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Prevalence and Clinical Characteristics of Asthma among Adolescents in Riobamba, Ecuador: A Cross-Sectional Study

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Abstract:

Introduction: Asthma is a global health concern that affects millions of people and has substantial social and economic impacts. Despite its significance, research in Riobamba, Ecuador has been limited since 1998. We conducted a cross-sectional study on 791 adolescents in Riobamba to assess the prevalence of asthma. Poorly controlled asthma leads to negative outcomes such as school ab- senteeism and lower academic achievement. Research on asthma is crucial, particularly in underserved regions. **Materials and Methods:** We randomly selected four schools in Riobamba, col- lected data via questionnaires, and performed data analysis, including chi-square tests, to evaluate associations. **Results:** The study revealed a cumulative asthma prevalence of 7.39 %, with no sig- nificant age or sex differences. Approximately 4.1 % of adolescents had experienced 4–12 wheezing attacks in the previous year, and 10.9 % woke up more than once a week due to wheezing. Exercise- induced asthma had a prevalence of 15.14 %, while 20.07 % reported a dry nighttime cough without an apparent cause. **Conclusion:** This study highlights the notable prevalence of asthma among ad- olescents in Riobamba, Ecuador, emphasizing the need for asthma management and preventive strategies. Comparisons with previous studies underscore the influence of geographic factors on prevalence. These findings contribute to the understanding of asthma prevalence in specific popu- lations, and aid in interventions and policies.

Keywords: Prevalence. Adolescent. Asma. Qualitative Research.

1. Introducción.

Asthma is a widespread global health concern, affecting over 250 million people worldwide, with a quarter of a billion children [1]. It is the most common chronic childhood condition and leads to more than 1000 preventable deaths daily [1,2]. This chronic respiratory disease, characterized by symptoms such as wheezing, coughing, and breathlessness, has profound implications for affected individuals and their families [3]. Poorly managed asthma results in negative outcomes, including increased school absenteeism, greater educational needs, lower academic achievement, missed workdays for caregivers, and financial stress [1].

Despite being a major public health issue, research on asthma in Riobamba has been limited since 1998 [4]. Additionally, asthma poses a substantial economic burden, exceeding $80 billion annually [1,2]. Notably, minority and socioeconomically disadvantaged children, particularly black children, bear a disproportionate share of the disease's morbidity and mortality [1,3,5]. To address these disparities and enhance asthma care, strategies have been introduced to remove obstacles in guideline-based care, enhance risk identification, bolster community-based care capacity, and sup- port preventive measures.

The global prevalence of asthma, particularly among children, underscores its importance as a major health concern. The lack of recent research in Riobamba necessitates a new study to under- stand the current status of asthma prevalence and management in this region. Despite medical ad-vances, asthma continues to impose a substantial societal and economic burden, emphasizing the urgent need for comprehensive and equitable asthma management to mitigate its impact and prevent avoidable deaths.

2. Materials and methods

This cross-sectional study was conducted at four schools in Riobamba. These institutions were randomly selected from a total population of 791 individuals. The study examined eight questions from the questionnaire: gender. Associations and homogeneity between questionnaire variables were assessed using the chi-squared

test. The relative risks of the variables by sex were calculated. A significance level of 95% was used for the statistical analysis. The questionnaire (Figure 1) was distributed to students with written instructions for completion by their parents or responsible adults. Once completed, the questionnaire was returned within four days to the class teacher, who then delivered it to the investigator.

Questions and Answers from the Written Questionnaire

1. Have you ever experienced wheezing or whistling in your chest in the past? Yes ( ) No ( )

   IF YOU ANSWERED "NO," PLEASE SKIP TO QUESTION 6
2. Have you had wheezing or whistling in your chest in the last twelve months? Yes ( ) No ( )

   IF YOU ANSWERED "NO," PLEASE SKIP TO QUESTION 6
3. How many episodes of wheezing or whistling in your chest have you had in the last twelve months?

   None ( ) 1 to 3 ( ) 4 to 12 ( ) More than 12 ( )
4. How many times have you awakened at night due to wheezing or whistling in your chest in the last twelve months?

   I have never awakened with wheezing ( ) Less than one night per week ( ) One or more nights per week ( )
5. Have the wheezing or whistling in your chest been severe enough that every two consecutive words, you had to stop to catch your breath in the last twelve months?

   Yes ( ) No ( )
6. Have you ever had asthma? Yes ( ) No ( )
7. Have you noticed wheezing while breathing, during or after exercising, in the last twelve months?

   Yes ( ) No ( )
8. Have you had a dry cough at night, unrelated to a cold or chest infection, in the last twelve months?

