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High impact chronic pain in children: exploration of associated characteristics and clinical factors in children and parents

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Background: Chronic pain in children can significantly impact daily functioning. While interdisciplinary pain rehabilitation is the recommended treatment, it is resource-intensive and limited in availability. Therefore, children with more complex symptoms, classified as High Impact Chronic Pain (HICP), need to be prioritized for interdisciplinary pain rehabilitation. However, HICP in children has been incompletely defined in previous literature, and associated factors remain underexplored. This study aimed to explore a broader biopsychosocial definition of HICP in children and to investigate characteristics and clinical factors in children and parents associated with HICP.

Method: This exploratory retrospective cross-sectional registry study included 484 children with chronic pain and their parents, referred to a tertiary pediatric pain clinic in Sweden. HICP was defined using five variables: pain intensity, pain interference, overall well-being, insomnia, and school absence. Children who met thresholds in at least three of these variables were classified as having HICP. Multivariable logistic regression models were used to identify factors in children and parents associated with HICP.

Results: A total of 60% of the participants met the criteria for HICP. Variables significantly associated with HICP included symptoms of depression (OR 1.10, $p = 0.001$) and psychological inflexibility (OR 1.06, $p = 0.001$) in children, as well as pain reactivity in parents (OR 1.05, $p = 0.018$).

Conclusion: Psychiatric comorbidity and behavioral aspects, including psychological inflexibility and parental pain reactivity, play key roles in pediatric HICP and should be considered when assessing and planning interventions. Addressing these factors may improve treatment outcomes and reduce long-term challenges.

KEYWORDS

adolescents, associated factors, children, functioning, high impact chronic pain, parents

1 Introduction

Chronic pain in children and adolescents (hereafter called children) is common, but the group is heterogeneous. Many children appear to cope well with chronic pain in daily life, whereas for others, pain is associated with high impact on a wide range of areas such as school attendance, physical and social activities, family functioning and psychological well-being (1–3). The latter has been referred to as “high impact chronic pain” (HICP) (4, 5). To assess functioning in chronic pain, a biopsychosocial approach is recommended in international studies and guidelines, emphasizing the interplay among biological, psychological, and social factors (3, 6, 7). This approach also forms the basis of interdisciplinary pain rehabilitation (IPR), grounded in a cognitive behavioral framework, which is the recommended treatment strategy for children with chronic pain (3).

IPR is typically provided in specialized pediatric pain clinics. However, access remains limited, and long geographical distances further restrict availability in countries such as Sweden (8, 9). This may lead to inadequate care and increase the risk that the pain persists into adulthood with limitations in physical and social activities, vocational ability and mental health (10–15). IPR is also resource-intensive and expensive in terms of personnel and treatment time (16). Consequently, children with more severe and complex symptoms, classified as having HICP, should be prioritized for IPR, and their specific needs and contributing factors must be clearly identified.

Previous studies on HICP in adults and children have mostly relied on pain intensity and pain interference for classification purposes (4, 5, 17–20), leaving an opportunity to adopt a broader biopsychosocial perspective that more fully captures the complexity of symptoms in children. In addition, the characteristics or clinical factors that contribute to HICP are not well investigated in children (4, 21, 22). For instance, studies including parental or behavioral aspects are lacking. These aspects need to be investigated in greater detail to enable tailored rehabilitation going forward.

To remedy the identified research gaps, the first aim of this study is to define HICP in children from a broader biopsychosocial perspective covering physical, psychological and social aspects, and including core outcome variables for pediatric pain studies (23, 24). The second aim is to investigate characteristics and clinical factors in children and their parents as potential factors associated with HICP as indicated by pain severity, pain interference, overall well-being, sleep disturbance and school absence.

2 Material and methods

2.1 Research design

This is an exploratory retrospective cross-sectional registry study of children with chronic pain and their parents at their first appointment at a tertiary pain clinic located in Sweden. The

study is part of a larger research project based on a clinical registry, previously described in detail (25). The study follows the Strengthening the Reporting of Observational studies in Epidemiology guidelines (STROBE) and contains the necessary items according to the STROBE checklist to properly report an observational study (26).

