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Biomarkers and Asthma Treatment: Experience at the Hospital Italiano de Córdoba

Biomarcadores y tratamiento del asma: Experiencia en el Hospital Italiano de Córdoba

Valentina Echegaray[1], Aníbal Bermúdez[1], María Elisa Uribe Echevarría[1], Viviana Moyano[1]

[1] Pulmonology Service, Hospital Italiano de Córdoba, Córdoba, Argentina.

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Correspondence
Valentina Echegaray. Email: valehegaray@gmail.com

ABSTRACT

Objective: To describe the clinical, inflammatory, functional, and therapeutic characteristics of asthma patients treated at a tertiary care center in Córdoba, Argentina.

Materials and methods: Observational, descriptive, cross-sectional study including 350 adult patients with a confirmed diagnosis of asthma according to the Spanish Guidelines for Asthma Management (GEMA 5.4) and Global Initiative for Asthma 2025 report (GINA). Sociodemographic variables, body mass index, smoking status, inflammatory biomarkers (peripheral blood eosinophils and total serum immunoglobulin E), clinical control assessed by a validated asthma control test, treatment adherence assessed by a validated inhaler-adherence questionnaire, lung function, and treatment characteristics, including inhaler devices and biologic therapies, were analyzed.

Results: Seventy-six percent of patients were women, with a predominance of individuals older than 60 years. Seventy-eight percent were overweight or obese and 36.4 % were classified as severe asthma. Eosinophil counts were elevated (≥300 cells/µL) in 38.7 % of patients, and total serum immunoglobulin E levels were elevated (≥150 IU/mL) in 39.9 %. Asthma was well controlled in 71.1 % of patients, and treatment adherence was good in 71.2 %. An obstructive pattern was observed in 29.1 % of patients. Ten percent were receiving biologic therapies, mainly omalizumab and mepolizumab.

Conclusions: This population shows a high burden of type 2 inflammation, a significant prevalence of severe asthma, and suboptimal disease control. The integration of inflammatory biomarkers, structured clinical assessment, and appropriate inhaler device selection is essential to optimize therapeutic strategies, particularly in candidates for targeted biologic therapies.

Key words: asthma | biomarkers | biologic therapy | asthma control | inhalation devices

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RESUMEN

Objetivo: Describir las características clínicas, inflamatorias, funcionales y terapéuticas de pacientes con asma atendidos en un centro de alta complejidad de la ciudad de Córdoba, Argentina.

Materiales y métodos: Estudio observacional, descriptivo y transversal que incluyó 350 pacientes adultos con diagnóstico de asma según guías GEMA 5.4 y GINA 2025. Se analizaron variables sociodemográficas, índice de masa corporal, tabaquismo, biomarcadores inflamatorios (eosinófilos en sangre periférica e inmunoglobulina E sérica total), control clínico mediante una prueba validada de control del asma, adherencia al tratamiento mediante un cuestionario validado de adherencia al tratamiento inhalatorio, función pulmonar y tipo de tratamiento recibido, incluidos los dispositivos inhalatorios y terapias biológicas.

Resultados: El 76 % de los pacientes fueron mujeres, con predominio del grupo mayor de 60 años. El 78 % presentó sobrepeso u obesidad y el 36,4 % fue clasificado como asma severa. El 38,7 % presentó eosinofilia elevada (≥300 células/µL) y el 39,9 % inmunoglobulina E sérica total elevada (≥150 UI/mL). El 71,1 % mostró buen control clínico y el 71,2 % buena adherencia al tratamiento. El 29,1 % presentó patrón obstructivo en la espirometría. El 10 % recibía terapias biológicas, principalmente mepolizumab y omalizumab.

Conclusiones: La población asmática evaluada presenta alta carga de inflamación tipo 2, elevada prevalencia de asma severa y control subóptimo. La integración de biomarcadores inflamatorios, evaluación clínica sistematizada y selección adecuada de dispositivos inhalatorios resulta clave para optimizar el abordaje terapéutico, especialmente en candidatos a terapias biológicas dirigidas.

Palabras clave: asma · biomarcadores · terapia biológica · control del asma · dispositivos de inhalación

INTRODUCTION

Asthma is a heterogeneous, chronic respiratory disease affecting approximately 300 million individuals worldwide. It remains a major public health challenge due to its substantial morbidity, detrimental impact on quality of life, and associated healthcare costs.[1,5] In Argentina, the estimated prevalence ranges from 8% to 12%, with regional, age-related, and environmental variations.[2,3]

Over the past few decades, our understanding of asthma has evolved from a broad clinical construct toward a more refined characterization of its endotypes and underlying pathophysiological mechanisms, particularly those linked to type 2 inflammation. In this context, biomarkers such as peripheral blood eosinophil counts and total serum immunoglobulin E levels have assumed a central role in patient phenotyping and therapeutic decision-making, especially regarding the selection of targeted biologic therapies.[5,6]

Current asthma management also requires the integration of objective tools to assess disease control and treatment adherence. Validated instruments, including the Asthma Control Test and the Test of Adherence to Inhalers, facilitate systematic evaluation in clinical practice and may contribute to improved risk stratification and treatment optimization.[7,8]

Despite advances in the understanding and treatment of asthma, a gap remains between evidence derived from population-based studies and clinical trials and the reality of routine clinical practice. In particular, integrated local data encompassing clinical characteristics, inflammatory biomarkers, disease control, treatment adherence, type of treatment, and inhaler device use remain limited in our setting. This lack of information hinders the adaptation of therapeutic strategies to the specific characteristics of patients managed at tertiary care centers.

