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Adaptation and validation of the Croatian version of the inventory of parent/caregiver responses to the children's pain experience (IRPEDNA)

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Abstract

Background Research has shown that parental behavior significantly influences children's pain experiences. The Inventory of Parent/Caregiver Responses to Children's Pain Experience (IRPEDNA) is a validated tool used to measure these reactions. Studies using the IRPEDNA have found that parental responses, shaped by cultural influences and individual perceptions, are closely linked to children's pain coping strategies and overall distress levels. The aim of this study was to translate, culturally adapt and validate the IRPEDNA for use in the Croatian language (IRPEDNA-Cro).

Methods We conducted a cross-sectional study between October and December 2012. A forward-backwards translation of the IRPEDNA from English to the Croatian language was performed according to the cross-cultural adaptation guidelines of self-report measures. The study participants were 200 parents: 100 mothers and 100 fathers from 100 families (both mother and father from the same family were included). They received IRPEDNA-Cro and Positive and Negative Affect Schedule (PANAS) questionnaires.

Results The three subscales of IRPEDNA-Cro showed good reliability: Solicitousness (α = 0.81, 95% CI 0.76 to 0.85), Discouragement (α = 0.75, 95% CI 0.68 to 0.80) and Promotion of Well Being (α = 0.75, 95% CI 0.68 to 0.80). The overall scale showed high reliability in terms of both internal consistency (α = 0.83, 95% CI 0.79 to 0.87) and in association with positive PANAS was α = 0.78 (95% CI 0.72 to 0.83), while reliability for negative PANAS scale was α = 0.87 (95% CI 0.84 to 0.90). Regression analysis showed that the Discouragement scale on IRPEDNA was the best predictor of both positive and negative affect.

Conclusion This article presents the translation and preliminary validation of a self-administered instrument designed to measure parents/caregivers' responses to children's pain behaviors in the Croatian language (IRPEDNA-Cro). The data showed that IRPEDNA-Cro provides valid and reliable information when used with Croatian-speaking adults.

Keywords Parent, Caregiver, Children, Pain, Educating parents, IRPEDNA, Validation, Croatia

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Background

Research has shown that parental behavior is associated with children's pain experiences, both in experimentally induced pain and clinical pain studies [1, 2]. For example, in relation to acute pain, it has been shown that some parents' behaviors influence children's distress during painful medical procedures [3, 4]. It is unclear how similar mothers and fathers are in their perceptions of their children's pain behaviors, as well as in their behavioral reactions [5]. However, there is mounting evidence showing that fathers and mothers react differently to their children's pain behaviors. For example, Walker and Zeman [6], examined the association between the child's age and gender, and parent's gender on their encouraging children's illness behavior in a sample of 58 school children aged 9 to 17 years. The data showed that although both parents encouraged children to adopt a sick role, it was the mothers who encouraged children's illness behavior more than fathers. The data also showed that girls and boys received different parental responses, for example, girls received more sympathy and were relieved more from responsibility during illness episodes than boys [6].

Based on the Transactional Model of Stress and Coping [7], a parent's response to a child's pain behavior (e.g., a solicitous response, such as staying at home to provide the child as much attention as possible) is influenced by the parent's appraisal of the child's condition and her or his perceived ability to cope with the problem. This appraisal not only shapes the caregiver's response but also affects their emotional state. For example, if the caregiver feels capable and effective in soothing the child's pain, positive affect (e.g., satisfaction) is more likely. However, if the caregiver feels overwhelmed or helpless, negative affect (e.g., frustration, anxiety) may result. In addition, negative affect may arise from maladaptive strategies, such as ruminating on the child's suffering or avoiding engagement, whereas positive affect may result from effective emotion regulation strategies, such as reappraising the situation as manageable or successfully implementing comforting behaviors.

Research suggests that positive affect is associated with adaptive caregiving behaviors, better emotion regulation and cognitive flexibility [8–10]. Therefore, parents with higher positive affect may feel confident in their child's ability to manage pain. Thus, one could expect a significant negative correlation with scores on the scale of "Discouragement" and a positive correlation with scores on the scale "Promotion of well-behaviors and coping". Moreover, parents with high positive affect are less likely to exhibit overprotective or excessively comforting behaviors, thus a weak negative to no correlation with scores on the "Solicitousness" scale could be hypothesized.