2.2 Participants and data collection

All children 10 to 18 years of age and their parents ($N = 484$) who were assessed at a Specialized Pediatric Pain Clinic (SPPC) for chronic pain at Skåne University Hospital, Sweden, between 2013 and 2021 and who approved participation in the registry were included in the study. Children were usually referred from pediatricians, child psychiatrists or primary care physicians and had previously undergone an assessment of any underlying cause/diagnosis for their pain. All children had chronic pain as defined by IASP, i.e., pain that persists or recurs for longer than 3 months. At least one parent attended the first appointment together with their child and answered the routine parental questionnaires.

Before the first assessment, children and their parents filled in the self-report questionnaires and background data which they sent in or brought with them to the clinic. Additional data were obtained from the interviews during the interdisciplinary assessment and the medical records, and kept together with the self-report data in the clinic’s registry.

Data on physical, psychological and social functioning as well as sociodemographic data, pain characteristics, and symptoms of psychiatric comorbidities for the present study, were obtained from the registry.

There were only 26 children under 10 years of age in the registry, and these were not included because most questionnaires are not validated for younger children and the parents routinely report the child’s functioning by proxy. Anyone not fluent in Swedish was offered an interpreter.

2.3 Assessments

2.3.1 High impact chronic pain

High impact chronic pain (HICP) was captured using five indicators: pain intensity (Numeric Rating Scale, NRS), pain interference (Pain Interference Index, PII), overall well-being (Pediatric Quality of Life Inventory total score, PedsQL tss, including physical, emotional, and role functioning), school absence (%), and sleep disturbance (Insomnia Severity Index, ISI). HICP was defined by meeting at least three of the following five criteria: NRS $\geq 5/10$ (27); PII $\geq 18/36$; PedsQL total score $<70\%$ (28); school absence $\geq 20\%$ (27); ISI $\geq 9/28$ (29, 30). Children meeting two or fewer of these criteria were classified as having low impact chronic pain (LICP). The domains covered all recommended mandatory and important outcome domains for pediatric pain research on chronic pain that are relevant for baseline assessment (24). School absence

due to pain is a major concern for many children with chronic pain, as it is often associated with declines in academic performance and broader aspects of school functioning (31, 32). Therefore, this domain was included in the definition of functioning.

2.4 Measures

2.4.1 Variables defining HICP

Numerical Rating Scale (NRS) was used to assess pain intensity (33, 34). The children were asked to rate the pain at the moment. NRS is graded 0 to 10, with 0 representing “no pain” and 10 “worst pain imaginable”. A pain score of ≥ 5 was considered high pain severity (27).

The *Pain Interference Index* (PII) was used to assess the impact of pain on daily life. Six questions are answered about how the pain during the past two weeks has affected various aspects of daily life such as physical activity, school, friends, leisure activities, sleep and mood. The maximum score is 36 and each answer is graded from 0 (not at all) to 6 (completely). The scale has shown good psychometric properties in studies of both children and adults with chronic pain in both Swedish and international studies (35–37). Internal consistency of items in the PII, determined by Cronbach’s α , was 0.86 in a Swedish study of children with chronic pain aged 7 and 18 years (35). As no established cut-off scores for HICP are currently available, we determined the threshold for high impact in this study based on the normal distribution of PII. Accordingly, a cut-off value of 18 was applied.

The *Pediatric Quality of Life Inventory* (PedsQL™ 4.0 Generic Core Scales) was used to assess overall well-being. PedsQL encompasses 4 subscales: physical functioning (8 items), emotional functioning (5 items), social functioning (5 items) and school functioning (5 items). Higher scores indicate better health-related quality of life (HRQoL). For children 8 years and older a cut-off score of 78 indicates special health care needs, 76 indicates chronic conditions and 70 indicates major chronic conditions (28). For this study the cut-off score for high impact was set to <70 . PedsQL self-report has shown high validity and reliability in an international study of children 5 to 16 years old and in a Swedish study of schoolchildren, with a Cronbach’s α of >0.7 for all subscales and close to 0.9 for the total score scale (38, 39).