   Yes ( ) No ( )

Figure 1. Respiratory Health Questionnaire. *Source: Gonzalez Diaz et al., 1998, Prevalence and Severity of Asthma in the 13-14-Year- Old Population of Bilbao, ANALES ESPAÑOLES DE PEDIATRIA. VOL. 48 Nº 6, 1998, pp. 608-14.*

Data Cleaning Surveys with obvious completion errors or incompleteness were removed from the dataset, resulting in a final sample of 568 surveys (71.8% of the initial population).

Ethical Considerations: In conducting the research described in this study, several ethical con- siderations were carefully addressed to ensure the well-being and rights of all participants involved.

1. *Informed Consent:*
   - Parents or guardians provided informed consent for their children's participation in the study as well as for the collection and use of their personal health informa- tion.
   - Participants were informed of the study's purpose, procedures, potential risks, and benefits. They were also made aware that participation was voluntary and that they could withdraw at any time without any consequences.
2. *Anonymity and Confidentiality:*
   - All collected data were kept confidential and anonymous to protect the privacy of participants.
   - Personal identifiers were removed from the dataset to ensure that individual res- ponses could not be linked to specific individuals.
3. *Data Handling and Storage:*
   - The data were securely stored to prevent unauthorized access and disclosure. Only authorized personnel had access to the data.
   - Data sharing and storage complied with relevant data protection regulations.
4. *Minimization of Harm:*
   - All efforts were made to minimize any potential harm or discomfort to participants during data collection.
   - Psychological distress and discomfort were avoided during the questionnaire de- sign and administration.
5. *Beneficence:*
   - This study aimed to contribute to the understanding of the prevalence of asthma and its potential associations. This information could help improve health care practices and outcomes in individuals with asthma.
6. *Research Ethics Approval:*
   - The research protocol was reviewed and approved by an ethics committee or ins- titutional review board, ensuring that the study met ethical standards and guideli- nes.
7. *Conflict of Interest:*
   - The researchers disclosed any potential conflicts of interest related to the study, such as financial interests or affiliations with organizations that could influence the research.
8. *Publication and Reporting:*
   - The research findings were reported accurately and transparently, avoiding the fabrication, falsification, or selective reporting of data.
   - All limitations of this study are acknowledged in the publication.
9. *Community Engagement:*
   - Researchers engaged with local communities, schools, and participants to foster trust and transparency in the research process.
10. *Compliance with the regulations:*
    - This study adhered to all relevant local, national, and international laws and regu- lations governing research involving human subjects.

Ethical considerations are crucial in any research involving human participants to ensure that the study is conducted with integrity, respect for individuals' rights, and commitment to well-being. Researchers must follow ethical guidelines to maintain the trust of the community and integrity of the research findings.

3. Results:

In this study, we analyzed the prevalence of asthma among 568 respondents, with 58.1 % being male and 41.9 % being female. The cumulative prevalence of asthma in the study population was found to be 7.39 % (95 % CI 5.52-9.84), while the current prevalence of asthma was also determined to be 7.39 % (95 % CI 5.52-9.84). Further examination of the data revealed additional insights:4.1% of the children reported experiencing between 4 and 12 wheezing attacks in the last 12 months, and 10.9 % reported waking up more than once a week due to respiratory issues. The prevalence of individuals who had ever had asthma was 4.93 % (95 % CI 3.43-7.03), and exercise-induced asthma was prevalent in 15.14 % (95 % CI 12.43-18.32) of the respondents. Additionally, 20.07 % (95 % CI 16.98-23.56) of the participants reported experiencing a dry nighttime cough without an apparent cause. Statistical analyses, including chi-square tests, were conducted to assess the potential associations between various factors and asthma prevalence. Interestingly, the results indicated that neither age nor sex had a significant influence on the presence of asthma, as the p-values for both age and sex (asymptotic significance, bilateral) were greater than 0.05. This study employed a cross-sectional design, encompassing a random selection of schools and comprehensive data anal- ysis, to thoroughly investigate the prevalence of asthma and its potential correlation with age and sex in the study population.

Table 1. Distribution of sample by sex

Sex

		Frequency	*Percentage*	*Percentage valid*	*Cumulative Percentage*
Valid	*Male*	336	59,2	59,2	59,2
	Female	232	40,8	40,8	100,0
	Total	568	100,0	100,0	

Table 1 presents the distribution of the sample by sex, highlighting that 59.2% of the respondents were male and 40.8% were female.

Figure 2. Distribution by sex and age by percentage.