Hospital Italiano de Córdoba is a referral center for respiratory diseases in central Argentina, managing a significant number of patients with asthma. However, no systematic data are available to comprehensively characterize this population from clinical, functional, and immunologic perspectives.

Therefore, the objective of this study was to describe the clinical, inflammatory, functional, and therapeutic characteristics of patients with asthma treated at the Hospital Italiano de Córdoba. Secondary objectives included characterization of sociodemographic and anthropometric profiles, assessment of inflammatory biomarkers, evaluation of asthma control and treatment adherence, and description of therapeutic strategies, including inhaler devices and biologic therapies. To provide local evidence that optimizes diagnostic and therapeutic approaches in real-world clinical practice.

MATERIALS AND METHODS

Study design

Retrospective, cross-sectional, observational study based on the review of electronic medical records of patients with a diagnosis of asthma treated at the Hospital Italiano de Córdoba.

Study population

The study included 350 adults (aged ≥ 18 years) with asthma diagnosed according to the GEMA 5.4 and GINA 2025 criteria.1,2 Patients were evaluated in the outpatient setting or during hospitalization between July 1, 2024, and July 1, 2025. The Hospital Italiano de Córdoba records approximately 12,000 respiratory consultations annually, of which 40% correspond to patients with asthma (approximately 4,800 patients/year). The 350 included patients met the criteria for a confirmed diagnosis of asthma and had complete data for the primary study variables at the time of review, representing 7.3% of the total population of patients with asthma treated during that period. Data were obtained retrospectively from the institutional electronic medical record using a standardized data extraction form. No additional exclusion criteria were applied. All patients meeting diagnostic criteria and with complete documentation of the variables of interest were included in the analysis.

Variables and definitions

The following variables were analyzed: sociodemographic characteristics (age and sex), anthropometric measures (body mass index [BMI], with obesity defined as BMI ≥ 30 kg/m^2), smoking status, and age at asthma diagnosis (childhood, < 18 years; adulthood, ≥ 18 years). Asthma control was assessed using the Asthma Control Test (ACT), a validated instrument with the following cut-off points: well-controlled asthma (score ≥ 20), partially controlled asthma (score 16-19), and poorly controlled asthma (score ≤ 15). Adherence to inhaled therapy was evaluated using the Test of Adherence to Inhalers (TAI). The TAI identifies patients with poor adherence, classifies adherence as good, intermediate, or poor, and characterizes patterns of non-adherence as erratic (items 1-5), deliberate (items 6-10), or unwitting (items 11-12). The instrument comprises a 10-item patient-completed questionnaire and a complementary 12-item version completed by both the patient and the healthcare professional. Asthma severity was classified based on the intensity of the required treatment following the GINA 2025 and GEMA 5.4 treatment steps. Mild asthma was defined as control achieved at steps 1 to 2 (low-dose inhaled corticosteroid [ICS], with or without as-needed formoterol, equivalent to budesonide 200–400 µg/day); moderate asthma corresponded to step 3 requirements (medium-dose ICS-LABA [long-acting beta-2 adrenergic bronchodilators], equivalent to budesonide 400–800 µg/day, or low-dose ICS combined with an LTRA [leukotriene receptor antagonists] or occasional LAMA [long-acting muscarinic antagonists]); and severe asthma was defined requiring steps 4 to 5 (high-dose ICS-LABA, equivalent to budesonide > 800 µg/day, with the addition of tiotropium or prescription biologics, including omalizumab, mepolizumab, or dupilumab). Inflammatory biomarkers included peripheral blood eosinophil counts (percentage and cells/mm^3) and total serum immunoglobulin E (IgE) levels (IU/mL). Pulmonary function was assessed by spirometry and categorized as normal, obstructive, or suggestive of a restrictive pattern according to the 2019 standards of the American Thoracic Society/European Respiratory Society (ATS/ERS). Treatment-related variables included type of drug, daily inhaled corticosteroid dose (µg/day), inhaler device type, and use of biologic therapies.

Statistical analysis

A descriptive and statistical analysis was performed. Quantitative variables were presented as mean and standard deviation or median and interquartile range as appropriate according to data distribution. Categorical variables were expressed as absolute and percentage frequencies.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki (2024 review), Good Clinical Practice guidelines of the National Administration of Drugs, Food, and Medical Devices (ANMAT), Provincial Law No. 9694, and National Law No. 25.326 on personal data protection. Given its retrospective observational design, the study was considered to involve minimal risk, according to the World Health Organization (WHO) classification. Investigators have no conflicts of interest to declare.

