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Factors Associated With Postsurgical Pain in Children and Adolescents With Cognitive Dysfunction

Débora Sierra-Núñez[1,2] | Alejandro Bosch-Alcaraz[3,4] | Sandra Parada-Almansa[1] | Mónica Castro-Fernández[1] | Susana Asensio-Sales[1] | Daniel Gracia-Martínez[1] | Anna Falcó-Pegueroles[5] | Mª. Ángeles Saz-Roy[4,6] | Esperanza Zuriguel-Pérez[7]

[1]Pediatric Surgery Hospitalization Unit, Vall D'hebron University Hospital, Barcelona, Spain | [2]University of Barcelona, Bellvitge Campus, Barcelona, Spain | [3]Department of Public Health, Mental Health and Maternal and Child Health Nursing, Faculty of Nursing, University of Barcelona, Barcelona, Spain | [4]Mental Health, Psychosocial and Complex Nursing Care Research Group-NURSEARCH, University of Barcelona, Barcelona, Spain | [5]Fundamental and Clinical Nursing Departament, Faculty of Nursing, University of Barcelona, Barcelona, Spain | [6]Department of Public Health, Mental Health and Maternal and Child Health Nursing, Faculty of Nursing, University of Barcelona (UB), Barcelona, Spain | [7]Department of Knowledge Management and Evaluation, Multidisciplinary Nursing Research Group, Vall D'hebron Research Institute. (VHIR), Vall D'hebron University Hospital, Barcelona, Spain

Correspondence: Débora Sierra-Núñez (debora.sierra.nunez@sergas.es) | Alejandro Bosch-Alcaraz (alejandrobosch@ub.edu)

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ABSTRACT

Aim: To describe the characteristics of paediatric postoperative patients with cognitive dysfunction and assess the prevalence of pain and associated factors.

Desing: A descriptive observational study.

Methods: Cross-sectional study in children and adolescents who had undergone surgery in the previous 72 h with cognitive dysfunction impeding verbal communication of pain. The Spanish-language version of the revised Face, Legs, Activity, Cry and Consolability scale was used to assess pain intensity.

Results: The 51 included patients underwent 1072 pain assessments. Moderate to severe pain was detected in 12.1% of the evaluations ($n = 130$). Girls showed more intense pain after analgesia than boys. Higher pain intensity before analgesia was associated with neurodegenerative disease and autism spectrum disorder.

Conclusion: In children with cognitive dysfunction, female sex and baseline cognitive conditions seem to be associated with more intense postsurgical pain.

Implications for the Profession and/or Patient Care: Hospital pain management protocols should differentiate between patients with cognitive dysfunction and patients with neurotypical development.

Impact:

- This study addresses the prevalence of postsurgical pain in paediatric patients with cognitive dysfunction and associated factors
- 12.1% of postsurgical evaluations showed moderate to severe pain. Female sex and baseline cognitive conditions seem to be associated with more intense postsurgical pain.
- This research will have an impact on the care of paediatric patients with cognitive dysfunction in postsurgical hospitalization units.

Reporting Method: This study was performed according to EQUATOR GUIDELINES and the STROBE statement.

Patient or Public Contribution: No Patient or Public Contribution.

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What Does This Paper Contribute to the Wider Global Clinical Community?

- 12.1% of postsurgical evaluations in children with cognitive dysfunction showed moderate to severe pain.
- Female sex seems to be associated with higher postanalgesia pain.
- Autism spectrum disorder and neurodegenerative disease seem to be associated with greater pain pre-analgesia.

1 | Introduction

The International Association for the Study of Pain defined it as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage." (International Association for the Study of Pain (IASP), n.d.) Currently, the most widely accepted definition is the one proposed by Amanda Williams and Kenneth Craig in 2016, which also considers cognitive and social aspects: "pain is a distressing experience associated with actual or potential tissue damage with sensory, emotional, cognitive and social components." (Williams and Craig 2016; Leyva Carmona et al. 2019) A comprehensive screening and assessment of pain must account for the child's age, development, cognitive and communication abilities, cultural identity, preferences and pain characteristics. Previous trauma and pain experiences can also influence how children experience pain (Registered Nurses' Association of Ontario (RNAO) 2024).

Cognitive dysfunction (CD) is defined as "diminished or impaired mental and/or intellectual function" and was introduced as a medical subject heading by the US National Library of Medicine in 2017. It also encompasses other terms such as cognitive or intellectual disability, understood as a level of intellectual functioning and adaptive skills in a child that are significantly below average for their chronological age (Crosta et al. 2014; Shapiro and O'Neill 2020). In children, different diseases may coexist with CD, such as cerebral palsy, autism spectrum disorders (ASD), epilepsy, chromosome disorders, or neurodegenerative diseases. (Blum 2011).