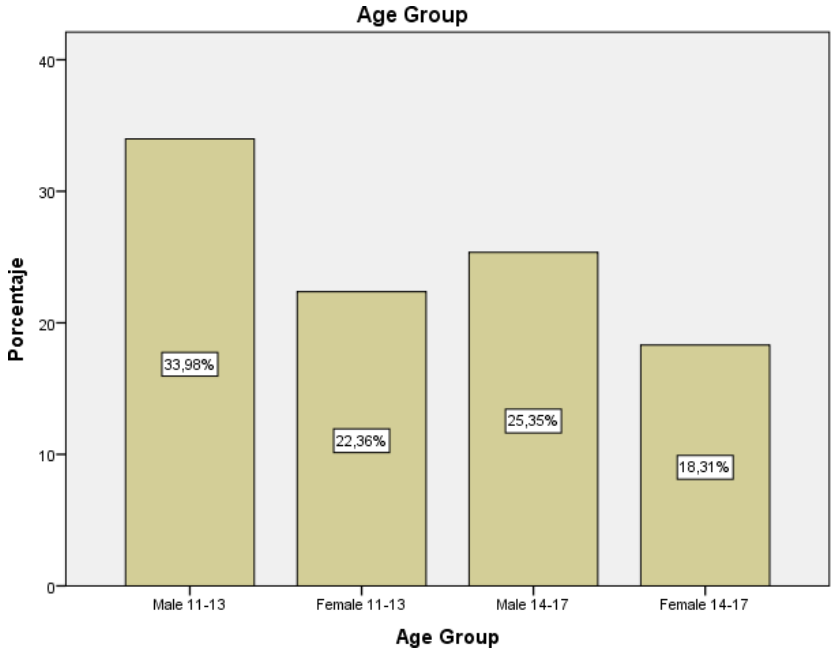

Figure 2 presents the distribution of children by age group and sex in the final sample of the 568 surveys. The percentages within each age group and sex were calculated with respect to the total within their respective age groups. The majority of participants fall into the age group (11-13), and the gender distribution shows a slight majority of boys in the sample.

Table 2. Responses to Question 3: How many wheezing attacks have occurred in the last 12 months?

Response	*Frequency*	*Percentage*	*Valid Percentage*	*Cumulative Percentage*
None	71	12.5%	58.2%	58.2%
1 to 3	46	8.1%	37.7%	95.9%
4 to 12	5	0.9%	4.1%	100.0%
Subtotal	122	21.5%	100.0%	
Missing (System)	446	78.5%		
Total	568	100.0%		

Table 2 indicates the prevalence according to Question 3 of the ISAAC standardized questionnaire: "How many wheezing attacks or whistling in the chest have you had in the last 12 months?" Options included: NONE: 58.20 % (95 % CI 48.93-67.06), 1 to 3: 37.70 % (95 % CI 29.09-46.93), 4 to 12:
4.10 % (95% CI 1.34-9.31).

Table 3. Responses to Question 4: How many times a week have you woken up at night because of wheezing?

Response	*Frequency*	*Percentage*	*Valid percentage*	*Cumulative percentage*
Never woken up with wheezing	98	17.3%	82.4%	82.4%
Once a week	8	1.4%	6.7%	89.1%
More than once a week	13	2.3%	10.9%	100.0%
Subtotal	119	21.0%	100.0%	
Missing (system)	449	79.0%		
Total	568	100.0%		

Table 3 indicates the prevalence according to Question 4 of the ISAAC standardized questionnaire: "How many times have you woken up at night due to wheezing or whistling in the chest in the last 12 months?" Options included: NEVER WOKEN UP WITH WHEEZING: 82.35 % (95 % CI 74.30-88.73), ONCE A WEEK OR LESS: 6.72 % (95 % CI 2.95-12.82), ONCE OR MORE A WEEK: 10.92 % (95 % CI 5.95-17.96).

Table 4. Have you ever had Asthma?

Have you ever had Asthma?

		Frequency	*Percentage*	*Valid percentage*	*Cumulative Percentage*
Valid	Yes (Male)	14	2,5	2,5	2,5
	No (Male)	323	56,9	56,9	59,3
	Yes (Female)	14	2,5	2,5	61,8
	No (Female)	217	38,2	38,2	100,0
	Total	568	100,0	100,0	

Table 5 presents the results of paired-sample t-tests conducted to assess the differences between the two sets of related variables. The table below summarizes these findings**.**

Table 5. Paired Samples t-Tests.