RESULTS

Sociodemographic characteristics

A total of 350 adult patients with a confirmed diagnosis of asthma according to GEMA 5.4 and GINA 2025 criteria were included in the analysis.[1,2] Women accounted for 76% of the cohort, whereas men represented 24% (Figure 1). Regarding age distribution, the predominant group was patients older than 60 years, followed by those aged 40 to 59 years (Figure 2). A total of 32.7% of participants reported a childhood diagnosis of asthma (< 18 years of age), whereas 67.3% were diagnosed during adulthood (Figure 3).

Body composition and smoking status

Based on body mass index (BMI), 47% of patients had normal weight (BMI, 18.5-24.9), 47% were overweight (BMI, 25.0-29.9), and 31% had obesity (BMI ≥ 30.0), resulting in a combined prevalence of excess weight of 78% (Figure 4). Regarding smoking status, 70.9% of the cohort had never smoked, 23.6% were former smokers, and 5.4% were current smokers (Figure 5).

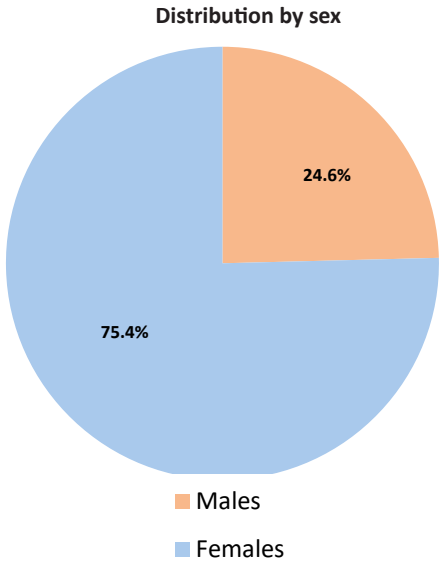
Asthma control and treatment adherence

Asthma control, assessed using the ACT, was classified as well controlled (ACT score ≥ 20) in 71.1% of patients, partially controlled (ACT score 16 -19) in 22,3%, and poorly controlled (ACT score ≤ 15) in 6,6% (Figure 6). Adherence to inhaled therapy, evaluated using the TAI, was classified as good in 71.2% of patients, intermediate in 28.8%, and poor in 0.6% (Figure 7).

Asthma severity classification

Asthma severity was classified according to treatment intensity, following the therapeutic steps outlined in GINA 2025 and GEMA 5.4, and taking into account ICS dose, use of LAMAs, and prescription of biologic therapies. 27.3% of patients were classified as having mild asthma, 36.4% as moderate asthma, and 36.4% as severe asthma (Figure 8).

Figure 1. Distribution by sex in the studied population.



Inflammatory biomarkers

Peripheral blood eosinophil counts were elevated (≥ 300 cells/µL) in 38,7% of patients, intermediate (150–299 cells/µL) in 32.2%, and low (< 150 cells/µL) in 29.1% (Figure 9). Total serum IgE levels were elevated (≥ 150 IU/mL) in 39.9% of patients (Figure 10). When analyzing the relationship between disease severity and biomarkers, an increasing trend was observed in mean eosinophil and IgE levels as severity categories advanced; with the highest values for both variables observed in patients with severe asthma (Figure 16).

Pulmonary function

Spirometric analysis demonstrated an obstructive pattern in 54% of patients, normal spirometry in 29.1%, and a pattern suggestive of restriction in 16.9% (Figure 11). Spirometric patterns were classified according to the 2019 guidelines of the ATS/ERS.

Pharmacologic treatment and inhaler devices

The most frequently used combinations were fluticasone/salmeterol (36.2%) and budesonide/

Figura 2. Distribution by age group.

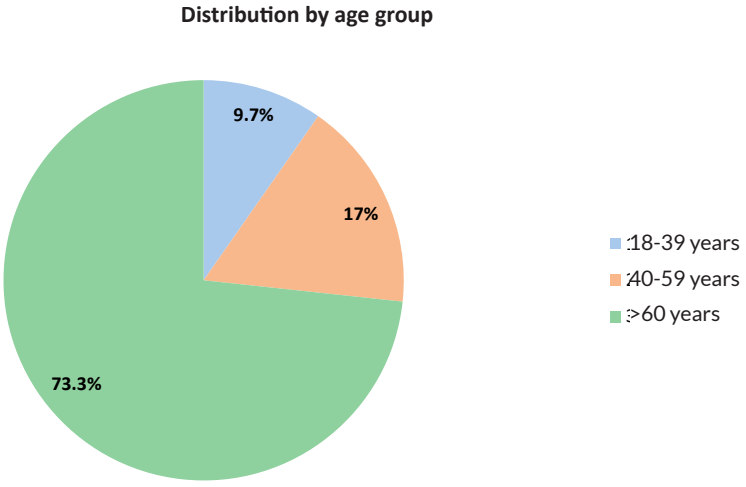
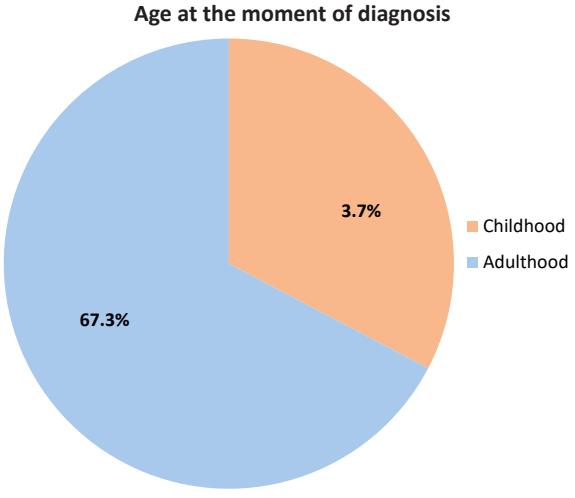


