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Long COVID in children and adolescents: Incidence and clinical characteristics in Buenos Aires, 2021-2023

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ABSTRACT

Introduction. Long COVID affects approximately 8.5% of the pediatric and adolescent population after SARS-CoV-2 infection, and vaccination could reduce its incidence.

Objectives. To determine the incidence of long COVID in children and adolescents aged 5 to 18 years, describe symptoms and duration, analyze differences by age and sex, estimate reinfections and school absenteeism, and evaluate its relationship with vaccination.

Population and methods. Prospective cohort study conducted between August 1, 2021, and February 1, 2023. To calculate incidence, patients with COVID-19 treated at a general acute care hospital in the Autonomous City of Buenos Aires were included; for characterization, cases referred from other centers were included as well. Descriptive and comparative analyses were performed, estimating incidence with 95% CI; STATA 14.0 was used (p <0.05). The study was approved by the Ethics Committee.

Results. Of 496 patients, 475 were included, and 21 were excluded due to severe comorbidities. The incidence of long COVID was 7.79% (95% CI 5.37-10.21). Those affected had a higher mean age (12.57 vs. 11.20 years; p = 0.02) and a higher incidence in unvaccinated or partially vaccinated individuals (11.48% vs. 5.48%; p = 0.018). The most common symptoms were fatigue, cough, and myalgia.

Conclusion. The incidence of long COVID was comparable to that reported in other pediatric series. A lower incidence was observed in children and adolescents with complete vaccination schedules, and fatigue was the most frequent clinical manifestation. These findings reinforce the need to continue generating evidence.

Keywords: *COVID-19; post-acute COVID-19 syndrome; pediatrics; COVID-19 vaccines.*

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INTRODUCTION

Post-COVID-19 condition, also named long COVID, in children and adolescents is a complex and heterogeneous clinical syndrome with a history of confirmed or probable SARS-CoV-2 infection. It is characterized by the persistence of symptoms for at least 2 months, with onset within 3 months of acute infection, and an impact on daily functioning.[1,2]

In 2023, the World Health Organization (WHO) published a consensus clinical definition of post-COVID-19 condition in children and adolescents, complementing the 2021 definition for the general population.[2]

Unlike the acute phase, long COVID in the pediatric population presents a fluctuating or recurrent course and multisystemic manifestations, with potential functional compromise. Its pathophysiology is not fully understood; however, mechanisms such as viral or antigenic persistence, immune dysregulation with low-grade chronic inflammation, post-infectious autoimmunity, endothelial and microvascular dysfunction, and autonomic nervous system dysfunction have been proposed to explain the clinical heterogeneity and persistence of symptoms. The absence of specific biomarkers and clinical variability reinforces the need for studies based on standardized definitions in the pediatric population.[1-3]

The estimated incidence of long COVID in children and adolescents ranges from 5% to 20%, with an average incidence of around 8.5% according to recent meta-analyses.[4-6] The most common persistent symptoms include fatigue, headache, difficulty concentrating, sleep disturbances, and dyspnea, which can affect quality of life, even after mild or asymptomatic acute episodes.[7-9] Previous studies describe a median age of 12 years, a female predominance, and a high proportion of patients with persistent symptoms up to 120 days after infection.[6-8]

Persistent symptoms can hinder school reintegration and regular physical activity, leading to increased school absenteeism and demand for medical care, and impacting mental health and overall well-being.[8-11]

COVID-19 vaccination has been shown to reduce the incidence of prolonged COVID in all age groups and, in the pediatric population, is associated with a shorter duration and less severe persistent symptoms.[12-16]

Although international evidence on long COVID has grown stronger, in Latin America, particularly in Argentina, the available data remain limited, with few studies in the pediatric population, underscoring the need for more evidence.[17-20]

The main objective of this study was to estimate the incidence and describe the clinical characteristics of long COVID in children and adolescents aged 5 to 18 years treated at a public hospital in the Autonomous City of Buenos Aires. In addition, persistent symptoms and their duration, differences by age and sex, reinfection and school absenteeism rates, the relationship with vaccination status, and the perceived impact on daily activities were analyzed to provide local evidence that contributes to a comprehensive understanding of long COVID in the pediatric population.