In contrast, negative affect is associated with increase reactivity [11, 12], leading to emotionally driven behaviors that may be more reactive, overprotective and less constructive behaviors. Therefore, one could expect a significant positive correlation with scores on both the scales of "Solicitousness" and "Discouragement" and a negative correlation with scores on the scale "Promotion of well-behaviors and coping".

In an attempt to study adults' reactions to children's pain behaviors and how those were associated with chronic pain and related disability, Huguet and colleagues developed and validated the Inventory of Parent/Caregiver Responses to the Children's Pain Experience (IRPEDNA) [13]. Based on their findings, the authors suggested that looking into separate parental reports, the extent to which fathers and mothers influenced their children's pain experience, and the impact on the children's overall adjustment (e.g. child distress, child pain coping, child pain experience), would be indicated [13].

IRPEDNA [13] is available in multiple languages (i.e., Catalan, Dutch, English, Icelandic, Spanish, and Thai) and has been instrumental in showing the importance of parental responses to children's pain. For example, In 2011, Vervoort and colleagues using the Dutch version found that mothers' and fathers' responses to their child's pain moderated the association between the child's pain catastrophizing and disability [14]. In addition, their study showed different reaction patterns for mothers and fathers; namely, higher levels of the child's catastrophizing were significantly associated with lower levels of solicitousness in fathers, and with higher levels of discouragement in mothers [14]. Kristjansdottir and colleagues used the Icelandic and Thai translations of IRPEDNA, in addition to the English version, to study cultural influences on parental responses to children's pain behaviors in Iceland, Thailand and Canada [15]. The study's findings indicated that parental pain-related reactions were informed by cultural models of parenting [15].

Esteve and colleagues [16] used the Spanish version of IRPEDNA to study the association between adults' reactions to children's pain behaviors, pain intensity as reported by children, and pain intensity as perceived by caregivers. Their findings suggest that the caregiver's and the children's psychological responses to pain are highly interrelated [16]. When parents are focused on symptoms (solicitousness) and displaying negative responses (discouragement), their children show higher distress and report higher pain intensity [13, 17–20]. In addition, there is also a version for teachers [21] showing similar robust properties as the original version.

The research briefly summarized above shows that IRPEDNA is a psychometrically robust questionnaire that provides valid and reliable information about

parents' and teachers' responses to the children's pain behavior.

Aim

The aims of this study were to (1) translate and adapt IRPEDNA for its use with Croatian-speaking adults; and (2) assess both convergent validity of IRPEDNA and reliability of the three scales when used with Croatian-speaking adults (IRPEDNA-Cro). On the basis of the findings from previous research briefly described above, we anticipated that IRPEDNA subscales would demonstrate high reliability and be predictive for positive and negative affect scales. In addition, we also wanted to explore whether demographic characteristics were associated with IRPEDNA-Cro scale scores.

Methods

Study design

This was a cross-sectional study conducted between October and December 2012.

Ethics

The study protocol was approved by the University of Split School of Medicine Ethics Committee (Klasa: 003–08/11 – 03/0005; Ur. Br. 2181-198-03-04/10-11-0039). Potential participants received a written invitation to take part in the study with detailed information about the objectives, procedure and study protocol. Those interested were asked to sign the informed consent form. The study was conducted in line with all the applicable codes and regulations.

Participants

Two hundred parents, 100 mothers and 100 fathers, from 100 families (both mother and father from the same family were included) were offered participation in the study. However, only 72 couples provided complete valid data. The data from these 144 participants were used in the analyses for this study.

The inclusion criteria for families in the field test were: participants were eligible for inclusion in the study if both the mother and father from the same family agreed to participate, were healthy, and had a child aged between 7 and 18 years who had experienced any type of acute pain within the three months preceding the study. All participants needed to be able to understand and read Croatian in order to complete the self-report questionnaires, including the IRPEDNA-Cro and PANAS. Recruitment took place in dental offices after the child's dental visit, and both parents were required to provide written informed consent for participation.