Figure 3. Age at the moment of diagnosis



formoterol (41.6%), followed by fluticasone furoate/vilanterol, fluticasone furoate/vilanterol/umeclidinium, and tiotropium bromide combinations (Figure 12). Regarding the type of inhaler device, pressurized metered-dose inhalers (pMDIs) were the most commonly used (38.1%). Dry powder inhalers (DPIs) accounted for 57.5% of all devices and included capsule-based devices (26.2%), Diskus (17.6%), Ellipta (8.8%), and Turbuhaler (4.9%) (Figure 13).

With respect to daily ICS dosing, 29.2% of patients received low-dose therapy, 40.4% medium-dose therapy, and 30.4% high-dose therapy, according to GEMA-defined dose ranges for budesonide, fluticasone propionate, and fluticasone furoate (Figure 14).

Biologic therapies

At the time of evaluation, 10% of patients were receiving biologic therapy. The most frequently prescribed biologics were mepolizumab and omalizumab, followed by dupilumab at a lower frequency. The remaining 90% were not receiving biologic therapy (Figure 15).

Asthma severity according to BMI category

When asthma severity was analyzed according to BMI category, it was observed that 40.3% of patients with normal weight had mild asthma, 37.7% had moderate asthma, and 19.5% had severe asthma. Among patients with overweight, the proportion of severe asthma increased to 40.6%, whereas the cases of mild asthma decreased to 23.6%. In patients with obesity, moderate (41.3%) and severe asthma (34.9%) predominated, while only 18.3% had mild disease (Figure 17).

DISCUSSION

To our knowledge, this is the first study conducted in Córdoba to comprehensively evaluate asthma prevalence, inflammatory biomarkers, asthma control (ACT), treatment adherence (TAI), inhaler device use, and biologic therapy according to the GINA 2025 and GEMA 5.4 guidelines.[1,2] This multidimensional approach, based on real-world clinical data, not only expands local knowledge but

Figure 4. Classification of the Body Mass Index (BMI).

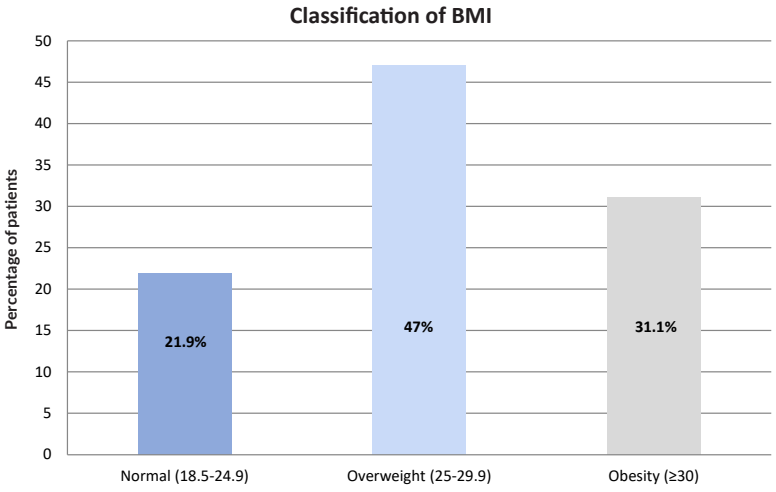


Figure 5. Classification by smoking status

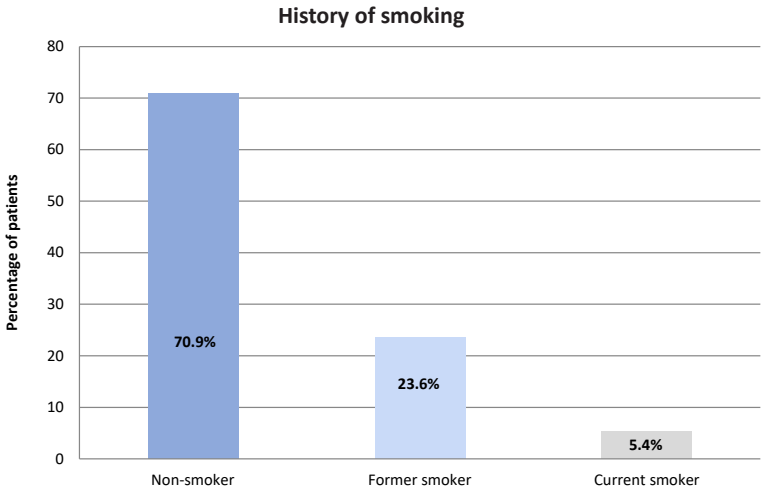


Figure 6. Asthma control level according to the ACT.