POPULATION AND METHODS

A prospective observational, descriptive, and analytical cohort study was conducted between August 1, 2021, and February 1, 2023. To estimate the incidence of long COVID, children and adolescents aged 5 to 18 years with a diagnosis of COVID-19 confirmed by RT-PCR, antigen test, or clinical-epidemiological criteria, treated on an outpatient basis at a general acute care hospital in the Autonomous City of Buenos Aires (hospital cohort), were consecutively included. Patients whose parents, caregivers, or guardians did not understand Spanish and/or those with severe comorbidities, at the investigator's discretion, were excluded (*Supplementary Material 1*).

The included cases were followed up by telephone interviews during the three months after epidemiological discharge, using a structured survey based on the ISARIC instrument, adapted to the local context, to identify the onset, persistence, or resolution of symptoms compatible with long COVID according to the WHO definition.[2] The instrument and the domains evaluated are described in the supplementary material.

The WHO definition of the pediatric population was adopted, with COVID-19 considered prolonged persistence of symptoms for at least two months, with onset within three months of acute SARS-CoV-2 infection.[2] In operational terms, the diagnosis was established 12 weeks after symptom onset, in the absence of an alternative cause.

Follow-up included predefined telephone contacts at 4, 8, and 12 weeks after symptom onset, allowing for systematic case identification.

Patients who remained symptomatic at 12 weeks, as defined by established clinical criteria (Supplementary Materials 1 and 2), were classified as cases of long COVID and invited to in-person clinical follow-up after signing an informed consent form.

Patients with a confirmed diagnosis of long COVID referred from other health centers were also included to broaden the clinical and evolutionary characterization (external subjects). In all cases that met the definition and gave their consent, follow-up was extended to 12 months after epidemiological discharge.

For the included patients, age, sex, comorbidities, persistent physical and psychological signs and symptoms, symptom duration, laboratory results, and basic complementary studies were recorded, along with the type and number of vaccine doses received. COVID-19 vaccination status was classified according to the recommendations in force during 2021-2023 at the time of infection: complete (two doses), incomplete (one dose), or unvaccinated, without considering booster doses, as they were progressively incorporated into the pediatric population during the study period.[21]

All patients were evaluated through basic clinical and functional studies; additional tests were requested based on clinical findings.

Health-related quality of life was also assessed using the PedsQL scale as an approximation of health status perception, and school absenteeism was described.[22]

The data were recorded in an *ad hoc* online form and consolidated in a database for review, cleaning, and statistical analysis.

Statistical analysis

Numerical variables were described using the mean and standard deviation, or the median and interquartile range, depending on their distribution; categorical variables were described using absolute and relative frequencies. The incidence of long COVID was estimated with a 95% confidence interval (95% CI). The incidence was compared between vaccinated and unvaccinated individuals using the χ^2 test. Demographic characteristics were compared between patients with and without long COVID using Student‘s *t-test* or Mann-Whitney test for continuous variables, and χ^2 test or Fisher›s exact test for categorical variables, as appropriate. A significance level of 0.05 was used in all analyses, and the assumptions of each test were verified. Statistical analysis was performed using STATA *software* version 14.0.

Ethical considerations

The research was conducted in accordance with current national and international ethical standards, the Declaration of Helsinki and its amendments, and the regulations of the Argentine Ministry of Health. The protocol was approved by the Institutional Ethics Committee and by the General Directorate of Teaching, Research, and Professional Development of the Government of the Autonomous City of Buenos Aires. All participants gave informed consent and, where appropriate, assent. The documentation was registered in the Buenos Aires Computerized Health Research Registry Platform (PRIISA.BA); good clinical practices (ICH E6) and confidentiality were always respected.