2 | Background

Children and adolescents with CD are at higher risk for pain than those with typical development. In addition to factors common in the paediatric age group, pain triggers include some symptoms related to the underlying disease (e.g., spasticity in patients with cerebral palsy) and increased exposure to invasive surgical and medical procedures (Crosta et al. 2014; Hauer and Houtrow 2017; Carter 2020; Westbom et al. 2017). However, pain continues to be poorly assessed and treated in paediatrics, especially in patients with communication difficulties, such as children with CD (Leyva Carmona et al. 2019; Mozo del Castillo et al. 2022). Reasons for inadequate pain assessment in this population include the lack of specific instruments, insufficient training of healthcare professionals, and the paucity of available scientific evidence (Carter 2020; Cascella et al. 2019; Barney et al. 2020; Saroyan et al. 2008; Doody and E. Bailey 2017; Massaro et al. 2014; Carter et al. 2016; Sierra-Núñez et al. 2023).

3 | The Study

Despite the vulnerability of children and adolescents with CD and the higher exposure of this population to surgical procedures, we found no recent studies exploring the factors that may influence pain intensity after surgery. Thus, this study aims to describe the characteristics of postsurgical paediatric patients with CD and their caregivers, assess the prevalence of pain, and identify factors associated with greater intensity of postsurgical pain.

4 | Methods

4.1 | Design

This descriptive, observational, cross-sectional study took place from July 2022 to June 2024 in the paediatric surgery unit of a Spanish tertiary children's hospital. The 26-bed unit performs operations of different surgical specialties and invasive medical procedures; in 2024, 1668 admissions were recorded, with an average stay of 4.19 days. This study was performed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

4.2 | Participants

Eligible children had a baseline diagnosis of CD, were admitted to the study unit and met the following selection criteria:

- *Inclusion criteria*: aged 2–18 years; diagnosis of a condition presenting with CD; surgical intervention in the previous 72 h; inability to verbally communicate the presence of pain; and signed informed consent by legal guardians
- *Exclusion criteria*: unaccompanied by a family member or residing in social-health institutions; language barrier; and children and adolescents in end-of-life situations
- *Withdrawal criteria*: need for sedatives or intravenous muscle relaxants in continuous infusion during the data collection process

Due to the low prevalence of hospitalized children meeting the selection criteria described, consecutive non-probability sampling was used.

4.3 | Sample Size

Fifty-one included children and adolescents with CD underwent 1072 pain intensity assessments. To confirm the representativeness of the sample size, the statistical power obtained was calculated based on the outcome variable, pain intensity, considering 130 assessments prior to analgesia administration that included follow-up assessments after analgesia administration. Before drug administration, the mean pain score was 4.6 points (standard deviation [SD] 2.2), and afterwards, it was 0.7 points (SD

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1.4). Assuming an alpha error of 5%, a power of over 90% was obtained.

4.4 | Study Variables

Sociodemographic and clinical variables were collected for both participants and their caregivers. In children, variables included (a) age, both as a continuous and categorical variable (preschool [2–5 years], primary school-aged [6–12 years], and adolescents [13–18 years]); (b) sex (male or XY/female or XX/intersex); (c) nationality; (d) type of surgery (by specialty); (e) underlying diagnosis (cerebral palsy, ASD, epilepsy, chromosome disorder, neurodegenerative disease, other encephalopathies); (f) history of surgery (yes/no); (g) number of comorbidities; (h) length of hospital stay in days; (i) pain intensity, as assessed using the Spanish-language version of the revised Face, Legs, Activity, Cry and Consolability scale (r-FLACC-S) scale (0–10 points); and (j) analgesic drugs administered (per day and week).

Variables for caregivers were: (a) kinship (mother, father, both mother and father, mother–mother, father–father, other); (b) nationality; (c) age (in years); (d) sex (male or XY, female or XX, intersex); (e) profession and (f) educational attainment (no studies, primary education, vocational training, university studies).

4.5 | Data Collection

An ad hoc data collection instrument was designed to record the sociodemographic and clinical characteristics of the participants and their caregivers. At the time of admission and after ascertaining that a patient met the inclusion criteria for the study, a member of the research team collected these explanatory variables, except for length of stay, which was recorded at discharge.

The outcome variable, pain intensity, was assessed with the r-FLACC-S, which uses descriptors of common pain behaviours in children with CD, structured in five items: face, legs or limbs, activity, cry, and consolability. The total score ranges from 0 to 10 and is interpreted as: 0 = relaxed and comfortable; 1–3 = mild discomfort; 4–6 = moderate pain; and 7–10 = severe pain/discomfort. The r-FLACC-S scale showed adequate reliability and validity. Internal consistency was good, with a Cronbach's alpha of 0.876 and a McDonald's omega of 0.880, while interobserver agreement showed a concordance correlation coefficient of 0.933. The instrument also demonstrated the ability to detect changes in the degree of pain after pharmacological intervention, obtaining a $p < 0.001$ in the Wilcoxon test (Sierra-Núñez et al. 2025).

The study and the data collection methods were presented to the nursing professionals on each work shift (day and night) of the paediatric surgery unit, and they were trained on the use of the r-FLACC-S scale. The nurses were responsible for assessing participants' pain intensity in accordance with the hospital's postsurgical pain management protocol; evaluations were performed every 4 h for the first 48 h after admission and before the administration of the prescribed analgesia. When the pain intensity score was more than 3 points, pain was re-evaluated 30 min after administering analgesia. Figure 1 illustrates the pain assessment protocol process.