The exclusion criteria were: incomplete family participation – if only one parent agreed to participate, or data were not available for both mother and father from the same family; ineligibility of the child– if the child was younger than 7 years or older than 18 years; if the child had not experienced any acute pain within the past 3 months; if either parent had a chronic medical or psychiatric condition that could interfere with accurate self-reporting or participation; if there were language barriers, i.e. if parents were not proficient in Croatian, which would prevent understanding or proper completion of the questionnaires.

Recruitment of participants

Participants were recruited in the dental offices of three study authors (NK, IBuc, and IK); where all consecutive parents of children attending dental procedures were screened for inclusion criteria and offered participation in the study at the end of their child's visit. If only one parent accompanied the child, and she or he expressed her or his willingness to participate, that individual was asked to invite the other parent to participate in the study, as both parents from the same family were asked to participate in this study.

Description of the procedure

Participants were asked to fill out a survey including questions about demographic issues and the IRPEDNA-Cro and Positive and Negative Affect Schedule (PANAS) questionnaires.

Variables and measures

Demographic information

All participants were asked to provide information about their age, marital status, educational level, and sex of the child.

PANAS

PANAS is a self-report measure of positive and negative affect [22]. It measures two primary dimensions of mood: (1) Positive affect refers the extent to which an individual feels enthusiastic, active and alert; and (2) Negative affect indicates subjective distress and unpleasurable engagement that includes a variety of aversive mood states such as anger, contempt, disgust, guilt, fear and nervousness [22]. For the PANAS, two typical items are: "Interested" (a positive affect item), and "Irritable" (a negative affect item). With PANAS, the participants are asked to gauge their feelings in the questionnaire containing 20 items. Each item is scored with a 5-item Likert scale ranging from "1 = Very Slightly or Not at all" to "5 = Extremely", to measure the extent to which the affect has been experienced in a specified time frame [22]. Psychometric properties of the scale have been explored by Krizanic et al. [23]. In this study, Chronbach's alpha for positive PANAS was $\alpha = 0.78$ (95% CI 0.72 to 0.83), while Chronbach's

alpha for negative PANAS scale was α = 0.87 (95% CI 0.84 to 0.90).

IRPEDNA

The original study informed about a questionnaire with 37 items and three interrelated scales, including: (1) solicitousness (which measures how much individuals show empathy, concern, and supportiveness in situations related to child pain; e.g., "Stay home from work to provide him/her with as much care and attention as possible."; this scale has 15 items); (2) discouragement (which measures the degree to which individuals suppress the child's expression of pain by minimizing the pain or actively discouraging to show pain; e.g., "W*onder how he/she can complain so much.*"; this scale has 10 items); and (3) promotion of well-behaviors and coping (which measures the degree to which individuals advise child to behave proactively; e.g., "*Advise your child to relax and breathe deeply*."; this scale has 12 items). The three scales showed good internal consistency, with coefficient alphas of 0.87, 0.83, and 0.87, respectively; they also showed good criterion-related validity [13].

Translation of IRPEDNA

A forward-backward translation of IRPEDNA from English to Croatian language was performed according to the guidelines for the process of cross-cultural adaptation of self-report measures [24, 25]. The first stage in adaptation was the forward translation from English to Croatian. Two forward translations were made by translators with different profiles. The first translator was familiar with the concept being examined to provide equivalency from a more clinical and measurement perspective. The other translator was not informed of the concepts being quantified and did not have medical or clinical background. This so called naïve translator was expected to detect different meaning of the original than the first translator and to offer a translation that reflects the language used by population [26].

In the second stage a synthesis of the translations was made. The two translators and a recording observer met. Working from the English version of the questionnaire as well as the first translator's (T1) and the second translator's (T2) versions, a synthesis of these translations was first conducted (producing one common translation T-12), with a written report carefully documenting the synthesis process, each of the issues addressed and how they were resolved.

In the third stage a back translation from Croatian to English was made. Working from the T-12 version of the questionnaire, a translator totally blind to the original version was asked to translate the T-12 version back to English language. Back translation is a validity check, preventing gross inconsistencies or conceptual errors. Two translators created BT1 and BT2 back translations.

