of cases by age, sex, and type of strabismus. For this purpose, Statistical Product and Service Solutions (SPSS) version 30.0 was used.

To calculate the incidence (I) of strabismus the formula was used:

$$I = \frac{\text{Patients diagnosed with strabismus during the years 2020-2024}}{\text{Total patients attended during the years 2020-2024}} \times 100$$

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To calculate the cumulative incidence (CI) of the condition, the formula was used:

IA = Patients diagnosed with strabismus during the years 2020-2024
---------- x 100
Population of the health area

The study complied with the ethical aspects established in the *Declaration of Helsinki*.[11] The confidentiality of the patients' personal data was guaranteed. The information resulting from the study was used solely for scientific purposes.

## RESULTS

In the period investigated (2020-2024), 7,343 patients were admitted to the hospital. Of these, 103 were diagnosed with strabismus (all types). The average annual incidence was 20.6 cases per year, with fluctuations in the number of diagnoses depending on the year analyzed (Table 1).

**Table 1** - Distribution of patients with strabismus according to the years covered by the study

| Years | Patients with strabismus | |
|---|---|---|
| | No. | % |
| 2020 | 4 | 3.88 |
| 2021 | 39 | 37.86 |
| 2022 | 22 | 21.35 |
| 2023 | 16 | 15.53 |
| 2024 | 22 | 21.35 |
| Total | 103 | 100 |

Source: medical records

In the years studied, a cumulative incidence of strabismus of 1.40 was observed.%. Esotropia was the most frequent, with values ranging between 32.1 % and 50.2 % annual cases. Its peak (50.2 %) was recorded in 2024; a second peak (48.5 %) was observed in 2020. The frequency of presentation of

exotropia was more variable (between 21.4% and 45.1% annual diagnoses); in 2021 a notable increase was observed, when it reached the highest percentage (45.1 %). Vertical strabismus was the least common; its incidence fluctuated between 4.3% and 13.7%, but it was the most prevalent in 2022 (13.7 %). Patients diagnosed with other types of strabismus represented between 5.1% and 18.6% of annual cases; the highest incidence was in 2020 (18.6%). However, in the last two years of the study (2023 and 2024), its proportion decreased to 6.2% and 9.4%, respectively. A stable trend was observed in the incidence of strabismus in the population treated at the hospital, with a predominance of cases of esotropia (Table 2).

**Table 2** - Distribution of patients with strabismus, according to their types and the years covered by the study

| Years | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of strabismus** | **2020** | | **2021** | | **2022** | | **2023** | | **2024** | | **Total** | |
| | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| Esotropia (comitant) | 1 | 0.97 | 15 | 14.56 | 7 | 6.80 | 12 | 11.65 | 8 | 7.77 | 43 | 41.74 |
| Exotropia (comitant) | 1 | 0.97 | 16 | 15.53 | 9 | 8.73 | 3 | 2.91 | 10 | 9.70 | 39 | 37.86 |
| Vertical | 0 | 0.00 | 2 | 1.94 | 4 | 3.88 | 0 | 0.00 | 1 | 0.97 | 7 | 6.80 |
| Others | 2 | 1.94 | 6 | 5.82 | 2 | 1.94 | 1 | 0.97 | 3 | 2.91 | 14 | 13.60 |
| Total | 4 | 3.88 | 39 | 37.86 | 22 | 21.35 | 16 | 15.53 | 22 | 21.35 | 103 | 100.00 |

Source: medical records

To assess the relationship between the number of patients treated and their gender distribution, a Pearson correlation analysis was performed. High positive correlations were found between the total number of patients treated and the number of men diagnosed ($r = 0.915$; $p = 0.005$) and women diagnosed ($r = 0.892$; $p = 0.013$). However, the relationship between the number of men and women treated was not statistically significant ($r = 0.723$; $p = 0.087$). This suggests that there is no direct proportional relationship between the number of diagnoses in men and women.