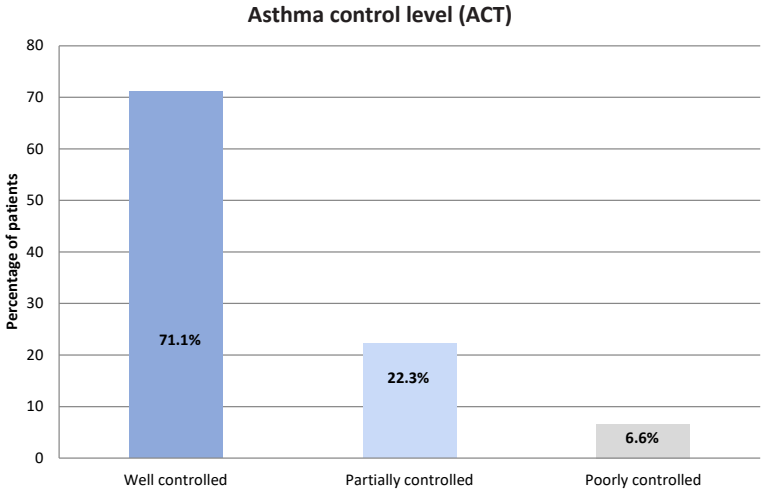


Figure 7. Level of adherence to inhalatory treatment (TAI).

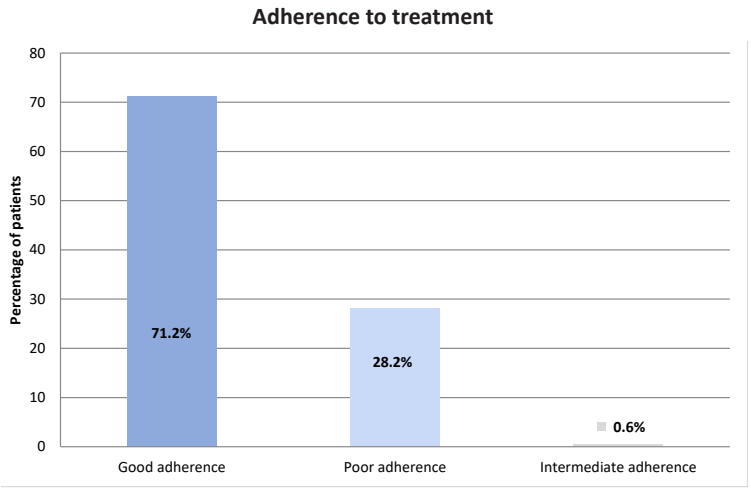


Figure 8. Classification of Asthma according to the therapeutic regimen (GINA/GEMA).

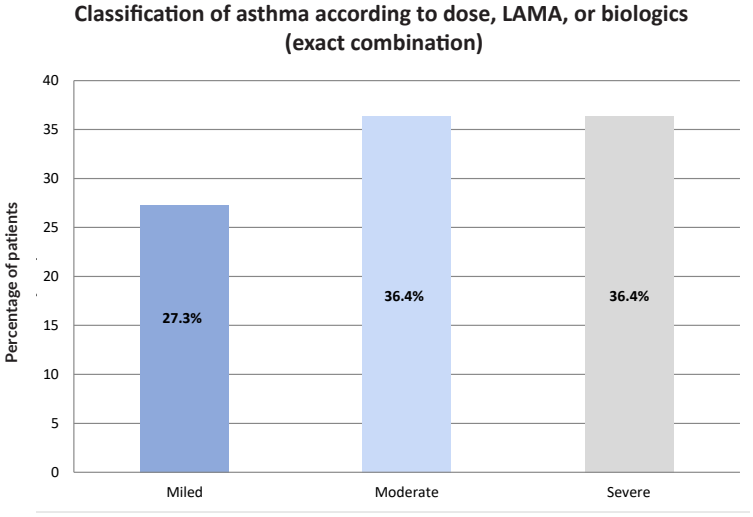


Figure 9. Eosinophil counts in peripheral blood.

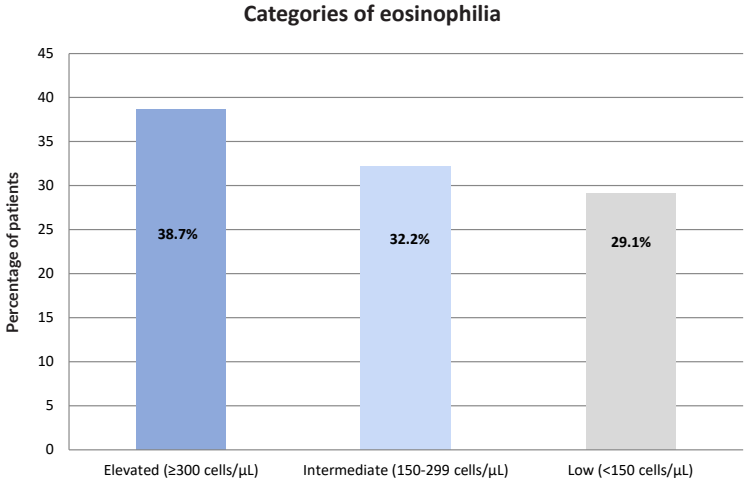


Figure 10. Distribution of total serum IgE levels.