In the fourth stage an expert committee consisting of the study authors and all translators convened to consolidate all the versions of the questionnaire and develop a prefinal version of the Croatian version of IRPEDNA (IRPEDNA-Cro). The committee revised all translations and reached a consensus regarding the IRPEDNA-Cro prefinal version.

Inclusion of 40 participants was recommended in the guidelines for the process of cross-cultural adaptation of self-report measures [27]. Each participant completed the test and then was interviewed. The purpose of this cognitive debriefing exercise was to assess the clarity, appropriateness of wording and acceptability of the translated questionnaire. The outcomes of the cognitive debriefing were discussed at another expert committee meeting, where decision about the content of the final version of the IRPEDNA-Cro was made. There was not any need to adapt/change at any level any of the items.

Data analyses

To describe the sample and study variables, we first computed number and percentages (for categorical variables) and the means and standard deviations (for continuous variables) of the demographic and study variables. To test which variables were predictive of PANAS scores, we entered IRPEDNA subscales in linear regression model where in first model the predictor was positive PANAS subscale, and negative PANAS scale was criteria in second model, in order to test convergent criterion validity similarly as previous studies validating IRPEDNA. To test if demographics were predictive of IRPEDNA subscales we developed three other linear regression models, in each of them IRPEDNA subscale was a criterion. Given the study's focus on convergent validity through predictive modeling, bivariate correlations were not computed or reported. All analyses were done with JASP v.0.16.2.0 (JASP Team, 2022).

Results

Sample characteristics

Table 1 provides a summary of the characteristics of the sample or participants. In total, 72 couples provided valid data for the study. The average age of fathers was slightly higher compared to mothers, while the average children' age was around 10 years. Majority of the couples were married or living in cohabitation, and possessed university studies (Table 1). Most children were males (Table 1).

Reliability of IRPEDNA-Cro

The three subscales of IRPEDNA showed good reliability: Solicitousness (α = 0.81, 95% CI 0.76 to 0.85), Discouragement (α = 0.75, 95% CI 0.68 to 0.80) and Promotion

Table 1 Descriptive characteristics of participants included in the sample (72 couples)

Variable		$\bar{X}$(SD)
Age	Mothers	37.3 (37.3)
	Fathers	39.2 (39.2)
	Children	9.8 (2.4)
Marital status (n, %)	Married/Cohabitating	130 (90)
	Divorced	14 (9)
Educational level (n, %)	High school	63 (44)
	University degree	81 (56)
Child sex (n, %)	Male	44 (61)
	Female	28 (39)
IRPEDNA		
	Solicitousness	45.7 (7.8)
	Discouragement	11.7 (6.0)
	Promotion of Well Being	35.7 (5.9)
PANAS		
	Positive	30.8 (5.8)
	Negative	13.1 (4.3)

of Well Being (α = 0.75, 95% CI 0.68 to 0.80). The overall scale score showed also a good reliability (α = 0.83, 95% CI 0.79 to 0.87).

Convergent validity

Regression analysis showed that the Discouragement subscale on IRPEDNA was the best predictor of both positive and negative affect (Tables 2 and 3). Solicitousness and Promotion of well-being were not related with neither positive or negative affect. Moreover, Discouragement subscale was the only significant predictor even when demographics like age, marital status and education were considered (Tables 2 and 3). However, the proportion of explained variance was very low (around 2.5% for positive and around 4.5% for negative affect).

