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Original Research Article

Changes in headache outcomes after guided website-based headache education: a pilot study with Spanish schoolchildren

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Abstract

Objective: Chronic headaches are one of the most prevalent health complaints in children and are associated with substantial impairments in daily life. Given the scarcity of specialized pediatric chronic pain treatment, educational websites delivering evidence-based information in a comprehensible, child-friendly way offer a promising alternative. In this pilot study, a single-arm intervention was conducted to investigate changes in headache outcomes following a guided, website-based pain education (*Los Cabezudos*) for Spanish schoolchildren and to explore associations with age.

Methods: From eight school classes, all children who consented were eligible to participate. $N = 210$ schoolchildren (10–14 years; $M = 11.8$, $SD = 1.2$) participated in two guided website-based headache education sessions at school. Headache knowledge, pain self-efficacy, pain intensity, and pain interference were measured before the intervention and at 1- and 2-month follow-up. Linear mixed multilevel models were used to detect the effects of time.

Results: Significant improvements were observed across all outcomes. Headache knowledge ($b = 0.20$, $p < .001$), pain self-efficacy ($b = 0.22$, $p < .001$), pain intensity (maximum: $b = -0.27$, $p = .002$; average: $b = -0.27$, $p = .001$), and pain interference ($b = -0.30$, $p = .002$) all improved significantly over time in children with recurrent headaches ($n = 26$). No significant interactions with age were found.

Conclusions: The results support the potential of a website-based educational intervention to improve key headache-related outcomes: knowledge, self-efficacy, intensity, and interference. Future randomized controlled trials are warranted to investigate the long-term effectiveness of pediatric website-based pain education.

Keywords: recurrent headaches, pediatric website, education, schoolchildren, longitudinal.

Headaches are among the most prevalent health complaints in children worldwide (Onofri et al., 2023). In Spain, one-third of schoolchildren aged 12–18 report recurrent headaches, and 11% report migraine symptoms (Torres-Ferrus et al., 2019). Many children with headaches report higher levels of disability (Torres-Ferrus et al., 2019), incur substantial school absenteeism (Könning et al., 2021), and experience higher rates of anxiety and depression (Wager et al., 2020). Headaches show high persistence, with only 24% of children with recurrent headaches experiencing remission at the 2-year follow-up (Kroener-Herwig & Carasco, 2016).

Pain education promotes a biopsychosocial perspective, enhancing children's knowledge about pain and its management, which empowers them to effectively cope with pain in their daily lives (Pate et al., 2021; Probyn et al., 2017). However, access to high-quality pain education often depends on the availability of pain-specialized healthcare professionals, and can impose substantial costs on healthcare systems (Groenewald et al., 2014). In Spain, specialized treatments for children with chronic pain are scarce (Reinoso-Barbero, 2021), and primary care lacks both specialized training and standardized treatment protocols (Miró et al., 2021).

Given these conditions, educational websites offer a cost-effective approach to pain education (de Oliveira Lima et al., 2021; Spoelman et al., 2016). Various school-based studies have found that web-based pain education can effectively increase children's knowledge about pain (Andias et al., 2018; Kisling et al., 2021; Martí et al., 2021). A recent randomized controlled trial (RCT) with German schoolchildren (Goldstein et al., 2025) found that engagement with a pediatric headache website enhanced headache-related knowledge. Among adults with chronic pain, web-based pain education has been shown to significantly improve pain-

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related outcomes including pain self-efficacy, pain intensity, and pain interference (de Oliveira Lima et al., 2021; Wilson et al., 2015). Pediatric studies, however, yield mixed results: while some studies report significant reductions in pain intensity and pain interference for children with chronic pain (Hicks et al., 2006; Kisling et al., 2021), others found descriptive but not statistically significant improvements in pain self-efficacy and pain intensity (Andias et al., 2018; Goldstein et al., 2025). Moreover, the impact of age on the effectiveness of online interventions has not been thoroughly investigated. Previous findings suggest that older children not only have higher conceptual pain knowledge (Wickering et al., 2023) but also seem to benefit more from online health programs (Hollis et al., 2017), thus older children may be more likely to respond positively to website-based pain education.

Given the high prevalence and severe consequences of headaches among Spanish children (Torres-Ferrus et al., 2019), there is a clear need for effective headache treatment options. Despite the promising potential of educational websites, to our knowledge, no pediatric website currently exists in Spain that provides information on headache and its management.