Therefore, in the distribution of patients by sex, an almost equal proportion of strabismus cases was observed. Of the 103 diagnosed, 52 were men (50.49%), and 51 women (49.51%). The proportion of cases among men and women was similar (Table 3).

**Table 3** – Distribution of patients with strabismus by sex during the period studied

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| Female patients | | Male patients | | Total | |
|---|---|---|---|---|---|
| No. | % | No. | % | No. | % |
| 51 | 49.51 | 52 | 50.49 | 103 | 100 |

Source: medical records

Patients with strabismus were distributed according to age groups. Children under one year: five (4.72 %). From one to five years: 47 (44.34%). From six to 10 years: 23 (21.70%). From 11 to 15 years: six (5.66%). From 15 to 20 years: six (5.66%). And over 20 years old: 19 (17.92%) (Table 4).

**Table 4** – Distribution of patients with strabismus according to age groups

| Age groups | Patients | |
|---|---|---|
| | No. | % |
| Children under one year old | 5 | 4.85 |
| 1-5 years | 47 | 45.63 |
| 6-10 years | 20 | 19.41 |
| 11-15 years | 6 | 5.82 |
| 15-20 years | 6 | 5.82 |
| Over 20 years old | 19 | 18.44 |
| Total | 103 | 100 |

Source: medical records

The correlation between the number of patients treated and the number of strabismus diagnoses by year showed a significant positive linear correlation. This could mean that the increased number of consultations would lead to the detection of more new cases (Table 5).

**Table 5** - Pearson correlation: total number of patients treated in relation to the total number of strabismus diagnoses

| Correlations | | Total number of patients treated | Total number of patients with strabismus |
|---|---|---|---|
| Total number of patients treated | Pearson correlation | 1 | -0.542 |
| | Sig. (bilateral) | | 0.345 |
| | N | 5 | 5 |
| Total number of patients with strabismus | Pearson correlation | -0.542 | 1 |
| | Sig. (bilateral) | 0.345 | |

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| | | | |
|---|---|---|---|
| | N | 5 | 12 |

Additionally, the correlation analysis between years and the number of patients diagnosed with strabismus yielded a coefficient of 0.084, with a statistical significance of 0.819. This indicates no significant relationship between time and the number of strabismus diagnoses (Table 6).

**Table 6** - Pearson Correlation: total number of patients diagnosed with strabismus with respect to the year

| **Correlations** | | **Year** | **Total number of patients with strabismus** |
|---|---|---|---|
| Year | Pearson correlation | 1 | 0.084 |
| | Sig. (bilateral) | | 0.819 |
| | N | 10 | 10 |
| Total number of patients with strabismus | Pearson correlation | 0.084 | 1 |
| | Sig. (bilateral) | 0.819 | |
| | N | 10 | 12 |

## DISCUSSION

Regarding the prevalence of strabismus, the results of the present study reflect a cumulative incidence of 1.4%. Which is considerably lower compared to those detected in international research.[2.9] This could be due to biases in the detection and registration of affected patients.

In terms of sex distribution, the proportion of men and women with strabismus is essentially equal. This data contrasts with previous studies indicating a higher prevalence in women due to hormonal factors and neuromuscular predisposition.[8,12] The difference could be due to the fact that the present study observed a linear correlation, rather than a relationship between sex and disease onset.

The analysis of strabismus cases according to their classification showed that esotropia remains the most common (between 32.1 % and 50.2 %), in agreement with those international studies[2,5,6] that report higher prevalence percentages of esotropia in Western populations. On the other hand, the incidence of exotropia was more variable; its maximum peak (45.1 %) was in 2021; which could be related to the impact of the COVID-19 pandemic on the population's visual habits, and the increase in childhood myopia (a documented risk factor for the development of this condition).[7]

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Pearson's correlation analysis showed no statistically significant relationship between the total number of patients treated and the number of diagnosed cases of strabismus. This suggests that the incidence of this eye disorder has not changed substantially in recent years.