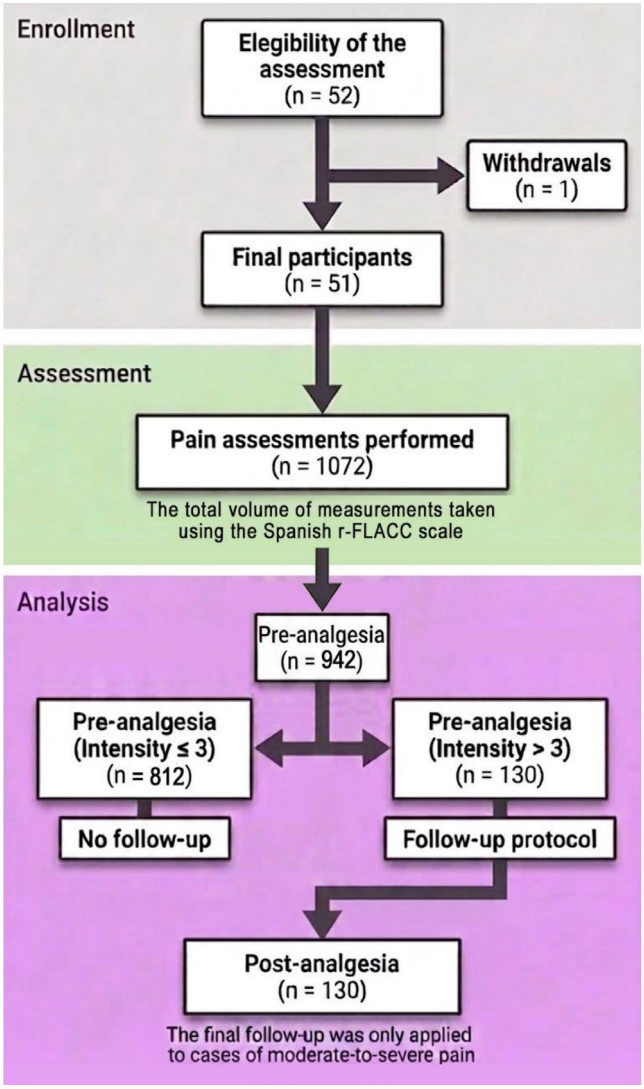


FIGURE 1 | Flow of the pain assessment protocol (Spanish r-FLACC). [Colour figure can be viewed at wileyonlinelibrary.com]

4.6 | Statistical Analysis

Study data were collected and managed using REDCap electronic data capture tools hosted at the Vall d'Hebron University Hospital (Harris et al. 2019). Analysis was undertaken using the SPSS statistical package (Armonk, NY: IBM Corp.). Continuous variables are expressed as mean (standard deviation, SD) and median (interquartile range, IQR) and categorical variables as frequencies and percentages.

To assess the factors associated with pain intensity, pre- and postanalgesia pain scores were analysed and compared according to explanatory variables. In the case of continuous variables, the Spearman correlation coefficient was calculated along with its 95% confidence interval (CI).

We fitted linear mixed-effects models to account for repeated measurements within individuals, treating pain level as the outcome variable. Subject-specific random intercepts were included in all models to account for within-subject correlation. For each analysis, we first specified a null model including only the intercept and a random effect for subject. We then fitted a second

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model that included the covariate of interest as a fixed effect while retaining the same random-effects structure. To evaluate the association between the covariate and pain level, we compared the two nested models using a likelihood ratio test. The resulting *p*-value was then used to determine whether the inclusion of the covariate significantly improved the model fit. This procedure was performed separately for three conditions: pre-analgesia measurements, post-analgesia measurements, and the change in pain level.

Furthermore, the correlation between the number of drugs administered per day and per week was calculated according to age groups, sex, underlying diagnosis, type of surgery and nationality. The Mann–Whitney *U* test or the Kruskal–Wallis test was used, as appropriate. *p* values of 0.05 or less were considered statistically significant.

4.7 | Ethical Considerations

The research ethics committee of the study center approved the protocol of the study (PR(AMI)238/2022), which was conducted in accordance with the principles of the Declaration of Helsinki and subsequent modifications (2024), as well as those of the Belmont Report (1979).

As the study participants were minors with CD, the research team provided the children's parents with sufficient information so that they could give their oral and written informed consent. Participant identities were coded to protect the confidentiality of personal data. The center's research institute was responsible for processing the personal data and only the researchers had access. To collect the data and store the completed questionnaires, an electronic data collection notebook was designed in REDCap. Data processing was performed following the guidelines of the Regulation 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of personal data and the free movement of data, as well as the Spanish Organic Law 3/2018 of 5 December for the Protection of Personal Data and the Guarantee of Digital Rights.

5 | Results

5.1 | Participant and Caregiver Characteristics

Fifty-two patients were selected for the study. One was withdrawn due to the need for sedatives in continuous intravenous infusion during the data collection process. Finally, 51 patients were included (76.5%, $n = 39$ male; mean age 7 years and 7 months, SD 5 years and 2 months).