This pilot study thus aims to evaluate the potential of a newly developed headache education website in improving several headache-related outcomes in Spanish schoolchildren. Given that the website had undergone a cultural and linguistic adaptation for the Spanish context, a pilot, single-arm design was considered appropriate to explore preliminary effects before investing in larger controlled trials. Although previous RCTs support the efficacy of pain education interventions, a pilot approach was needed to evaluate the contextual fit within the Spanish school setting. Based on prior research, we hypothesize that children will show significant improvements in headache knowledge, pain self-efficacy, pain intensity, and pain interference after the headache education intervention. These outcomes are assessed at three time points. In addition, we explore whether changes in headache knowledge are associated with headache frequency. Finally, as suggested by previous findings (Hollis et al., 2017), we investigate whether improvements in outcomes are positively associated with age.

Methods

This pilot study is part of an international research project between the German Paediatric Pain Centre (Germany) and the University of Málaga (Spain), using a single-arm intervention design. No changes to the study methods, assessments, or measurements were made after pilot trial commencement. No prespecified criteria for proceeding to a definitive trial were set, and the trial was completed as planned. This pilot study was not prospectively registered. Data, syntaxes, and study material are available upon request. Reporting of this pilot trial adheres to the CONSORT extension for pilot and feasibility trials (see Appendix S1 for the completed checklist).

Ethics

The study was conducted in accordance with the Declaration of Helsinki. In line with standard procedure, caregivers granted their consent to the school director at the beginning of the school year, permitting their children to take part in research studies approved by the school. All caregivers were provided with comprehensive study information with the option to withdraw their consent. Children were informed that their participation was voluntary and that they could withdraw at any time. Participants were not compensated for their participation. The ethics committee of experimentation of the University of Málaga approved the project on February 27, 2024 (approval number: CEUMA 211/2023).

Participants

Participants were recruited between April and June 2024, during the regular school year, at a primary and secondary school in Málaga, Spain. Schoolchildren from the last 2 years of primary school and the first 2 years of secondary school (US grades 5–8) were eligible to participate. Schoolchildren were derived from a general sample, so no history of headaches (e.g., medical diagnoses, past or current treatment) was known before the study start. Headache history information was collected at baseline. To determine the required sample size, we conducted a power simulation for multilevel analyses. Assuming a minimum intraclass correlation coefficient (ICC) of .10 (Zhang & Wang, 2017), an alpha of .05, and using 1000 replications to ensure stable results (*R* package *mlmpower*; Keller, 2023), we estimated the necessary number of participants. Informed by prior longitudinal research conducted in schools, we anticipated approximately 5% randomly missing data at follow-ups (Goldstein et al., 2025). To achieve 90% statistical power for detecting a fixed effect of time across three measurement points, a sample size of $n = 50$ was required to detect an effect explaining 6.5% of the within-person variance. This corresponds to small to moderate effect sizes (R^2 = .01–.06; Lovakov and Agadullina, 2021), consistent with findings from previous web-based education studies targeting pain intensity and interference (De Oliveira Lima et al., 2021). Based on the finding that approximately one-third of the Spanish schoolchildren population report recurrent headaches (Torres-Ferrus et al., 2019), we required $N = 150$ participants. To account for an estimated participation rate of 69% reported in a comparable school-based study (Wager et al., 2020), the target sample size was increased to $N = 200$.

In total, $N = 222$ children from eight classes consented and thus were eligible to participate in the study. No additional inclusion or exclusion criteria were applied beyond consent and classroom membership. Participants who were absent at the baseline assessment (T0; $n = 12$) could still participate in the website-based headache education sessions; however, they were excluded from data analyses. The analyzed sample consisted of $N = 210$ participants (10–14 years old; $M = 11.8$, $SD = 1.2$). The sample sizes at the 1-month (T1) and 2-month (T2) follow-up assessments were $N = 192$ and $N = 146$, respectively (see Figure 1).

Procedure

The study included three measurement points and two guided website-based headache education sessions (see Figure 2). Follow-up assessments were conducted 1 month (T1) and 2 months (T2) after the baseline assessment (T0). All participants completed the baseline assessment immediately before the first headache education session. The electronic data assessments were programmed using *REDCap* (Harris et al., 2009). T0 and T1 were completed at school on computers, while T2 was completed voluntarily at home. This procedure