RESULTS

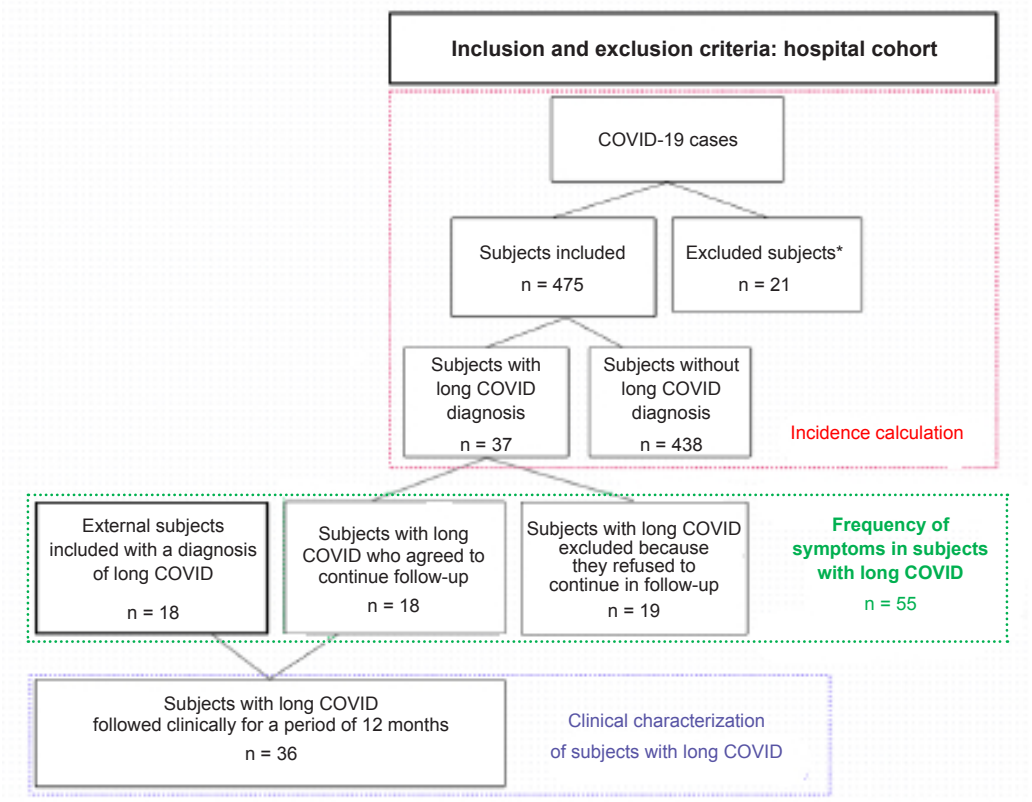
Incidence calculation

Of the 496 patients evaluated, 475 were included, and 21 were excluded due to severe comorbidities. The hospital cohort consisted of children and adolescents aged 5 to 18 years diagnosed with COVID-19 who were treated on an outpatient basis at a general acute care hospital in the Autonomous City of Buenos Aires, with a mean age of 11.38 years; none had preexisting severe comorbidities (*Figure 1*). Thirty-seven patients met the criteria for long COVID,[2] corresponding to an incidence of 7.79% (95% CI 5.37-10.21). Those affected had a higher mean age than those not affected (12.57 vs. 11.20 years; $p = 0.02$) (*Table 1*). Likewise, the incidence of long COVID was lower in vaccinated patients compared to unvaccinated patients (5.48% vs. 11.48%; $p = 0.018$) (*Table 2*).

Frequency of symptoms in subjects with long COVID

In addition to the 37 patients with long COVID recruited from the hospital cohort, 18 patients were referred from other centers that met the case definition (external subjects). *Table 3* summarizes symptom frequencies among all subjects with long COVID (n = 55). The mean age was 12.87 years (SD 3.32); 56.36% were female, and none had serious preexisting comorbidities. The most common symptoms were fatigue, cough, myalgia, and dyspnea.

Figure 1. Flowchart: Inclusion and exclusion criteria



** Twenty-one subjects were excluded due to severe comorbidities, at the investigator's discretion.*
Source: Own elaboration.

Clinical characterization of patients with long COVID during 12 months of follow-up

Of the 37 patients diagnosed with long COVID identified at the institution, 18 agreed to continue clinical follow-up (hospital cohort), joined by 18 patients referred from other centers (external subjects). A total of 36 patients were followed for 12 months (*Table 4*). The mean duration of symptoms was 213.06 days (SD 68.69).