The most common underlying diagnosis was chromosome disorder ($n = 15$; 29.4%), while 16 patients (31.4%) fell into the category of "other" diagnoses. The mean length of stay was 3.9 days (SD 4.7), and the most frequent type of surgery was trauma/orthopaedic surgery ($n = 16$; 33.3%). Most participants (76.5%, $n = 39$) had already undergone other surgical interventions (Table 1).

Over half the children (54.9%, $n = 28$) were accompanied by both parents, with Spanish nationality standing out as the most common ($n = 31$; 60.8%). The parents' mean age was 39 years (SD 11).

TABLE 1 | Participant characteristics ($n = 51$).

Variable	*n* (%)
Age	
Preschool (2–5 years)	25 (49.0%)
Primary school age (6–12 years)	14 (27.5%)
Adolescents (12–18 years)	12 (23.5%)
Sex	
Male (XY)	39 (76.5%)
Female (XX)	12 (23.5%)
Nationality	
Spain	40 (78.4%)
North African countries	8 (15.7%)
Latin American countries	2 (3.9%)
Missing data	1 (2.0%)
Type of surgical intervention	
Trauma or orthopaedic surgery	16 (31.4%)
Gastrointestinal surgery	9 (17.6%)
Neurosurgery	9 (17.6%)
Otorhinolaryngology	5 (9.8%)
Abdominal surgery	4 (7.8%)
Urological surgery	4 (7.8%)
Spinal surgery	1 (2.0%)
Missing data	3 (5.9%)
History of surgery	
Yes	39 (76.5%)
No	12 (23.5%)
Underlying diagnosis	
Chromosome disorder	15 (29.4%)
Infantile cerebral palsy	11 (21.6%)
Autism spectrum disorder	5 (9.8%)
Neurodegenerative	3 (5.9%)
Epilepsy	1 (2.0%)
Other	16 (31.4%)

Women were the primary caregivers for 39 (76.5%) of the children. About half (47%, $n = 24$) of the primary caregivers were not employed, and vocational training was the most frequent level of educational attainment (45%, $n = 23$).

5.2 | Pain Intensity and Associated Factors

A total of 1072 pain intensity assessments were performed: 942 before the administration of analgesia and 130 afterwards. The mean of pain assessments per patient was 18.5 (SD 6.9). The

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mean score was 0.9 points (SD 1.8). In 942 assessments (87.8%) before analgesia was administered, the score was 3 points or less, precluding the need for further follow-up. The rest (12.1%, $n = 130$) showed moderate to severe pain, with a mean intensity score of 4.6 points (SD 2.2) before analgesia administration and 0.7 (SD 1.4) at postanalgesia follow-up.

The univariate factors associated with pain intensity were underlying diagnosis, nationality, type of surgical intervention, and sex. Regarding pain intensity pre-analgesia, among cases with initially moderate to severe pain (> 3 points), there was a significant association with the underlying diagnosis ($p = 0.004$), particularly neurodegenerative disease (7.7 points, SD 1.2) and ASD (6.1 points, SD 1.9). In addition, pre-analgesia pain was associated with nationality ($p = 0.012$), with patients from Spain reporting lower scores (0.9 points, SD 1.8) than those from other countries. Patients from North African countries reported a mean score of 1.0 (SD 2.1), and those from Latin American countries reported a mean score of 1.0 (SD 1.5). The type of surgical intervention was also related to pre-analgesia pain intensity, in cases registering moderate–severe pain ($p = 0.037$). The mean pain intensity was higher for otorhinolaryngological (6.8 points, SD 1.5) and urological (6.4 points, SD 1.9) surgeries. Postanalgesia, pain intensity was higher in girls than in boys (1.2 points, SD 1.8 versus 0.5 points, SD 1.2; $p = 0.015$). Table 2 shows the results of the analysis of the relationship between pain intensity and the various factors considered. For quantitative variables, Spearman correlation coefficients, along with their confidence intervals are reported. For qualitative variables, descriptive statistics of pain are provided for each category. As described in the Methods section, a mixed-effects model was employed to evaluate the relationship between each variable and pain intensity. These analyses were conducted separately for pre-analgesia pain (in both in the full sample and in the subset of individuals with follow-up data), post-analgesia pain and the change in pain (calculated as the difference between pre- and post-analgesia measurements) (Figure 1).

In addition to the study's primary objective, the number of analgesics administered to participants per day and per week was analysed according to key demographic and clinical variables. This analysis was conducted to assess whether the frequency of analgesia administration might have interfered with the pain intensity results. Eight participants were excluded from the study due to incomplete medication administration records. No statistically significant relationship was found between the number of drugs administered and the variables analysed (Table 3).

6 | Discussion

In the present study, moderate to severe postoperative pain was observed in 12.1% of the pain assessments in children and adolescents with CD, with a mean intensity score of 4.6/10 points (SD 2.2). Despite the prevalence of this problem, there are few published studies with which to contrast our findings and little evidence on factors that may potentially be associated with greater intensity of postsurgical pain in this population.