Pair	*Mean Difference*	*Standard Deviation*	*Standard Error*	*95% Confidence Interval*	*t-value*	*Degrees of Freedom*	*p-value*
Pair 1	Ever Had Asthma - Age Group	0.484	0.557	0.023	0.438 to 0.530	20.719	567
Pair 2	Sex - Ever Had Asthma	-1.356	0.531	0.022	-1.399 to -1.312	-60.789	567

Pair 1 (Ever Had Asthma - Age Group): The first pair of variables under consideration is "Ever Had Asthma" and "Age Group." The mean difference between these two variables is 0.484, with a standard deviation of 0.557. The standard error of the mean is 0.023. The 95 % confidence interval for the difference in means ranges from 0.438 to 0.530. The t-value for this pair is 20.719, with 567 degrees of freedom, resulting in a highly significant p-value of 0.000. When we delved deeper into this analysis with gender differentiation, we observed that

among males, 2.5 % reported having asthma, while 56.9 % did not. Among females, 2.5 % reported having asthma, while 38.2% did not. These sex-specific differences could contribute to the overall mean difference observed, where participants with asthma tended to be slightly older on average than those without. This nuanced in- sight underscores the importance of considering sex-related variations in future studies.

Pair 2 (Sex - Ever Had Asthma): The second pair of variables includes "Sex" and "Ever Had Asthma." In this case, the mean difference is -1.356, and the standard deviation is 0.531. The stand- ard error of the mean is 0.022. The 95 % confidence interval for the difference in means spans from-1.399 to -1.312. The t-value for this pair is -60.789, with 567 degrees of freedom, yielding an extremely significant p-value of 0.000. When we examined this pair in terms of sex, we found that among males, 2.5 % reported having asthma, while 2.5% reported having asthma. However, the majority of males (56.9 %) did not report having asthma, compared to a lower percentage of females (38.2 %) who did not report having asthma. These sex-specific differences are critical for under- standing the significant mean difference observed, indicating that individuals who report having asthma are more likely to be of the opposite sex. This sex-based disparity highlights a potential avenue for further research on asthma.

Table 6. Chi-Square Table for "No Asthma" Responses by Gender

	Males	*Females*	*Total*
No Asthma	*323*	*217*	*540*
Have Asthma	*14*	*14*	*28*
Total	*337*	*231*	*568*

Chi-Square Analysis (Ever Had Asthma Group): a chi-square analysis was conducted to explore the association between the variable "Ever Had Asthma" and gender. According to the data, Males who reported having asthma:14 cases (2.5 %), Males who reported not having asthma:323 cases (56.9 %), Females who reported having asthma:14 cases (2.5 %), Females who reported not having asthma:217 cases (38.2 %), To compare the "No Asthma" responses between males and females, we will use a chi-square test.

The calculated chi-square value was 60.789 with 1 deg of freedom. The p-value associated with this chi-square value is 0.000, which is less than the conventional significance level of 0.05. The results of the chi-square analysis reveal a highly

significant association between "No Asthma" re- sponses and gender. This indicates that "No Asthma" responses are not independent of the partici- pants' gender. The chi-square analysis highlights a clear association between "No Asthma" re- sponses and the gender of the participants. While the number of cases reporting having asthma is equal in both sexes (14 cases each), the significant difference lies in the "No Asthma" responses. Specifically, a higher percentage of males (56.9 %) reported "No Asthma than females (38.2 %). This difference is statistically significant, suggesting that males have a more pronounced tendency to report not having asthma than females. These findings underscore the importance of considering sex as a relevant factor in asthma research and related approaches. There may be underlying differ- ences in the perception or diagnosis of asthma that affected the participants' responses.

In this study, we employed a systematic approach to investigate the prevalence of asthma among adolescents aged 13–17 years over the past five years.

Scope and Bias

The analysis of the scope and biases in the study is crucial for understanding the potential limita- tions and implications of the findings. One notable observation is the sex distribution in the sample, as indicated in Table 1. The study sample appeared to be skewed toward a higher representation of males (59.2 %) than females (40.8 %). This sex imbalance could introduce bias into the study results, as there may be sex-related differences in asthma prevalence, symptom reporting, or healthcare- seeking behavior. As a result, these findings may not be representative of the entire population. The sample size was 568, which is a relatively small sample size for analyzing asthma prevalence and related factors. A larger and more diverse sample size could provide more robust and generalizable results. This study was conducted within a specific geographic area or population, which may limit the generalizability of the findings to broader populations. These results may not be applicable to other regions or demographic groups. The study findings were based on self-reported data from the participants. Self-reported data are subject to potential response bias, as individuals may under- report or over-report their asthma status, symptoms, or other related information. This bias can affect the accuracy of the prevalence estimates. This study did not provide contextual information about factors such as socioeconomic status, access to healthcare, environmental factors, or family history of asthma. These factors can significantly influence the prevalence and severity of asthma but were not considered in the