In the second step of the prediction analysis, we implemented three regression models in which we wanted to assess which personal characteristics are predictive for IRPEDNA subscale scores. For all three models, we

Table 2 Regression model of prediction of positive PANAS scale

Variable	Level	Unstandardized coefficients	Standard Error	Standardized coefficients	t	*p*	Adjusted R^2
(Intercept)		26.037	5.778		4.506	< 0.001	0.025
Solicitousness		-0.024	0.087	-0.033	-0.28	0.78	
Discouragement		0.264	0.1	0.249	2.629	0.01	
Promotion of well being		-0.066	0.118	-0.065	-0.561	0.576	
Parent	Father						
	Mother	0.446	1.086		0.411	0.682	
Age of parent (in years)		0.087	0.132	0.07	0.656	0.513	
Child sex	Male						
	Female	1.021	1.087		0.939	0.35	
Child Age (in years)		0.183	0.238	0.081	0.768	0.444	
Marital status	Married or cohabitation						
	Divorced	1.338	1.844		0.725	0.47	
Education	High school						
	University	-0.438	1.074		-0.408	0.684	

Table 3 Regression model of prediction of negative PANAS scale

Variable	Level	Unstandardized coefficients	Standard Error	Standardized coefficients	t	*p*	Adjusted R^2
(Intercept)		7.014	3.998		1.755	0.082	0.045
Solicitousness		0.064	0.06	0.127	1.075	0.285	
Discouragement		0.206	0.069	0.277	2.961	0.004	
Promotion of well being		-0.109	0.082	-0.154	-1.340	0.183	
Parent	Father						
	Mother	0.179	0.752		0.238	0.813	
Age of parent (in years)		0.085	0.091	0.099	0.931	0.354	
Child sex	Male						
	Female	-0.222	0.752		-0.295	0.769	
Child Age (in years)		0.141	0.165	0.09	0.858	0.393	
Marital status	Married or cohabitation						
	Divorced	0.759	1.276		0.595	0.553	
Education	High school						
	University	-0.285	0.743		-0.383	0.702	

Table 4 Regression model of prediction of solicitousness scale

Variable	Level	Unstandardized coefficients	Standard Error	Standardized coefficients	t	*p*	Adjusted R^2
(Intercept)		47.316	5.868		8.063	< 0.001	0.048
Parent	Father						
	Mother	1.894	1.383		1.370	0.173	
Age of parent (in years)		-0.163	0.168	-0.098	-0.968	0.335	
Child sex	Male						
	Female	2.264	1.399		1.618	0.108	
Child_Age (in years)		0.414	0.308	0.133	1.343	0.182	
Marital status	Married or cohabitation						
	Divorced	-3.561	2.318		-1.536	0.127	
Education	High school						
	University	-1.492	1.382		-1.080	0.282	

Table 5 Regression model of prediction of discouragement scale

Variable	Level	Unstandardized coefficients	Standard Error	Standardized coefficients	t	*p*	Adjusted R^2
(Intercept)		4.603	4.647		0.991	0.324	0.009
Parent	Father						
	Mother	0.979	1.047		0.934	0.352	
Age of parent (in years)		0.126	0.132	0.095	0.952	0.343	
Child sex	Male						
	Female	-0.409	1.050		-0.389	0.698	
Child_Age (in years)		0.112	0.238	0.045	0.472	0.637	
Marital status	Married or cohabitation						
	Divorced	-1.611	1.741		-0.925	0.356	
Education	High school						
	University	1.761	1.032		1.706	0.090	

Table 6 Regression model of prediction of promotion of well-being scale

Variable	Level	Unstandardized coefficients	Standard Error	Standardized coefficients	t	*p*	Adjusted R^2
(Intercept)		34.378	4.268		8.054	< 0.001	0.072
Parent	Father						
	Mother	-0.457	0.985		-0.464	0.643	
Age of parent (in years)		-0.039	0.124	-0.031	-0.317	0.752	
Child sex	Male						
	Female	-0.524	1.001		-0.524	0.601	
Child_Age (in years)		0.414	0.23	0.171	1.801	0.074	
Marital status	Married or cohabitation						
	Divorced	-5.656	1.601		-3.532	0.001	
Education	High school						
	University	-0.39	0.991		-0.393	0.695	

entered information on the parent sex, age of the parents, child sex, child age in years, marital status, educational degree.

In assessment of predictors of higher scores or IRPEDNA subscales, we entered available demographics of both children and parents in analysis and found that for Solicitousness and Discouragement were no significant predictors (Tables 4 and 5), while married parents were more likely than divorced to score higher on Promotion of Well-being subscale (Table 6). Other predictors were not predictive for IRPEDNA subscale scores.