In their research, Hauer & Houtrow and Mckinnon et al. studied patients with CD and cerebral palsy, observing more intense and frequent daily pain in females and those with more severe disability (Hauer and Houtrow 2017; Mckinnon et al. 2019). Our study is consistent with these findings with regard to sex, as girls showed higher average pain intensity than boys after receiving analgesia (1.2 points, SD 1.8 versus 0.5 points, SD 1.2). However, the same was not true for the degree of disability. In our study, the number of comorbidities, length of stay, and history of surgery were not statistically related to pain intensity. As no evidence on this potential relationship has been published, these results cannot be compared with those of previous studies.

Previous studies in children and adolescents with cerebral palsy related older age with higher prevalence and intensity of pain in their daily lives (Mckinnon et al. 2019; Jayanath et al. 2016). However, in our study, no relationship was observed between the age of participants with CD and the intensity of postsurgical pain when analysed in absolute terms or when stratified into age groups.

In our sample, underlying diseases associated with higher pain intensity before analgesia were neurodegenerative diseases and ASD, with mean pain scores of 7.7 points (SD 1.2) and 6.1 points (SD 1.9), respectively. A recent review by Nicolardi et al. studied pain perception in patients with autism using standardized protocols such as Quantitative Sensory Testing, questioning the supposed hyposensitivity to pain in persons with ASD, as reported by their parents (Nicolardi et al. 2023). However, the included studies in this review—and others (Moore 2014; Clarke 2015)—reported contradictory results. Nicolardi et al.'s review obtained different results on pain perception according to the method used. To complicate matters further, some authors contend that people with ASD show greater variability of responses, paradoxical perception of pain, and allodynia. The lack of studies on the subject in the paediatric population with ASD is a further challenge (Nicolardi et al. 2023; Moore 2014; Clarke 2015). As for neurodegenerative diseases, to our knowledge no published studies have described the prevalence of pain in affected patients or investigated its relationship with postsurgical pain. However, one study found that after scoliosis surgery, patients with Rett syndrome received less analgesia than patients with neurotypical development. Girls with Rett syndrome received significantly less morphine-equivalent opioids after surgery (mean 0.26 mg/kg/day, SD 0.10) compared to girls with adolescent idiopathic scoliosis (mean 0.47 mg/kg/day, SD 0.13) or cerebral palsy (mean 0.40 mg/kg/day; SD 0.14) (Barney et al. 2017). These data stand in contrast with our results, which showed no direct relationship between the underlying disease and the number of analgesic drugs administered after surgery ($p = 0.560$). That said, in our study all participants presented CD, and the results are not compared with participants with neurotypical development.

Although a literature review did not yield previous research with which to compare these findings, in our study otorhinolaryngological and urological surgeries were associated with greater pain intensity. These data should be interpreted with caution due to the large number of categories for the variable and the small number of cases in each. However, a future line of research may be warranted to contribute to improved analgesia in children with CD undergoing these types of procedures.

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TABLE 2 | Factors related to pain intensity, as assessed by the Spanish-language version of the revised Face, Legs, Activity, Cry and Consolability scale (r-FLACC-S) ($n = 1073$ assessments).

	Pre-analgesia mild pain (no follow-up necessary)			Pre-analgesia moderate–severe pain (with follow-up)			Post-analgesia follow-up			Pre-post analgesia		
Continuous variables	***N***	**Correlation[a] (95% CI)**	***p***	***N***	**Correlation[a] (95% CI)**	***p***	***N***	**Correlation[a] (95% CI)**	***p***	***N***	**Correlation[a] (95% CI)**	***p***
Age (years)	942	0.044 (−0.020, 0.108)	0.173	130	−0.285 (−0.436, −0.119)	0.001	130	−0.031 (−0.202, 0.141)	0.723	130	0.244 (0.075, 0.400)	0.005
N comorbidities	942	−0.033 (−0.096, 0.031)	0.317	130	0.181 (0.009, 0.343)	0.039	130	−0.010 (−0.182, 0.162)	0.907	130	−0.185 (−0.346, −0.013)	0.035
Length of stay (days)	770	0.057 (−0.014, 0.127)	0.116	100	−0.115 (−0.304, 0.084)	0.255	100	0.137 (−0.061, 0.325)	0.174	100	0.226 (0.031, 0.404)	0.024
Categorical variables	***N***	**Mean (SD)**	**Median (IQR)**	***N***	**Mean (SD)**	**Median (IQR)**	***N***	**Mean (SD)**	**Median (IQR)**	***N***	**MD (SD)**	**Median difference (IQR)**
Age												
2–5 years	468	0.9 (1.9)	0.0 (0, 0.5)	60	5.0 (2.2)	5.0 (3, 7)	60	0.9 (1.6)	0.0 (0;1)	60	−4.1 (2.5)	−4.0 (−6, −2.5)
6–12 years	276	1.1 (2.0)	0.0 (0, 1.5)	46	4.5 (2.3)	4.0 (2, 6)	46	0.6 (1.3)	0.0 (0;1)	46	−3.9 (2.5)	−4.0 (−6, −2)
13–18 years	198	0.8 (1.4)	0.0 (0, 1)	24	3.8 (1.6)	3.0 (2.5, 5)	24	0.5 (1.0)	0.0 (0;0)	24	−3.3 (1.5)	−3.0 (−5, −2)
p value[b]		0.106			0.400			0.273			0.406	
Sex												
Male (or XY)	706	0.9 (1.8)	0.0 (0, 1)	88	4.8 (2.1)	5.0 (3, 6)	88	0.5 (1.2)	0.0 (0;5)	88	−4.3 (2.2)	−4.0 (−6, −3)
Female (or XX)	236	1.0 (1.9)	0.0 (0, 1)	42	4.1 (2.2)	4.0 (2, 6)	42	1.2 (1.8)	0.0 (0;2)	42	−2.9 (2.4)	−2.0 (−5, −1)
p value[b]		0.400			0.708			**0.012**			0.240	
Nationality												
Spain	712	0.9 (1.8)	0.0 (0, 1)	94	4.7 (2.1)	4.5 (3, 6)	94	0.7 (1.4)	0.0 (0, 1)	94	−4.0 (2.3)	−4.0 (−6, −2)
North African countries	164	1.0 (2.1)	0.0 (0, 1)	26	5.0 (2.4)	5.0 (3, 7)	26	1.1 (1.7)	0.0 (0, 2)	26	−3.9 (2.8)	−4.0 (−6, −2)
Latin American countries	44	1.0 (1.5)	0.0 (0, 2)	6	3.0 (1.7)	2.5 (2, 5)	6	0.0 (0.0)	0.0 (0, 0)	6	−3.0 (1.7)	−2.5 (−5, −2)
p value[b]		**0.012**			0.092			0.236			0.376	