School absence was recorded by the number of school days missed as reported by the child’s parents, which has previously been shown to correlate well with official school attendance records (31). Late arrival to school or leaving school early due to pain was recorded as a half day missed. For HICP classification purposes, a cut-off of $\geq 20\%$ school absence per week attributable solely to pain was applied. An earlier study has suggested similar cut-off scores for high pain related limitation (27).

The *Insomnia Severity Index* (ISI) was used to assess sleep disturbances. The ISI consists of 7 items rated from 0 (not a problem/not at all) to 4 (very much) and covers different

aspects of sleep disturbances such as falling asleep, nocturnal and early morning awakenings, satisfaction with sleep and impaired daily functioning due to sleep difficulties. Maximum score is 28 and higher scores indicate greater impact on sleep. Cut-off for adults are set to: 0–7 no clinically significant insomnia; 8–14 subthreshold insomnia; 15–21 moderate clinical insomnia; 22–28 severe clinical insomnia (40). The ISI has been shown to be a reliable and validated instrument for detecting insomnia and for evaluating treatment effects and has been translated into different languages (41). A Chinese study validated ISI for adolescents 12 to 19 years old in a general population and used a cut-off score of 9 (29). This cut-off has later shown satisfactory psychometric properties in a Swedish study of children 10 to 18 years old with chronic pain, with measured internal consistency, Cronbach’s α of 0.88 (30). Hence, a cut-off of 9 was used for HICP in this study.

2.4.2 Associated variables

2.4.2.1 Sociodemographics

Sex and age were registered for all participants. Marital status, highest education, and employment rate were also recorded for parents and dichotomized.

2.4.2.2 Pain characteristics

Children marked on a pain chart the parts of the body where they were in pain (42). The location(s) that hurt the most were marked with an “X”, and the number of pain locations was dichotomized into <3 or ≥ 3 . During the assessment, parents were asked whether they experienced any ongoing long-term pain and, if so, how it impacted their ability to work. Work ability was dichotomized into working full-/part time or being on sick leave, disability pension, old-age pension or unemployed.

2.4.2.3 Psychological and coping/behavioral factors

Center for Epidemiological Studies—Depression Child (CES-DC) was used to assess symptoms of depression in children over the past week. CES-DC is a 20-item scale with a maximum score of 60. A cut-off score of 24 has been identified in a Swedish study as sufficiently specific for detecting depressive disorders in adolescents. The scale has been validated both internationally and within Sweden (43, 44).

Pain Reactivity Scale-child (PRS-c) was used to measure psychological reactivity such as pain-related worrying in children. Five statements about pain-related concerns and emotional reactions are graded from 0 (not at all) to 6 (always). The maximum score is 30 and higher scores indicate more discomfort. Several Swedish studies have used PRS for research on chronic pain in children and adults and PRS has satisfactory psychometric properties (37, 45, 46).

Pain Reactivity Scale-Parent (PRS-p) was used to report the parent’s worry about the child’s pain. The five questions in the questionnaire are the same as in the child questionnaire, but with the parent’s point of view, such as “How often do you worry about your child’s pain?”. The scoring is the same as for the PRS child form, with a maximum score of 30 (37, 45).

Psychological Inflexibility in Pain Scale (PIPS) was used to assess psychological inflexibility in children, with two subscales assessing pain avoidance (8 items) and cognitive fusion (4 items). These are rated from 1 (never true) to 7 (always true), with a maximum score of 84. High scores indicate higher psychological inflexibility. PIPS has shown acceptable validity and reliability for adults (47–49) and for children (50).

Parental Psychological Flexibility Questionnaire (PPFQ-10) was used to capture parental responses to the child's pain in terms of psychological flexibility. Psychological flexibility is defined as the parent's willingness to experience distress related to the child's pain in the service of valued behaviour. PPFQ-10 is a short version of PPFQ, which are both valid and reliable tools (51–53). The internal consistency for PPFQ-10 in a Swedish sample of parents of children with chronic pain measured a Cronbach's α of 0.86 (53). Questions are rated from 0 (never true) to 6 (always true). Maximum score of PPFQ-10 is 60 and higher scores indicate greater psychological flexibility (52–54).