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analysis. The study did not provide information about the timeframe during which the data were collected. Changes in asthma prevalence and awareness over time could affect the relevance of these findings. The method used to select schools or participants may intro- duce a selection bias if certain schools or individuals are more likely to be included in the study based on specific criteria. There may be a reporting bias related to the categorization of asthma (e.g., "Ever Had Asthma") without considering its severity or clinical diagnosis. This could lead to an overestimation or underestimation of the true asthma burden. The study did not control for potential confounding variables, such as age, socioeconomic status, or environmental exposure. Failure to account for these factors may have affected the validity of the reported associations. While the chi-square test was used to analyze associations, more advanced statistical techniques may be required to account for potential confounders and interactions between variables.

Information recovery

We applied specific filters to our search, including 'Free full text,' 'Observational Study,' 'Humans,' and 'Adolescent: 13-18 years.' To ensure the relevance of our findings, we also used DeCS/MeSH terms, focusing on 'Prevalence,' 'Cross-Sectional Studies,' and 'Asthma.' Furthermore, we excluded studies related to 'other diseases' to maintain focus on asthma among adolescents. By utilizing these criteria and conducting a comprehensive review of the literature, we aimed to provide a current and accurate understanding of the prevalence of asthma in this age group, thus contributing valuable insights to the existing body of research. The methodological search did not yield any articles similar to ours, except for the foundational study by Gonzalez et al.

4. Discussion

This study aimed to analyze the prevalence of asthma among 568 respondents aged 13–17 years in Riobamba. Our findings revealed a cumulative prevalence of asthma of 7.39 % (95 % CI 5.52-9.84) within this population. Additionally, we explored various aspects of asthma such as the frequency of wheezing attacks, nighttime awakenings due to wheezing, and exercise-induced asthma. Interestingly, our analysis showed that neither age nor sex significantly influenced the presence of asthma in the study population.

When comparing our results to the study conducted by Diaz et al. (1998) in Bilbao, Spain, several factors were identified that could explain variations in

asthma prevalence. Geographic location, environmental factors, and diagnostic criteria can all contribute to the differences in prevalence rates between populations. Additionally, variations in the sample sizes and age groups studied between the two research efforts may have played a role in the observed differences. Importantly, asthma prevalence varies significantly across different regions and populations, making it crucial to consider these factors when interpreting our findings [4].

Furthermore, we found it valuable to draw parallels between our study and that of Herrera and Cavada [6]. Although their study primarily focused on hospitalization and mortality rates related to asthma in children aged 5–15 years, they revealed significant regional disparities in hospitalization rates [6]. Given the potential similarities in geographical characteristics, these findings may offer insights into the geographic variability in asthma prevalence among adolescents in a specific con- text. Nonetheless, it is essential to recognize that our research addresses asthma prevalence in a distinct age group with different objectives, making a direct comparison challenging.

Another noteworthy study by Wang et al. (2021) explored the association between proton pump inhibitor (PPI) use and asthma risk in children [7]. While our study concentrated on asthma prevalence in a specific adolescent population, Wang et al. investigated the impact of PPI use on asthma risk across various pediatric age groups in Sweden. Their findings indicated a significant association between PPI initiation and an increased risk of asthma, particularly in infants and tod- dlers [7]. Although our research and Wang et al.'s study differed significantly in scope and objec- tives, they collectively highlight the importance of considering medication-related factors in asthma development among children and adolescents.[7].

Lastly, we acknowledge the relevance of Fontan et al.'s study, which evaluated the quality of life of children and adolescents with asthma [8]. Their research focused on factors such as disease control, disease severity, comorbidities, and treatment adherence [8]. While our study primarily provides prevalence data for adolescents in Riobamba, the findings of Fontan et al. underscore the broader impact of asthma on well-being. They found that poorer disease control, higher disease severity, and allergic comorbidities were associated with reduced quality of life [8]. Taken together, these studies emphasize the need for comprehensive asthma management strategies that consider both the prevalence and quality of life factors [8].

5. Conclussions

This study provides valuable insights into asthma prevalence among adolescents

in Riobamba, highlighting the importance of considering geographic, demographic, and environmental factors when interpreting prevalence data. Asthma remains a complex condition influenced by a range of factors, and our findings, in conjunction with existing research, underscore the need for tailored healthcare interventions that address not only the prevalence, but also the broader impact of asthma on individuals' lives. Future research efforts should continue to explore the multifaceted nature of asthma and its implications for adolescent health and well-being.

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