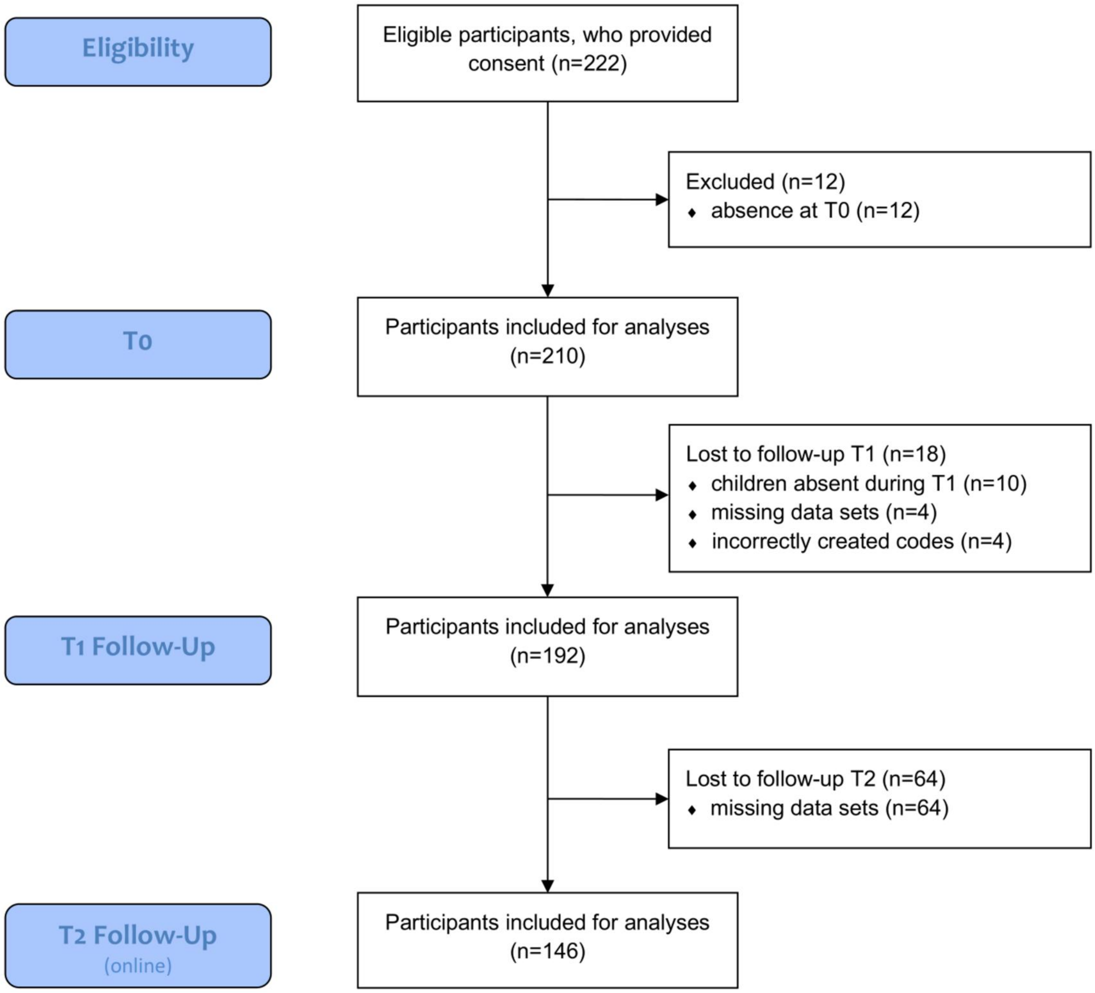

Figure 1. Participation flowchart. *Note.* Assessments took place at three stages: Baseline (T0), 1-month follow-up (T1), and 2-month follow-up (T2). Lost to follow-up values are calculated relative to baseline (T0). *N* = number of participants with available datasets per assessment.

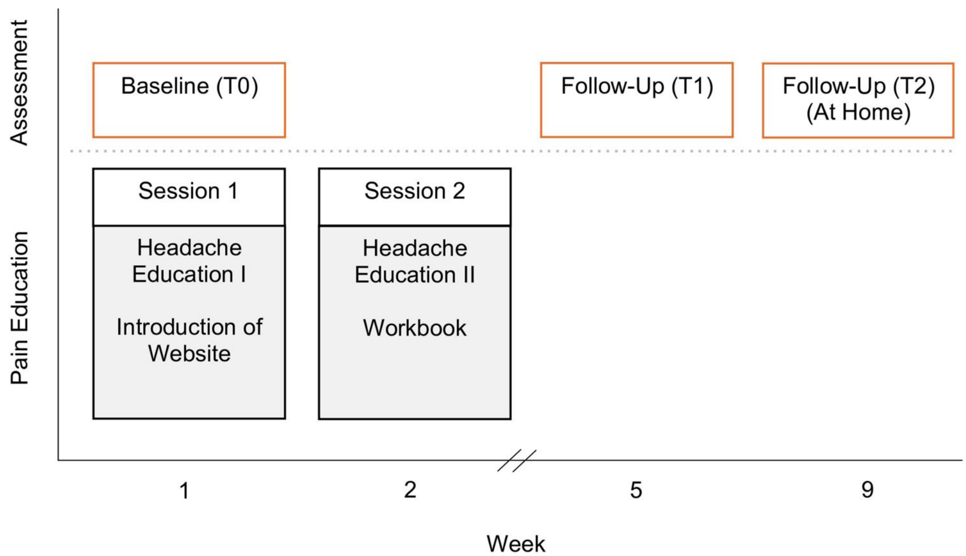

Figure 2. Assessments and headache education sessions. *Note.* Assessments are shown on the top line; headache education sessions in appear on the bottom line. The time sequence of events within a session is ordered from top to bottom.

was implemented to examine the feasibility of online data collection in Spanish schools and to compare participation rates with those of school-based assessments. All school education sessions were scheduled during periods that, according to the curriculum, are reserved for transversal activities and educational projects. Each session lasted 55 min, with each assessment taking 25–35 min.