2.5 Ethical considerations

Written information was sent to all families, who without exception, gave their consent to the storage of information and the use of data for future research. The study was approved by the Swedish Ethical Review Authority 2021-07-26 (No. 2021-02709). Throughout the study the Declaration of Helsinki for research on humans was followed.

2.6 Data analyses

A binary variable for HICP was constructed. Children who had at least 3 of 5 of the following items were considered to have HICP: Pain intensity (NRS present) $\geq 5/10$ (27), Pain interference (PII) $\geq 18/36$ (see Measures section), Quality of life total score (PedsQL) < 70 (28), Sleep disturbance (ISI) ≥ 9 (29, 30), and School absence $\geq 20\%$ (27). The cut-off values were determined *a priori*, primarily based on the previous literature outlined in Section 2.4.1, which defines the HICP variables. All children had data for at least 3 items and therefore none were excluded due to missing data.

Logistic regression models were constructed to investigate potential characteristics and clinical factors in children and parents that were associated with HICP. Univariable models were constructed for the 17 potential associated variables. All associated variables with a p -value lower than 0.3 were then included in the final multivariate models. Since many variables were significant, one multivariable model was made using the variables that were associated with the child, and one model was made using variables that were associated with the parent(s). A two-tailed significance level of $p = 0.05$ defined significance.

A formal power analysis was not conducted because this was a registry-based study with a fixed sample size determined by the number of eligible cases during the study period. This is in accordance with the STROBE guidelines.

Statistical analysis was performed in R version 4.3.3 (reference: R Core Team (2024). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.)

3 Results

3.1 Participants

In Table 1 descriptive statistics for the 484 children and parents are presented. A total of 289 (59.7%) of the children were considered to have HICP according to the definition used here. Overall, missing data were minimal, as all information was collected during the initial clinic visit and any incomplete questionnaire responses were completed upon arrival.

There were more girls than boys among the participants (72.1% vs. 27.9%), but the distribution for the respective sex in the LICP and HICP groups was comparable. Mean age was around 14 years in both groups. Headache was the most common pain location (28.9%), followed by musculoskeletal pain (24.4%) and abdominal pain (20.0%) in the overall study group, with the same ranking observed in both comparison groups. Widespread pain was more common in the high impact group (19.7%) than in the low (7.7%). More than half of the participants had pain in ≥ 3 locations, but a higher percentage of multiple pain locations was found in the high impact group (61.2%) compared to the low impact group (43.6%).

Most accompanying parents were mothers 387 (80.0%), who completed the questionnaires. The percentage of mothers and fathers attending were equal in the high and low impact groups. The level of parental education was higher in the low impact group, (64.1%) compared to the high impact group (48.1%). Parents were generally employed to a high degree (80.6%), but there were more employed parents in the low-impact group than in the high impact group. Most parents were married or in a partnership (80.2%), with a slight predominance of single parents (21.1%) in the group with high impact on child functioning compared to (14.9%) in the low impact group. Sixty percent of parents reported experiencing chronic pain themselves. Families in which both parents had chronic pain were more common in the high impact group (26.3%) compared to the low impact group (17.4%). However, there was no difference between the groups when only one parent had chronic pain.

3.2 Multivariable logistic regression analysis

The multivariable logistic regression analyses are described in detail in Tables 2, 3. A multitude of child variables (age, primary pain location, number of pain locations, symptoms of depression, psychological inflexibility and pain reactivity) and parental variables (higher educational level, psychological flexibility and pain reactivity) had a p -value lower than 0.3 and were included in the final multivariate models. Variables associated with

TABLE 1 Descriptive statistics for children with chronic pain and their parents divided into groups of low and high impact chronic pain.