Raw data collected within the study are available on Open Science Framework (https://osf.io/um3x2/).

Discussion

The findings in this study confirm the reliability and validity of the Croatian version of IRPEDNA. The results were consistent with the original version. At present, we are not aware of any other tools for measuring parents/

caregivers' responses to children's pain episodes in Croatian language. Thus, the translation and validation of IRPEDNA-Cro is a significant contribution to advance the study of pain in children, particularly in relation to the responses to the parents to the child's pain behaviors, a modifiable factor that has been suggested to be important in managing acute [28] and chronic pain [29, 30].

Family and parents, as an environmental context, can influence child's pain experience [31, 32]. This has been explained with the theory that child learns how to interpret and manage pain symptoms via parental modelling and operant conditioning [33–35].

In 2020, Moore and colleagues studied the effects of parental distraction during acute children's pain. They examined children's pain symptoms and parental use of verbal distraction during a cold pressor task in a community sample of 530 twin children aged 7–12 years and their primary caregivers [28]. Results indicated a positive association between parental distraction and children's pain tolerance, which was not related to intensity and unpleasantness. However, these associations were qualified by significant moderation. In families with higher socioeconomic status, parental distraction was an effective technique in children's pain management, associated with higher pain tolerance and lower pain intensity and unpleasantness. However, for families with lower socioeconomic status, these same benefits of parental distraction were not observed [28].

Miró and colleagues studied factors predictive of chronic pediatric pain and related disability in a Delphi study among professionals with a specific interest in chronic pain in children and adolescents [29]. They found that among the most important factors associated with chronic pain were parental psychological characteristics, namely parental emotional instability. For disability, high parental anxiety was identified as one of the most important factors. The authors suggested that a full picture of chronic pediatric pain and related disability needs to consider different units, including the child, the parents and the environment, as well as different levels of analysis, such as physiology, emotions, cognitions, and behaviors [29].

The authors of IRPEDNA [13] aimed to develop and instrument that could be used for learning about the interaction of adults with children in pain. It is acknowledged that some assessment instruments have been available. For example, Walker and Zeman studied the effects of child age and gender, parent gender, and type of child illness on parents' responses to their children's illness behavior, and they developed the Illness Behavior Encouragement Scale [6]. Manimala et al. made a comparison of the effects of parents' distraction versus reassurance on children's coping and distress during immunizations by using the Child-Adult Medical Procedure Interaction Scale, children's self-report of their fear, and parents' reports of their ability to help their child and of their own upset [36].

Reid et al. studied parent-child interactions during pain-inducing exercise tasks among children aged 11 to 17 years suffering from fibromyalgia, juvenile rheumatoid arthritis. Children and parents completed Functional Disability Inventory and Pain Coping Questionnaire [37]. Blount et al. assessed the influence of the immediate social environment on the child's ability to cope during painful medical procedures by using the Child-Adult Medical Procedure Interaction Scale (CAMPIS) [3].

However, those instruments were mainly focused on the effect of parents solicitously attending to signs of pain and distress of their children. Other types of reactions among adults also need to be taken into consideration because they can influence children's pain-related behavior and their ability to cope [38]. Furthermore, those instruments were developed based on parents' reactions to children suffering from chronic disabling pain issues. It needs to be acknowledged that parents will likely react/behave differently when faced with acute versus chronic pain in a child [13]. IRPEDNA was developed as a solution for these issues, to include reactions that go beyond simple solicitous attention, and to include parental reactions to both acute and chronic pain conditions of children [13].

When analyzing the correlations between the subscales of the IRPEDNA tool and the PANAS measures, 'Discouragement' emerged as a better predictor of the negative PANAS scores. This significance indicates that feelings of discouragement, possibly representing aspects such as doubt, disheartenment, or a lack of motivation, are strongly aligned with the experiences of negative affect as captured by the PANAS.

In practical terms, this finding suggests that interventions or support strategies aimed at reducing feelings of discouragement might be effective in decreasing overall negative emotional states. For example, in settings such as mental health or educational environments, focusing on building resilience, enhancing self-efficacy, and providing encouragement could mitigate the negative affective states linked with discouragement. By addressing this key predictor, practitioners can better target their efforts to improve emotional well-being and foster a more positive emotional environment.