(Continues)

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TABLE 2 | (Continued)

Continuous variables	Pre-analgesia mild pain (no follow-up necessary)			Pre-analgesia moderate–severe pain (with follow-up)			Post-analgesia follow-up			Pre-post analgesia		
	N	Correlation[a] (95% CI)	*p*	*N*	Correlation[a] (95% CI)	*p*	*N*	Correlation[a] (95% CI)	*p*	*N*	Correlation[a] (95% CI)	*p*
Type of surgical intervention												
Otorhinolaryngology	60	0.9 (2.0)	0.0 (0, 0)	4	6.8 (1.5)	7.0 (5.5, 8)	4	1.2 (1.5)	1.0 (0, 2.5)	4	−5.5 (2.1)	−5.5 (−7, −4)
Trauma/orthopaedic	292	1.3 (2.2)	0.0 (0, 2)	62	4.8 (2.2)	5.0 (3, 7)	62	0.9 (1.7)	0.0 (0, 1)	62	−3.9 (2.4)	−3.5 (−6, −2)
Neurosurgery	210	0.6 (1.5)	0.0 (0, 0)	18	4.8 (1.8)	5.0 (3, 6)	18	0.6 (1.3)	0.0 (0, 0)	18	−4.2 (1.7)	−4.0 (−5, −3)
Spinal	16	0.5 (1.2)	0.0 (0, 0)	2	3.5 (0.7)	3.5 (3, 4)	2	0.0 (0.0)	0.0 (0, 0)	2	−3.5 (0.7)	−3.5 (−4, −3)
Gastrointestinal	212	0.6 (1.4)	0.0 (0, 0)	16	4.1 (2.2)	3.0 (3, 5)	16	0.3 (0.5)	0.0 (0, 1)	16	−3.8 (2.4)	−3.0 (−4.5, −2)
Urological	56	1.4 (2.6)	0.0 (0, 2)	10	6.4 (1.9)	6.5 (5, 8)	10	0.3 (0.5)	0.0 (0, 1)	10	−6.1 (2.0)	−6.0 (−7, −5)
Abdominal	56	0.6 (1.1)	0.0 (0, 1)	6	2.0 (0.6)	2.0 (2, 2)	6	0.0 (0.0)	0.0 (0, 0)	6	−2.0 (0.6)	−2.0 (−2, −2)
p value[b]		0.833			**0.037**			0.408			0.256	
Primary diagnosis												
Infantile cerebral palsy	226	1.0 (1.9)	0.0 (0, 1)	40	4.5 (2.1)	5.0 (3, 6)	40	0.8 (1.5)	0.0 (0, 1)	40	−3.7 (2.4)	−3.0 (−5.5, −2)
Autism spectrum	76	1.0 (2.2)	0.0 (0, 0)	10	6.1 (1.9)	5.5 (5, 7)	10	0.0 (0.0)	0.0 (0, 0)	10	−6.1 (1.9)	−5.5 (−7, −5)
Epilepsy	22	1.1 (1.2)	1.0 (0, 2)	4	2.2 (0.5)	2.0 (2, 2.5)	4	0.8 (0.5)	1.0 (0.5, 1)	4	−1.5 (0.6)	−1.5 (−2, −1)
Chromosome disorder	284	0.8 (1.7)	0.0 (0, 0.5)	32	4.4 (2.2)	4.0 (3, 6)	32	0.7 (1.3)	0.0 (0, 1)	32	−3.8 (2.6)	−3.5 (−6, −2)
Neurodegenerative	56	1.0 (2.4)	0.0 (0, 0)	6	7.7 (1.2)	7.5 (7, 9)	6	1.3 (2.1)	0.0 (0, 4)	6	−6.3 (2.5)	−6.5 (−9, −4)
Other	278	0.9 (1.7)	0.0 (0, 1)	38	4.1 (2.0)	3.5 (3, 6)	38	0.8 (1.6)	0.0 (0, 1)	38	−3.3 (1.7)	−3.0 (−4, −2)
p value[b]		0.071			**0.004**			0.560			**0.049**	
History of surgery												
No	244	1.1 (2.0)	0.0 (0, 2)	42	4.5 (2.2)	4.0 (3, 6)	42	0.7 (1.2)	0.0 (0, 1)	42	−3.8 (2.4)	−4.0 (−5, −2)
Yes	698	0.8 (1.8)	0.0 (0, 1)	88	4.6 (2.2)	4.5 (3, 6)	88	0.7 (1.5)	0.0 (0, 1)	88	−3.9 (2.3)	−3.0 (−5.5, −2)
p value[b]		0.408			0.687			0.935			0.946	