Variables	Low impact chronic pain N = 195 ^a	High impact chronic pain N = 289 ^a	Total N = 484 ^a
Variables related to the child			
Age			
Mean (SD)	14.0 (2.17)	14.5 (2.13)	14.3 (2.16)
Median [Min, Max]	14.0 [10.0, 18.0]	15.0 [10.0, 18.0]	15.0 [10.0, 18.0]
Sex			
Female	135 (69.2%)	214 (74.0%)	349 (72.1%)
Male	60 (30.8%)	75 (26.0%)	135 (27.9%)
Months since pain started			
Mean (SD)	47.5 (39.4)	50.4 (39.9)	50.4 (39.9)
Median [Min, Max]	36.0 [1.50, 204]	38.5 [3.00, 190]	38.5 [3.00, 190]
Missing	0 (0%)	1 (0.3%)	1 (0.3%)
Pain location			
Headache	63 (32.3%)	77 (26.6%)	140 (28.9%)
Abdominal pain	38 (19.5%)	59 (20.4%)	97 (20.0%)
Back or neck pain	23 (11.8%)	34 (11.8%)	57 (11.8%)
Musculoskeletal pain	56 (28.7%)	62 (21.5%)	118 (24.4%)
Widespread pain	15 (7.7%)	57 (19.7%)	72 (14.9%)
Number of pain locations			
One	80 (41.0%)	82 (28.4%)	162 (33.5%)
Two	30 (15.4%)	30 (10.4%)	60 (12.4%)
Three or more	85 (43.6%)	177 (61.2%)	262 (54.1%)
Depression			
Mean (SD)	16.2 (8.55)	28.4 (11.1)	23.5 (11.8)
Median [Min, Max]	15.0 [0, 46.0]	28.0 [3.00, 58.0]	22.0 [0, 58.0]
Missing	4 (2.1%)	4 (1.4%)	8 (1.7%)
Psychological Inflexibility			
Mean (SD)	42.4 (12.4)	57.4 (13.6)	51.3 (15.0)
Median [Min, Max]	41.0 [15.0, 80.0]	58.0 [15.0, 84.0]	51.0 [15.0, 84.0]
Missing	1 (0.5%)	5 (1.7%)	6 (1.2%)
Pain reactivity			
Mean (SD)	12.8 (6.94)	18.5 (7.26)	16.2 (7.67)
Median [Min, Max]	13.0 [0, 30.0]	19.0 [0, 30.0]	16.0 [0, 30.0]
Missing	0 (0%)	1 (0.3%)	1 (0.2%)
Variables related to the reporting parent			
Age			
Mean (SD)	45.9 (4.93)	45.5 (5.87)	45.7 (5.50)
Median [Min, Max]	46.0 [32.0, 59.0]	46.0 [30.0, 72.0]	46.0 [30.0, 72.0]
Missing	1 (0.5%)	6 (2.1%)	7 (1.4%)
Sex			
Female	157 (80.5%)	230 (79.6%)	387 (80.0%)
Male	37 (19.0%)	54 (18.7%)	91 (18.8%)
Missing	1 (0.5%)	5 (1.7%)	6 (1.2%)
Highest education			
High school or less	68 (34.9%)	143 (49.5%)	211 (43.6%)
College or university	125 (64.1%)	139 (48.1%)	264 (54.5%)
Missing	2 (1.0%)	7 (2.4%)	9 (1.9%)
Marital status			
Married + partnership	165 (84.6%)	223 (77.2%)	388 (80.2%)
Single/widowed	29 (14.9%)	61 (21.1%)	90 (18.6%)
Missing	1 (0.5%)	5 (1.7%)	6 (1.2%)
Employment			
Employed	169 (86.7%)	221 (76.5%)	390 (80.6%)
Not employed	25 (12.8%)	63 (21.8%)	88 (18.2%)
Missing	1 (0.5%)	5 (1.7%)	6 (1.2%)

(Continued)

TABLE 1 Continued

Variables	Low impact chronic pain <i>N</i> = 195 ^a	High impact chronic pain <i>N</i> = 289 ^a	Total <i>N</i> = 484 ^a
Chronic pain, both parents			
No	66 (33.8%)	84 (29.1%)	150 (31.0%)
Yes—one parent	75 (38.5%)	105 (36.3%)	180 (37.2%)
Yes—both parents	34 (17.4%)	76 (26.3%)	110 (22.7%)
Missing	20 (10.3%)	24 (8.3%)	44 (9.1%)
Psychological flexibility			
Mean (SD)	32.1 (10.3)	26.7 (11.6)	28.9 (11.4)
Median [Min, Max]	32.5 [5.00, 52.0]	26.0 [0, 55.0]	29.0 [0, 55.0]
Missing	13 (6.7%)	23 (8.0%)	36 (7.4%)
Pain reactivity			
Mean (SD)	16.6 (7.22)	20.3 (7.17)	18.8 (7.41)
Median [Min, Max]	17.0 [0, 30.0]	21.0 [1.00, 30.0]	19.0 [0, 30.0]
Missing	3 (1.5%)	3 (1.0%)	(1.2%)

^a*n* (%).