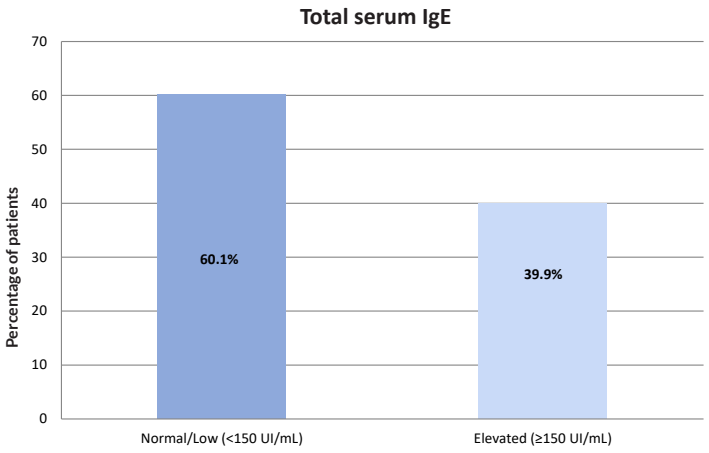


Figure 11. Spirometric pattern..

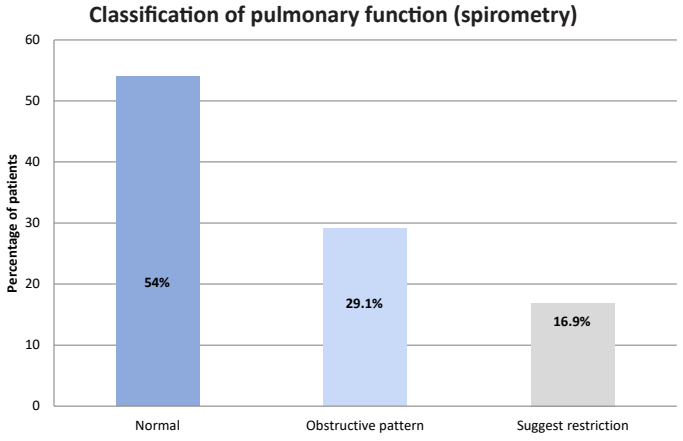


Figure 12. Treatment distribution according to pharmacologic combination.

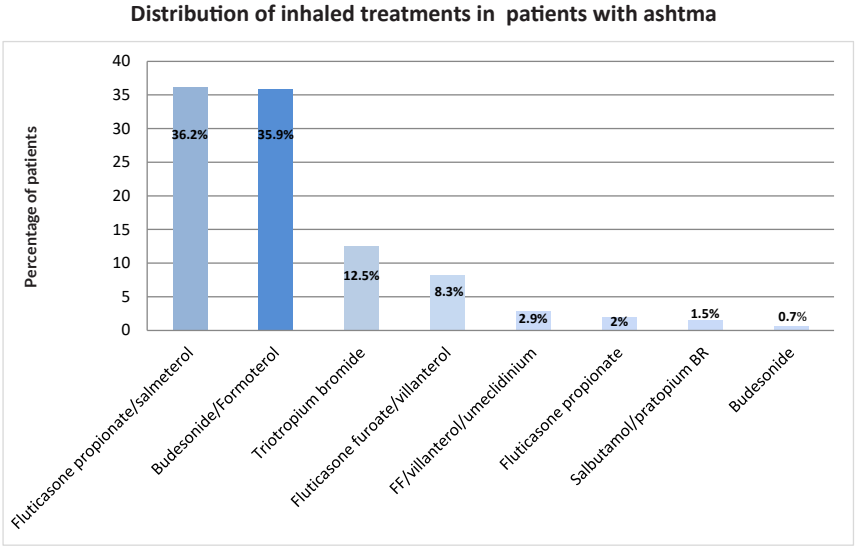


Figure 13. Type of inhaler used.

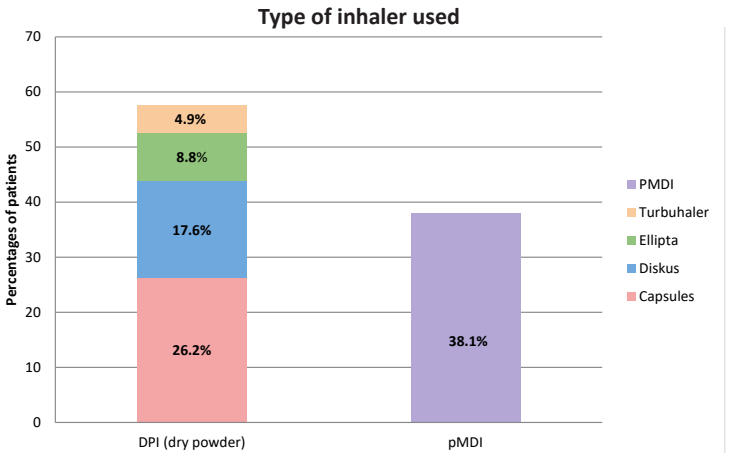


Figure 14. Classification of patients according to daily dose of inhaled corticosteroids.