(Continues)

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TABLE 2 | (Continued)

Continuous variables	Pre-analgesia mild pain (no follow-up necessary)			Pre-analgesia moderate–severe pain (with follow-up)			Post-analgesia follow-up			Pre-post analgesia		
	N	Correlation[a] (95% CI)	*p*	*N*	Correlation[a] (95% CI)	*p*	*N*	Correlation[a] (95% CI)	*p*	*N*	Correlation[a] (95% CI)	*p*
Caregiver												
Mother	406	1.1 (1.9)	0.0 (0, 2)	76	4.1 (2.1)	4.0 (2.5, 5.5)	76	0.7 (1.4)	0.0 (0, 1)	76	−3.4 (2.4)	−3.0 (−5, −2)
Father	12	0.5 (1.2)	0.0 (0, 0)	0			0			0		
Both	524	0.8 (1.8)	0.0 (0, 0)	54	5.2 (2.2)	5.5 (3, 7)	54	0.8 (1.5)	0.0 (0, 1)	54	−4.4 (2.2)	−4.0 (−6, −3)
p value[b]		0.559			0.157			0.835			0.265	

Abbreviations: CI, confidence Interval; IQR, interquartile range; SD, standard deviation.
[a]Spearman's correlation coefficient.
[b]Mixed model. Statistically significant *p* values in bold.

A relationship was found between patients' nationality and the intensity of their postoperative pain. Therefore, culture and ethnicity should be considered when assessing and managing pain. As some research suggests, culture and ethnicity may affect how people experience pain and cope with it (Registered Nurses' Association of Ontario (RNAO) 2024; Jimenez and Bautista 2014; Gagnon et al. 2014; Krupić et al. 2019).

The presence of the primary caregiver was not associated with the perceived pain intensity. However, an investigation by Byiers et al. on parental pain catastrophizing and postsurgical pain outcomes in children with cerebral palsy suggested a potential influence of parental sex on children's pain outcomes (Byiers et al. 2021). Similar to our study, Byiers et al.'s study included a limited number of pain assessments in participants accompanied only by their parents, making the results inconclusive but pointing to the need for further research.

6.1 | Limitations

Despite the additional time allocated for the recruitment process, the narrow inclusion criteria—paediatric surgical patients with CD—resulted in a small sample size. The small sample size and the specific location of the study are both limitations. Furthermore, the diversity of the study population could also represent a limitation. Even so, to add rigour and external validity to the results, statistical power was calculated and a robust value was obtained (>90%). In addition, several pain assessments were performed in each participant (every 4 h during the first 48 h postadmission), which enlarges the dataset used for analysis. Nevertheless, some categories had a small number of cases, so the results should be interpreted with caution.

Moreover, although the difference in pain intensity by sex was not the main objective of the study, the differential results observed—with girls showing greater intensity of pain—suggest the need for future studies with an adequate design and sample size to evaluate this relationship. The scarcity of published research on the study topic, hindering the comparability and interpretation of the results obtained, also highlights the need for further research.

7 | Conclusions

This study shows a prevalence of 12.1% of moderate to severe postoperative pain in pain assessments undertaken in paediatric patients with cognitive dysfunction. More intense pain was associated with female sex and the diagnoses of ASD and neurodegenerative disease. Other factors that could influence the assessment and management of pain are the sex of the caregiver and the type of surgical intervention. Due to the heterogeneity of the study population, the results of this study should be interpreted with caution. Further research is required in different settings and with larger sample sizes to corroborate these findings. Hospital pain management protocols should differentiate between patients with CD and patients with neurotypical development, since those with CD have a greater susceptibility to pain, and their difficulties in communicating may result in more prolonged and intense pain after surgery.

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TABLE 3 | Association between drugs administered and patient characteristics.