TABLE 2 Results for the multivariable logistic regression analysis focused on child variables associated with high impact chronic pain in children (10–18 years) in a specialized pediatric pain clinic in Sweden.

Variables	Odds ratios (95% CI)	<i>p</i> -value
Age	1.075 (0.96; 1.205)	0.212
Sex - male	1.134 (0.66; 1.961)	0.649
Pain location (reference category: headache)		0.465
Abdominal	1.175 (0.596; 2.324)	
Back or neck	1.213 (0.557; 2.664)	
Musculoskeletal	0.867 (0.459; 1.636)	
WSP	1.949 (0.808; 4.853)	
Number of pain locations (reference category: one)		0.540
Two	0.675 (0.317; 1.423)	
Three or more	0.799 (0.45; 1.408)	
Depression	1.101 (1.07; 1.134)	<0.0001
Psychological inflexibility	1.064 (1.043; 1.088)	<0.0001
Pain reactivity	0.99 (0.95; 1.031)	0.616

N = 484, α = 0.05.

CI, confidence interval; WSP, widespread pain.

children were analyzed separately from variables associated with parents. Only a few variables were significantly associated with HICP in the multivariate models. Among the child variables symptoms of depression and psychological inflexibility were significant for HICP. When analyzing variables associated with parents, pain reactivity was significantly associated with HICP.

4 Discussion

The aims of the present exploratory study were to define HICP from a wider biopsychosocial perspective and to investigate characteristics and clinical factors in children and parents as variables associated with HICP, as indicated by pain severity, pain interference, overall well-being, sleep disturbance and school absence. The major findings were that symptoms of depression and psychological inflexibility in children, as well as

TABLE 3 Results for the multivariable logistic regression analysis focused on parental variables associated with high impact chronic pain in children (10–18 years) in a specialized pediatric pain clinic in Sweden.

Variables	Odds ratios (95% CI)	<i>p</i> -value
Parental education (college or university)	0.782 (0.501; 1.219)	0.277
Marital status (living apart relationship, single, or widowed)	1.34 (0.756; 2.424)	0.322
Employment rate (not employed)	1.542 (0.83; 2.948)	0.178
Parental pain (reference category: no)		0.267
Yes—one parent	1.09 (0.672; 1.769)	
Yes—both parents	1.571 (0.892; 2.795)	
Parental psychological flexibility	0.98 (0.953; 1.007)	0.143
Parental pain reactivity	1.05 (1.009; 1.094)	0.018

N = 484, α = 0.05.

CI, confidence interval.

pain reactivity in parents were associated with HICP. Several sociodemographic and pain-related factors in children and parents differed between the groups of children with high and low impact chronic pain.

This study adds to the very few studies investigating HICP in children (4, 17, 18). Previous studies have used a limited and narrower definition of HICP, leaving out psychosocial aspects of the biopsychosocial model in their classification attempts (4, 5, 17–20). As a result, these approaches do not fully reflect the biopsychosocial principles emphasized in current international pediatric chronic pain guidelines (3, 55). Neither parental nor behavioral aspects have been included, making the present study unique, as both variables have been described as important factors for the development of chronic pain (56). Our proposed definition builds upon previous conceptualizations of HICP, integrating all components of the biopsychosocial model and encompassing the recommended mandatory and key outcome domains for pediatric chronic pain research that are relevant to baseline assessment (24). In doing so, we align with existing international guidelines while further refining the assessment of high impact chronic pain in children. This approach resonates with the biopsychosocial principles emphasized in contemporary

frameworks such as the WHO guidelines, the Lancet Child & Adolescent Health Commission, the European Pain Federation (EFIC) pain recommendations, and the IASP/ Special Interest Group (SIG) on pediatric pain statements (3, 55, 57, 58). By incorporating these perspectives, our definition not only reflects current best practice but also advances the conceptualization of HICP in pediatric populations.