Participants in the study did not report problems in self-completing IRPEDNA-Cro. Moreover, it was easily filled in, quickly and there were very few blank responses. There were 72% of couples who provided complete valid data. Therefore, it does seem that, like the original version, IRPEDNA-Cro was understandable, it had an adequate length, and could be self-completed. This makes

supervision by qualified personnel unnecessary, so that it is feasible in everyday clinical practice.

The adaptation, translation, and cross-cultural validation of psychometric tools are essential to ensure their reliability, validity, and cultural relevance across different populations. Psychological constructs such as pain, stress, or anxiety may be interpreted and expressed differently in various cultures, so merely translating a tool is not sufficient. The process of adaptation ensures that the tool resonates culturally, accurately capturing the experiences and perspectives of the target population. Additionally, cross-cultural validation ensures measurement invariance, meaning the tool measures the same construct consistently across different groups, allowing for fair comparisons. This is particularly important in global research contexts where tools must be applicable and comparable across countries, ensuring the findings are both accurate and globally relevant. Without proper adaptation and validation, psychometric tools may fail to measure what they intend, leading to biased or invalid results [27].

Pain-related tools are continuously developed and validated globally. A recent example is a study of Diotaiuti et al., published in 2023, which described psychometric evaluation of the Italian short version of the Fear of Pain Questionnaire-III, including psychometric properties, measurement invariance across gender, convergent, and discriminant validity. This study offers a significant example of how the psychometric evaluation of questionnaires related to fear of pain is approached [39].

Furthermore, Sole et al. evaluated the psychometric properties of the Cognitive Fusion Questionnaire (CFQ) in a sample of adolescents. Their results supported the psychometric properties of the CFQ to study the role that cognitive fusion may play in functioning among adolescents [40]. Another group has shown the reliability and validity of the 10-item version of the Children's Depression Inventory (CDI-S) in a sample of young individuals with physical disabilities [41]. Miró et al. provided additional support for the reliability and validity of the Pediatric version of the Survey of Pain Attitudes (Peds-SOPA), and suggested that children's pain attitudes and beliefs might be important intervention targets in pain treatment [30]. In a sample of children aged 6 and 8 years, maximum pain intensity was analyzed with four scales, including Visual Analogue Scale, Coloured Analogue Scale, Faces Pain Scale-Revised and Numerical Rating Scale-11. The results indicated that these four instruments measure one common factor but that they were not concordant [42].

All these studies highlight the ongoing development and validation of pain-related tools, demonstrating the importance of psychometric evaluation in assessing fear of pain, cognitive fusion, depression, and pain attitudes in various populations while also identifying measurement challenges in pediatric pain assessment.

In this study, we focused on dental pain because acute dental pain is common in childhood, and it can cause significant distress, interfering with children's daily activities. Understanding how parents or caregivers respond to this pain is critical, as their reactions may influence their children's pain perception, coping mechanisms, and emotional well-being. Therefore, studying IRPEDNA psychometric properties in this context would ensure its suitability for capturing culturally relevant parental responses to acute dental pain, thus contributing to improving pain management strategies for Croatian children and their families.

While the study is focused on a specific context of acute dental pain, its findings can be generalized to other pain contexts, both acute and potentially chronic, by considering the universality of parental influence on pain, cultural and psychological validity, and impact on emotional regulation and coping. The study confirms that parental responses, such as Solicitousness, Discouragement, and Promotion of Well-Being, influence children's emotional and behavioral responses to pain. These findings align with existing research suggesting that parental behaviors impact pain experiences across various contexts, including injuries, post-surgical pain, pain caused by medical procedures and chronic pain conditions [43–46]. The psychological mechanisms behind these influences, such as reinforcement of pain behaviors or support for coping strategies, are likely consistent across pain types [47].