Variables	*N* drugs administered per day			*N* drugs administered per week		
	N patients	Mean (SD)	Median (IQR)	*N* patients	Mean (SD)	Median (IQR)
Age						
2–5 years	20	1.6 (1.5)	1.0 (0.6, 2.0)	20	11.1 (10.4)	7.0 (4.5, 14.0)
6–12 years	13	1.1 (0.9)	1.0 (0.8, 1.5)	13	8.0 (6.1)	7.0 (5.6, 10.5)
13–18 years	10	1.2 (1.4)	1.0 (0.8, 1.2)	10	8.6 (9.8)	7.0 (5.4, 8.8)
Total	43	1.4 (1.3)	1.0 (0.7, 1.5)	43	9.6 (9.1)	7.0 (5.0, 10.5)
p value[a]		0.872			0.872	
Sex						
Male (or XY)	34	1.2 (1.1)	1.0 (0.7, 1.0)	34	8.1 (7.6)	7.0 (5.0, 7.0)
Female (or XX)	9	2.2 (1.8)	1.5 (1.0, 3.5)	9	15.1 (12.3)	10.5 (7.0, 24.5)
Total	43	1.4 (1.3)	1.0 (0.7, 1.5)	43	9.6 (9.1)	7.0 (5.0, 10.5)
p value[b]		0.119			0.119	
Primary diagnosis						
Infantile cerebral palsy	11	1.1 (0.8)	1.0 (0.8, 1.2)	11	8.0 (5.9)	7.0 (5.4, 8.8)
Autism spectrum	4	1.4 (0.5)	1.2 (1.0, 1.8)	4	9.6 (3.4)	8.8 (7.0, 12.2)
Epilepsy	0			0		
Chromosome disorder	10	2.1 (1.9)	1.0 (0.7, 4.0)	10	14.4 (13.1)	7.0 (5.0, 28.0)
Neurodegenerative	3	0.7 (0.6)	1.0 (0.0, 1.0)	3	4.7 (4.0)	7.0 (0.0, 7.0)
Other	15	1.2 (1.3)	1.0 (0.4, 1.4)	15	8.5 (9.1)	7.0 (3.0, 9.8)
Total	43	1.4 (1.3)	1.0 (0.7, 1.5)	43	9.6 (9.1)	7.0 (5.0, 10.5)
p value[a]		0.560			0.560	
Nationality						
Spain	36	1.4 (1.3)	1.0 (0.7, 1.5)	36	9.8 (9.2)	7.0 (5.1, 10.5)
North African countries	6	1.3 (1.4)	0.9 (0.7, 1.0)	6	8.8 (9.8)	6.3 (5.0, 7.0)
Latin American countries	1	0.8 (—)	0.8 (0.8, 0.8)	1	5.8 (—)	5.8 (5.8, 5.8)
Total	43	1.4 (1.3)	1.0 (0.7, 1.5)	43	9.6 (9.1)	7.0 (5.0, 10.5)
p value[a]		0.724			0.724	
Type of surgical intervention						
Otorhinolaryngology	4	2.0 (1.4)	1.5 (1.0, 3.0)	4	14.0 (9.9)	10.5 (7.0, 21.0)
Trauma/orthopaedic	16	1.6 (1.6)	1.0 (0.7, 1.8)	16	11.0 (10.9)	7.0 (5.2, 12.2)
Neurosurgery	7	0.9 (0.3)	0.8 (0.7, 1.0)	7	6.3 (2.2)	5.8 (4.7, 7.0)
Spinal	1	0.8 (—)	0.8 (0.8, 0.8)	1	5.6 (—)	5.6 (5.6, 5.6)
Gastrointestinal	8	0.6 (0.5)	0.5 (0.1, 1.0)	8	4.0 (3.4)	3.6 (0.9, 7.0)
Urological	2	2.0 (1.4)	2.0 (1.0, 3.0)	2	14.0 (9.9)	14.0 (7.0, 21.0)
Abdominal	3	2.7 (2.1)	2.0 (1.0, 5.0)	3	18.7 (14.6)	14.0 (7.0, 35.0)
Total	41	1.4 (1.3)	1.0 (0.7, 1.5)	41	9.7 (9.3)	7.0 (5.0, 10.5)
p value[a]		0.090			0.090	

Abbreviations: IQR: interquartile range; SD: standard deviation.
[a]Kruskal-Wallis test.
[b]Mann Whitney *U* test.

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Author Contributions

Débora Sierra-Núñez: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, resources, supervision, visualization and writing (original draft). **Alejandro Bosch-Alcaraz:** conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, validation, visualization and writing (review and editing). **Sandra Parada-Almansa:** data curation and investigation. **Mónica Castro-Fernández:** data curation, investigation and supervision. **Susana Asensio-Sales:** data curation and investigation. **Daniel Gracia-Martínez:** data curation and investigation. **Anna Falcó-Pegueroles:** formal analysis, funding, project administration and validation. **Mª. Ángeles Saz-Roy:** formal analysis, funding and validation. **Esperanza Zuriguel-Pérez:** funding acquisition, investigation, methodology, project administration, resources, supervision, validation, visualization and writing (review and editing).

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Research data are not shared.

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