The role of genetic inheritance in the development of strabismus has been widely studied. A strong familial influence has been identified in esotropia.[1] However, environmental and neurological factors are also key in the development of strabismus. It has been observed that patients with neurodevelopmental disorders are more predisposed to developing strabismus, with a distribution of 65.3% esotropia, and 32.7 % exotropia. In addition, sensory strabismus – characterized by ocular deviation secondary to visual loss – has prevalences ranging from 5.00% and 9.00%.[9]

In the analysis by age, it was observed that the highest proportion of cases (44.34% was in the one- to five-year-old group. This finding is consistent with the peak detection rate in early childhood, as evidenced by frequent pediatric evaluations and ophthalmologic screening.[13]

The high proportion of strabismus detected in preschool-aged children is associated with the more frequent contact of parents with health services, which enables timely diagnosis.[13] The six to ten year-old group also accounts for a considerable number of cases (21,70%). This is because during school age, visual problems may appear that were not detected in previous stages or were exacerbated by the visual demands of studying.[14]

On the other hand, among adolescents aged 11 to 15 and 15 to 20, the percentages were equal (5.66%). This coincidence indicates that, at these ages, strabismus is diagnosed less frequently, or it is a persistent case from childhood.[15] In the group over 20 years old (17.92%), diagnoses may correspond to both strabismus not detected in childhood or to forms acquired in adulthood. Factors such as visual stress or certain systemic conditions may contribute to the appearance or decompensation of a latent deviation.[14]

The study provided updated data on the incidence of strabismus among patients treated at the Ambato General Teaching Hospital during the 2020-2024 period. These data were compared with previous studies conducted in other countries and regions.

Although there is valuable scientific evidence on the epidemiology of strabismus, the lack of detailed local studies limits the development of preventive and therapeutic strategies tailored to the Ecuadorian population. Data collection at this hospital will allow us to assess whether the distribution of strabismus subtypes follows the trends observed in the international literature, or whether specific factors influence its prevalence in this region.

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Based on these findings, we recognize the need to strengthen early detection programs for strabismus and ophthalmologic care to prevent long-term complications such as amblyopia and binocular vision loss. Additional studies exploring associated risk factors would be useful: family history, visual habits, prolonged use of digital screens, and concomitant neurological diseases.

This study was limited by the lack of national literature specifically addressing the incidence of strabismus in local Ecuadorian populations; this made it impossible to compare its results with other studies under similar conditions.

## CONCLUSIONS

During the 2020-2024 period, the cumulative incidence of strabismus at the Ambato Regional Teaching Hospital was lower than the figures reported in the international literature. This could have been due to biases in the detection and registration of affected patients. The proportions of cases in both sexes did not show statistically significant differences. The slight upward trend in this diagnosis in women should be investigated to identify possible predisposing factors. Esotropia was the most common. The variability in the incidence of exotropia may be related to changes in visual habits during and after the COVID-19 pandemic, and this should be studied. The proportion of cases has remained stable over time in the population. Although this study focused on a specific institution in the province of Tungurahua, the data it provided are relevant for future research at the national level.

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## Conflicts of interest

The authors declare that there are no conflicts of interest.

## Authors' contribution

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ISSN: 1029-3035
RNPS: 1821

Carlos Alberto Pérez-Padilla: conceptualization, data curation, formal analysis, research, project administration, resources, supervision, validation, writing, review, and editing.

Zaihrys del Carmen Herrera-Lazo: funding acquisition, research, methodology, supervision, visualization, writing of the original draft.

María del Carmen Yabor-Labrada: formal analysis, research, methodology, software, visualization, writing of the original draft.

Symone Shyram Villacrés-Moya: data curation, formal analysis, research, software, visualization, writing of the original draft.

## Financing

Self-financed.