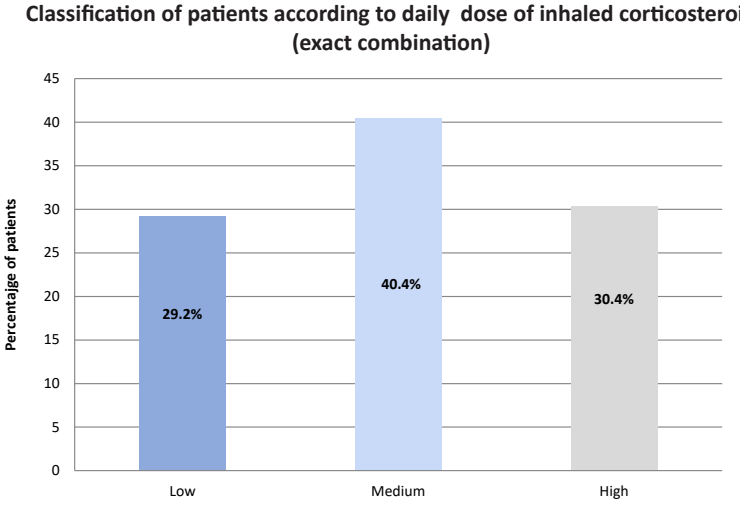


Figure 15. Use of biologic therapies.

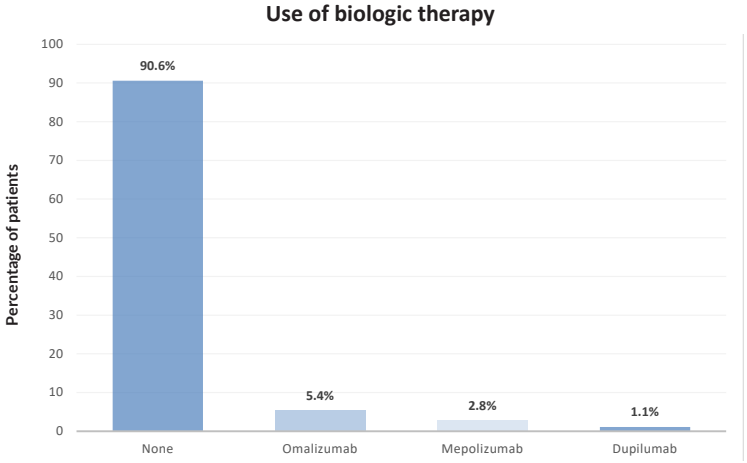


Figure 16. Relationship between asthma severity and inflammatory biomarkers.

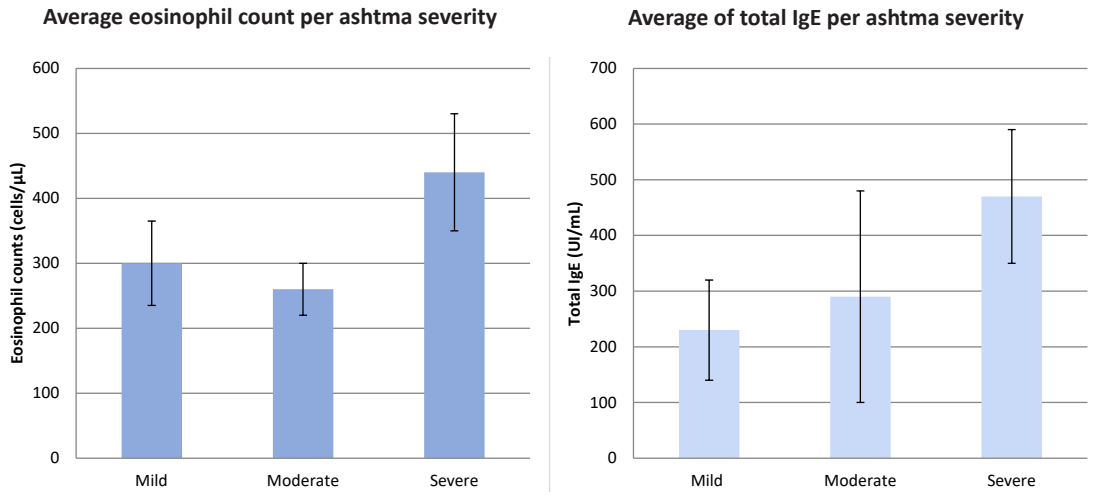
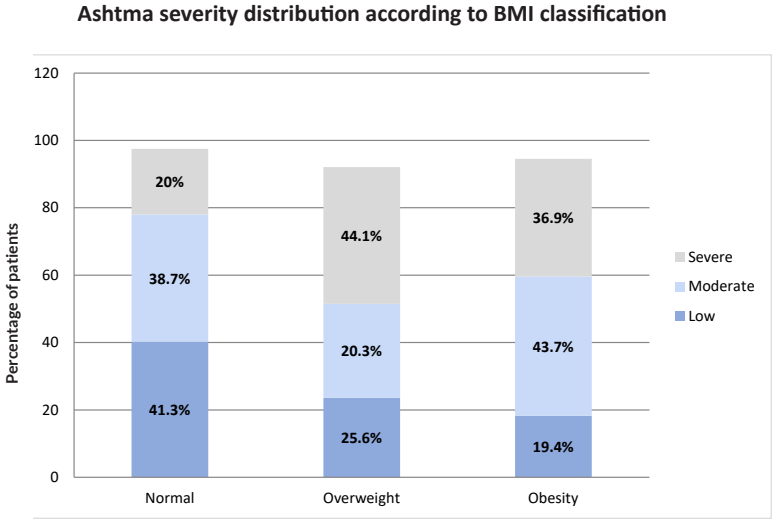