Children with complex symptoms should be managed in tertiary care, a recommendation supported by our findings, as the majority (59.7%) were classified as having HICP. A similar proportion (63%) was reported in a German tertiary care study (18), which contrasts sharply with school-based studies where only 5%–10% of children were identified as having HICP, likely due to differences in population severity and assessment context. School samples represent the general population with mostly mild pain, whereas tertiary care should include the most severe and complex cases (4, 17).

All participants had experienced pain for more than three months, consistent with the International Association for the Study of Pain (IASP) definition of chronic pain. It could be hypothesized that a longer duration of pain would be associated with greater impairment in daily functioning. However, our analyses revealed no apparent difference between the HICP and LICP groups with respect to the mean duration of pain prior to assessment. These findings suggest that pain duration alone is unlikely to account for the greater impact on daily life observed among children with high impact chronic pain.

When investigating child-related variables associated with HICP, only higher levels of depressive symptoms and psychological inflexibility turned out significant. Depression is together with anxiety the most common psychiatric comorbidity in children with chronic pain (59–61) with a prevalence which is more than three times higher than in the general population (62). Previous studies have shown relations between psychiatric comorbidity and increased pain, poorer quality of life, and reduced functioning in everyday life (63–67), as well as an increased risk of continued problems into adulthood (14). This underscores the critical role of depressive symptoms in HICP and highlights the necessity of addressing mental health within pediatric chronic pain treatment, particularly in tertiary care settings (3, 62, 64, 68). One treatment strategy with proven effect for depression is Cognitive behavioral therapy (CBT). Since this treatment paradigm is the most used within chronic pain treatment, CBT strategies to specifically target depression could easily be integrated in IPR (69) or possibly used outside specialized pain care to prevent HICP (68).

As mentioned earlier, higher baseline values of psychological inflexibility (consisting of items assessing pain avoidance and cognitive fusion) were associated with HICP in this study. This finding is important for the choice of interventions in the rehabilitation of children with chronic pain. Psychological flexibility is about acting in line with one's chosen values in the presence of unwanted thoughts, emotions or bodily symptoms. While psychological flexibility promotes resilience and action, psychological inflexibility captures opposite processes such as behavioral avoidance, restriction and inactivity (51). Acceptance

and Commitment Therapy (ACT) is a treatment focusing on wellbeing and valued activity through heightened psychological flexibility (70). The findings in the present study are in agreement with earlier studies in adults with chronic pain, where psychological inflexibility has been shown to predict worse treatment outcomes (71, 72). Specific screening and intensive targeting of psychological inflexibility using treatment strategies from ACT during treatment may be beneficial for individuals with HICP.

Psychological flexibility in parents, as assessed by PPFQ, has repeatedly been found to be negatively correlated to child functioning in earlier studies (52, 54), but no significant difference was found in the present study when comparing groups of high and low impact chronic pain. This in contrast to the finding regarding psychological inflexibility in children.

When examining parent-related variables associated with HICP, only pain reactivity, specifically parental worry about the child's pain, was significant. Such parental responses may influence the child's psychological flexibility, potentially reinforcing maladaptive coping pattern (54). This finding is also consistent with the fear-avoidance model, a CBT-based framework for chronic pain with strong empirical support. The model emphasizes pain-related worry, captured in this study, as well as catastrophizing and avoidance behaviors, which have been extensively documented in adults (51, 73). This model is also applicable for children, but in such instances, it needs to be contextual and reflect the interaction between children and parents (74, 75). Parents' reactions such as catastrophizing, worrying and protective behavior with regard to the child's pain have been shown to have a negative impact on the child's reactions and to trigger avoidance behaviors in relation to pain (75–77). The findings of this study underscore the importance of interventions that address parental responses, such as pain reactivity, in the rehabilitation of children with chronic pain.