The study identified the Discouragement scale as a strong predictor of both positive and negative emotional states. This relationship underscores how negative parental responses (e.g., dismissing or discouraging a child's pain expression) can contribute to greater emotional distress, regardless of the pain source. This finding is likely transferable to other contexts, such as chronic or recurring pain conditions, where emotional regulation plays a critical role in pain coping strategies [48].

Furthermore, while the study addresses acute dental pain, the patterns of parental responses measured by IRPEDNA are also relevant in chronic pain contexts. For example, Solicitousness—excessive attention to pain—has been shown in other studies to reinforce maladaptive behaviors and prolong pain experiences in chronic conditions [49]. Similarly, Promotion of Well-Being may support better coping strategies across acute and chronic pain settings.

Our findings emphasize the importance of addressing parental responses in managing pediatric pain across different clinical scenarios. Educating parents about supportive behaviors that encourage adaptive coping strategies could improve outcomes in various pain contexts. If these results were corroborated in future studies,

they underscore the importance of addressing parental affect to improve caregiving responses to children's pain. Intervention programs could be focus to enhance parental positive affect (e.g., positive reappraisal training) and reduce negative affect (e.g., cognitive-behavioral stress management) in order to improve their responses to a child's pain. Moreover, parents with high negative affect could also benefit from strategies to reframe their perceptions of their child's pain and develop more adaptive caregiving responses.

Limitations

This study has some limitations that should be taken into account when interpreting the results. First, the data came from a convenient sample of children with acute pain and their parents which limits the generalizability of the findings. Thus, aditional studies are needed to evaluate the psychometric properties of IRPEDNA-Cro in samples with different pain-related conditions (e.g., in samples of children with chronic pain). In addition, the study was cross-sectional and we were not able to evaluate test-retest reliability properties.

While this study demonstrated promising internal consistency and convergent validity for IRPEDNA-Cro, we did not perform a Confirmatory Factor Analysis (CFA) to verify the underlying factor structure of the translated version. This was due to sample size constraints and the preliminary nature of this validation. Future research using larger and more diverse samples should address this gap by conducting CFA and assessing model fit indices to confirm the structural validity of IRPEDNA-Cro.

The findings of this study contribute to the growing evidence that this questionnaire can be used across populations with different languages, and also extends support for its use in children undergoing dental procedures.

Conclusion

Despite the study's limitations, this study provides important information about a new questionnaire that can be used to improve our understanding of the pain experienced by children in Croatia. The findings suggest that the IRPEDNA-Cro scale's scores provide reliable and valid measures of parents' reactions to their children's pain behaviors.

Abbreviations

CAMPIS	Child-Adult Medical Procedure Interaction Scale
CDI-S	Children's Depression Inventory
CFA	Confirmatory Factor Analysis
CFQ	Cognitive Fusion Questionnaire
IRPEDNA-Cro	Croatian version of the Inventory of Parent/Caregiver Responses to the Children's Pain Experience
IRPEDNA	Inventory of Parent/Caregiver Responses to the Children's Pain Experience
PANAS	Positive and Negative Affect Schedule
Peds-SOPA	Pediatric version of the Survey of Pain Attitudes

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Author contributions

Study design: LP, AB, JM. Data acquisition, analysis, and interpretation: NK, IBul*, IBuc*, IK, AB, LP, JM. Writing of the first draft: LP, AB. Revising the first draft for important intellectual content: NK, IBul, IBuc, IK, AB, LP, JM. Approval of the final version, and agreeing to be accountable for the work: NK, IBul, IBuc, IK, AB, LP, JM. ***Since we have two co-authors with the same initials (Ivan Bucan and Ivan Buljan), in this Author Contribution statement, author Ivan Buljan is denoted as IBul, and Ivan Bucan as IBuc**.

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Data availability

All raw data collected within the study are available on Open Science Framework (https://osf.io/um3x2/).

Declarations

Ethics approval and consent to participate

The study protocol was approved by the University of Split School of Medicine Ethics Committee (Klasa: 003–08/11 – 03/0005; Ur. Br. 2181-198-03-04/10-11-0039). Potential participants received a written invitation to take part in the study with detailed information about the objectives, procedure and study protocol. Those interested were asked to sign the informed consent form. The study was conducted in line with all the applicable codes and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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