Figure 17. Asthma severity according to BMI classification.



also provides evidence that is comparable with international studies.

At the national level, the only comparable study is that conducted by Parisi et al at Hospital Italiano de Buenos Aires, 3 which reported a 6% prevalence (n = 66) in an adult population and focused primarily on general clinical variables. Although both studies share a cross-sectional design conducted in private healthcare institutions, our study differs in several important respects, including a larger sample size (n = 350), the incorporation of immunologic data (blood eosinophil count and total IgE levels), therapeutic severity classification, and the assessment of treatment adherence, asthma control, and biologic therapy use. In our cohort, 36.4% of patients were classified as having severe asthma, 34% had blood eosinophil counts > 300 cells/µL, and 61% had elevated total IgE levels, indicating a substantial burden of type 2 inflammation.[14]

These findings are consistent with international reports from Hong Kong and Lebanon,[6,7] which described a high prevalence of eosinophilic phenotypes and elevated IgE levels. The coexistence of these biomarkers has been recognized as a key determinant for selecting targeted biologic therapies. The similarity in

these patterns reinforces the concept of a shared global pathophysiology.

The comparison with the PREPARE study[4] conducted in Brazil, Peru, and Colombia also revealed similarities regarding the use of inhaled corticosteroids and the characterization of severe asthma. However, the prevalence of eosinophilia (≥ 300 cells/µL) in our cohort (38.7%) was slightly lower than previously reported, potentially reflecting regional differences in inflammatory profiles or prior exposure to systemic corticosteroids.

From a clinical point of view, the predominance of female patients (76%) is consistent with previous reports and may be related to hormonal and environmental factors. The high rate of overweight and obesity (78% with BMI ≥ 25) underscores the relevance of the asthma-obesity phenotype, which has been associated with poor asthma control and reduced responsiveness to inhaled steroids.[9] Only 53% of patients achieved well-controlled asthma (ACT score ≥ 20), a concerning finding that nevertheless agrees with international studies reporting optimal control rates ranging from 40% to 60%.[10] Intermediate or poor adherence (28.8%) was clearly associated with poorer asthma control, suggesting that educational and follow-up interventions could improve prognosis.

An additional strength of the present study is the inclusion of the specific inhaler device type used; an aspect that remains poorly explored in the domestic literature. Device selection –pMDI, DPI, Diskus, Ellipta, and Turbuhaler– is relevant because it directly influences inhaler technique, treatment adherence, and therapeutic efficacy. In this study, the pressurized metered-dose inhaler (pMDI) was the most commonly used (38.1%). Appropriate device selection tailored to patient characteristics, together with adequate inhaler education, remains essential for optimizing treatment outcomes.11

Overall, our findings support the integration of standardized tools such as the ACT and TAI, enabling systematic, reproducible, and internationally comparable assessment of asthma. The use of biomarkers and precise therapeutic criteria helps rationalize resource allocation, particularly for biologic therapies, thereby optimizing asthma management within demanding clinical settings.[12,13]

Study limitations

This study has several limitations. First, its retrospective, single-center design may limit the generalizability of the findings. Also, the absence of inferential analysis precludes the establishment of statistical associations among the evaluated variables. Nonetheless, our findings provide relevant insights into real-world clinical practice and establish a foundation for future analytical studies.

CONCLUSION

This study provides a comprehensive characterization of adults with asthma treated at a tertiary care center in Córdoba by integrating clinical, functional, and immunologic variables according to current international standards. The high prevalence of severe asthma, the frequent presence of type 2 inflammation, low control rates, and suboptimal adherence reinforce the need for a personalized, long-term management approach. In addition, including the type of inhaler device used and the use of biologic therapies provide information that has been underreported in the domestic literature. The data obtained are clinically useful and also help as a foundation to improve decision-making, optimize resources, and guide future research and healthcare planning at the regional level.

Conflict of interest

Authors have no conflict of interest to declare that are relevant to the content of this article.

Funding

The authors declare that this study received no external funding.

Author contributions

All authors reviewed and approved the final manuscript and made substantial contributions to the study.

Ethics approval, informed consent, and confidentiality

All procedures involving human participants conformed to the ethical standards of the institutional research committee, the World Medical Association Declaration of Helsinki (2024 revision) and its subsequent amendments, or comparable ethical standards.

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