Exercise-associated fatigue was the most frequent symptom and the last to resolve. All patients in follow-up were evaluated using a

Table 1. Age according to the presence of long COVID in the hospital cohort (n = 475)

	Long COVID (n = 37)	No long COVID (n = 438)	*p*-value
Age in years, mean (SD)	12.57 (3.25)	11.20 (3.46)	0.02

No differences were observed by gender.
Source: Own elaboration.
SD: standard deviation.

Table 2. Incidence of long COVID according to full vaccination in hospital cohort (n = 475)

Long COVID	Complete vaccination (n = 292)	Incomplete/no vaccination (n = 183)	*p*-value
Present, n (%)	16 (5.48)	21 (11.48)	0.018

Complete vaccination: 2 doses.
Incomplete vaccination: 1 dose.
Source: Own elaboration.

comprehensive approach that included physical examination, electrocardiogram, cardiological evaluation, six-minute walk test, sit-to-stand test, and laboratory studies according to current guidelines.[23] In patients with dyspnea or persistent cough, pre- and post-bronchodilator spirometry was performed.

Eight patients presented a pathological drop in oxygen saturation during the walking test, with rapid recovery; chest X-rays were normal in all cases. In one patient with a persistent cough, tomography revealed bilateral juxtacisural nodules with no clear etiology. In spirometry, 11 patients had alterations in mean flows, and one had a mild restrictive pattern. Ten patients received treatment with formoterol/budesonide, with complete symptom resolution in 8 and partial improvement in 2; all continued to be followed by a pulmonologist (*Table 4*).

Four patients presented with myalgia and transient elevation of creatine phosphokinase (CPK), responding well to nonsteroidal anti-inflammatory drugs. One case of mild pericarditis was identified, with a favorable clinical evolution. Likewise, hyporexia with weight loss and psychoemotional symptoms were recorded, all of which were resolved with an interdisciplinary approach. Three patients reported school absenteeism associated with fatigue and emotional symptoms; the remaining manifestations progressed favorably without requiring additional interventions (*Tables 3 and 4*). Thirty-four patients were included in the analysis of disease perception; two were excluded due to young age. The evaluation was performed using the Pediatric Quality of Life Inventory (PedsQL) scale,[22] and 55.56% perceived the disease as mild (*Table 5*).

DISCUSSION

Long COVID is an emerging challenge in pediatrics due to its heterogeneous clinical manifestations and potential functional impacts. In this prospective cohort, the estimated incidence in children and adolescents treated at a public hospital in the Autonomous City of Buenos Aires

Table 3. Symptoms in children and adolescents with long COVID. Hospital cohort and external subjects (n = 55)

Symptom	n (%)
Fatigue	50 (90.91)
Cough	19 (34.75)
Shortness of breath	18 (32.75)
Muscle pain	19 (34.54)
No elevated CPK	15 (27.37)
With elevated CPK	4 (7.27)
Lack of concentration	13 (23.64)
Headache	13 (23.64)
Anosmia	6 (10.91)
Nasal congestion	6 (10.91)
Decreased school performance	5 (9.09)
School absenteeism	3 (5.45)
Abdominal pain	3 (5.45)
Hair loss	3 (5.45)
Hypoxia	2 (3.64)
Weight loss	2 (3.64)
Hives	2 (3.64)
Dysphonia	2 (3.64)
Chest pain	2 (3.64)
Diarrhea	1 (1.82)
Angioedema	1 (1.82)
Pericarditis	1 (1.82)

CPK: creatine phosphokinase.

Source: Own elaboration.