The strengths of this study include its large sample size (484 participants), the breadth of variables examined, and the inclusion of parental factors in a real-world clinical setting, as all children aged 10 years or older admitted for assessment at the SPPC were included. However, the findings should be interpreted in light of certain limitations. In accordance with the STROBE guidelines, no significance tests were performed to describe differences in characteristics between the HICP and LICP groups in Table 1.

Another limitation is the retrospective design and registry data which obviously only allow for cross-sectional and no causality analyses. While we can anticipate that the associated factors, such as symptoms of depression, greater psychological inflexibility, and/or parental pain reactivity, may contribute to an escalation in pain impact, they could equally be consequences of high pain-related interference in daily life. Although we believe these factors play a role in the maintenance of pain, this conclusion cannot be drawn from the present data. Future research is needed to investigate these relationships further.

The cut-off values used to define HICP in this study were primarily informed by prior literature. However, we acknowledge that a more robust justification is warranted. In

this exploratory study, no sensitivity analyses were conducted to test alternative thresholds. Further studies should focus on validating the selected variables and their corresponding cut-offs to strengthen reliability and generalizability.

The participants were all attending a specialized pediatric pain clinic, and the results cannot be generalized to children with chronic pain in other clinical contexts. As in most studies, the majority of parents accompanying their child to the clinic were mothers, which may have influenced findings related to parental factors and underscores the importance of including fathers in future research. Self-report data from questionnaires were used to identify symptoms of depression which is not sufficient as a diagnostic tool and self-report scales can only provide a provisional diagnosis.

The suggested core outcome set of measures for pediatric pain studies was followed as far as possible (24). However, because not all recommended questionnaires are translated and validated for children in Swedish, a few non-validated questionnaires were used, e.g., the PRS. However, it is commonly used and has been proven sufficient in capturing pain-related reactions (46, 78). The PIPS, which was used to assess psychological inflexibility in the participating children, has demonstrated acceptable validity and reliability in children and adults (47–50). Still, the representativity of the total score as a measure of all aspects of psychological (in)flexibility has been questioned in some studies (48, 79). Another limitation is the risk of bias, since the pain physician involved in the assessment was also the first author of the present study.

Given the high costs and limited availability of IPR, it is crucial to further investigate which children truly benefit from this intervention. Additionally, the subgroup classified as having LICI warrants closer examination to better understand their needs. This group may include at least two distinct subcategories: one that could benefit from support within primary care, and another that may require only clear explanations, reassurance, and self-management strategies. Gaining a better understanding could help optimize the use of resources and ensure that children are directed to the most appropriate care pathways.

In conclusion, further development of the definition of HICP is proposed using a broader biopsychosocial perspective to more fully capture the complexity of these symptoms. This study also highlights symptoms of depression and psychological inflexibility in children, as well as parental pain reactivity, as associated with HICP. These findings underscore the importance of taking psychiatric comorbidity and child and parental behavioral aspects into account when tailoring interventions for children with chronic pain. Specific assessment and targeting of depressive symptoms and psychological inflexibility in children, and pain reactivity in parents, during pain rehabilitation may improve treatment results in terms of functioning and reduce the risk of ongoing challenges into adulthood, especially in individuals with HICP.

Data availability statement

The datasets presented in this article are not readily available because the data that support the findings of this

study are not openly available due to reasons of sensitivity. Requests to access the datasets should be directed to ulla.caverius@med.lu.se.

Ethics statement

The studies involving humans were approved by the Swedish Ethical Review Authority (Etikprövningsmyndigheten) Dnr 2021-02709. The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because this study is a retrospective registry-based study covering the period 2013–2021. It was not feasible to contact all individuals included in the registry, and it was considered ethically inappropriate to approach participants several years after their rehabilitation at the clinic. Many of the children had experienced psychological distress at the time of treatment, and their current mental health status was unknown at the time of the study. All participants received written information about inclusion in the registry and the possibility of future research based on anonymized registry data, following ethical approval. Participants were given the option to decline participation in the registry and future research using the registry data, with clear instructions provided on how to opt out.

Author contributions

UC: Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Formal analysis. MR: Writing – review & editing, Conceptualization, Supervision. JL: Writing – review & editing, Conceptualization, Supervision. SÅ: Conceptualization, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

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