Table 4. Characteristics of prolonged COVID in subjects who continued to be followed up in the hospital cohort and external subjects (n = 36)

Duration of symptoms in days, mean (SD)	213.06 (68.69)
Laboratory abnormalities, n (%)	5 (13.89)
Pathological walking test, n (%)	8 (22.22)
Pathological chair test, n (%)	5 (13.89)
Pathological spirometry (n/n = 19), n (%)	12/19
Spirometry pattern (n/n = 12)	
Obstructive	11/12
Restrictive	1/12
Pathological chest CT scan (n/n = 7), n (%)	1/7 *
Chest X-ray without pathology, n (%)	36 (100)
Pathological cardiological evaluation, n (%)	1 (2.78)
Presence of reinfection, n (%)	12 (33.33)
Use of formoterol + budesonide, n (%)	10 (27.78)
Use of NSAIDs, n (%)	18 (50.00)

CT: chest tomography; NSAID: nonsteroidal anti-inflammatory drugs; SD: standard deviation.

** 2 mm nodule on the apical segment of the lower right lobe, adjacent to the cistern, and 5 mm nodule on the apical segment of the lower left lobe, adjacent to the cistern.*

Source: Own elaboration.

was 7.79%, consistent with meta-analyses and population studies in Europe and North America that report incidences close to 7-8.5% in the pediatric population.[24-29]

The clinical profile observed was multisystemic, with a predominance of exercise-associated fatigue and respiratory and musculoskeletal symptoms, in line with international literature. Fatigue was the most frequent symptom and the one that took the longest to resolve. Likewise, patients with prolonged COVID had a higher mean age than those without persistent symptoms, suggesting that age could be a risk factor, although the underlying mechanisms remain unclear.[17,19,24,25]

The diversity of clinical manifestations underscores the importance of an interdisciplinary approach. In this cohort, comprehensive evaluation identified rare but clinically relevant functional alterations in respiratory, muscular, and cardiovascular systems, with favorable outcomes under specialized follow-up, in accordance with international recommendations for post-acute evaluation in the pediatric population.[23]

A lower incidence of long COVID was observed among children and adolescents who were fully vaccinated at the time of infection, consistent with international evidence suggesting that vaccination protects against the development of persistent symptoms.[12-17,28,29] However, this association should be interpreted with caution due to the observational design and potential confounding factors, which do not allow causal inference, although it provides local evidence of potential vaccination benefits beyond acute disease prevention.

Exploratory analyses of reinfection,[26] school absenteeism, and perceptions of health status

Table 5. Degree of patient perception of the disease. Hospital cohort and external subjects who agreed to continue follow-up (n = 34)

Degree of perception	n (%)
Mild	20 (55.56)
Moderate	12 (33.33)
Severe	2 (11.11)

Source: Own elaboration.

showed functional and psychosocial impacts in a proportion of patients. Although these findings should be interpreted descriptively due to the limited sample size and the absence of a specific control group, they highlight relevant dimensions of long COVID in the pediatric population.

Among the strengths of the study are its prospective design, systematic follow-up, and use of a case definition aligned with the WHO for the pediatric population.[2] The main limitations include its single-center nature, reduced diagnostic testing during certain periods, and the limited size of the cohort in long-term follow-up, which prevented adjustment of the analysis for potential confounders.

The results of this study are consistent with the available international literature and provide relevant data in the context of limited local information. The WHO has noted wide variations in incidence estimates across countries, driven by differences in diagnostic criteria, follow-up methodologies, and epidemiological contexts.[30] Likewise, the American Academy of Pediatrics warns of the need to interpret these findings with caution, given the limited standardization of operational definitions and the possible underestimation of mild or fluctuating cases.[31] In this context, it is pertinent to continue developing studies that contribute to a better characterization of long COVID in the pediatric population.

CONCLUSION

This study allowed us to estimate the incidence of long COVID and describe its clinical characteristics in children and adolescents aged 5 to 18 years treated at a public hospital in the Autonomous City of Buenos Aires. In this population, cases were concentrated in older patients, and a lower incidence of long COVID was observed in those who had completed their vaccination schedules at the time of infection. From a clinical standpoint, fatigue was the most frequently identified symptom. Additional analyses regarding reinfection, school absenteeism, and perceived health impact should be interpreted as exploratory descriptive findings. These results provide local evidence on long COVID in the pediatric population and highlight the need to continue generating information in this age group. ■

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The supplementary material provided with this article is presented as submitted by the authors. It is available at: https://www.sap.org.ar/docs/publicaciones/archivosarg/2026/10958_AO_Fernandez_Anexo.pdf

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