Guided website-based headache education intervention

The website (www.los-cabezudos.com) delivers evidence-based information on the two most prevalent types of primary headaches, tension-type headache and migraine (Onofri et al., 2023). It provides an overview of the origin, course, and symptoms of headaches and offers practical tips on prevention and alleviation. Additionally, it introduces modulating factors such as movement, relaxation, and sleep. Website content is conveyed in a child-friendly way, including playful elements such as videos, quizzes, and self-checks, as well as oral and visual instructions for relaxation techniques. The Spanish website was launched at the beginning of the study, ensuring that participants had no prior exposure to it. The website was translated into Spanish from the original German website, as well as its translated English version (English: www.headeggs.org; German: www.meine-kopfsache.com). The software DeepL (2024) was used for the initial translation, which was meticulously reviewed by a bilingual team of psychologists specialized in chronic pain. The name of the Spanish website, *Los Cabezudos*, was chosen by the research team at the University of Málaga and pretested for comprehensibility with six Spanish children aged 11–17 ($M = 13.8$ years, $SD = 2.0$ years).

Researchers guided the website-based education sessions in class. Prior to the intervention, the researchers received standardized training to ensure consistent implementation across classes. During the first education session (see Figure 2), participants were introduced to the educational website and watched an educational video explaining the most common types of headaches. One week later, during the second education session, participants explored the website by completing an interactive workbook designed to complement the website's content. The workbook included engaging, age-appropriate questions that guided participants through the various sections and videos in a playful manner (see www.los-cabezudos.com/wp-content/uploads/GYMKHANA.pdf). To answer the questions, participants had to independently navigate the website and watch the relevant videos. Throughout the data collection period, the website remained accessible to all study participants.

Measures

All survey questions were mandatory. Participation was pseudonymized, assigning each participant a unique code comprising (1) the first two numbers of their date of birth, (2) the last letter of their first name, (3) the number of siblings, and (4) the first letter of their first surname. This code allowed data from different surveys to be linked. Demographic information such as age, gender, and class was collected to describe the sample.

Headache knowledge

We assessed headache knowledge using the 12-item Headache Knowledge Questionnaire, originally developed and validated through item response theory analyses (e.g., satisfactory item fit statistics: $a < 6$, $b = -3.49$ to 3.40, $g < .08$) in a German website-based headache education study (Goldstein et al., 2025). The headache knowledge questionnaire was translated into Spanish using a forward-backward approach (Tsang et al., 2017). Four bilingual translators from Germany and Spain conducted the forward translation of the questionnaire with the assistance of DeepL (2024). The backward translation was performed using the Vasco Translator V4 electronic translation device (Vasco Electronics, 2022). Item response theory analyses confirmed that the Spanish version retained comparable psychometric properties and item parameters to the original German version (see Appendix S2). The 12 single-choice items span five headache-related categories: global headache knowledge, tension-type headaches, migraine, headache management, and headache prevention. Each question includes four possible options, of which one is correct (e.g., "What helps with tension-type headaches? 1. Medication and rest, 2. Sleeping a lot and eating lots of fruit, 3. Movement/Exercise and distraction, 4. Concentrating on the pain and wishing really hard for it to go away."). Correct answers were coded as 1; incorrect answers were coded as 0. All items were summed to a total score (range: 0–12). The Spanish translation of the Headache Knowledge Questionnaire is available in Appendix S3.

Pain self-efficacy

Pain self-efficacy is defined as the confidence in one's ability to successfully manage pain (Stahlschmidt et al., 2019). To measure pain self-efficacy, participants completed the Pain Self-Efficacy Questionnaire (PSEQ; Nicholas, 2007). The Catalan version of the PSEQ has been validated in a pediatric sample in Spain (Castarlenas et al., 2020), demonstrating excellent reliability and good convergent and divergent validity. For this study, the bilingual authors provided a Spanish translation of the validated Catalan PSEQ. Participants indicated their confidence in being able to function when having pain (e.g., "I can still do many of the things I enjoy doing, such as hobbies or leisure activities, despite pain") on a 7-point scale ranging from 0 = *not confident at all* to 6 = *completely confident*. Item scores were summed to a total score (range: 0–60), with higher scores reflecting greater pain self-efficacy. Internal consistency was excellent across all assessments (T0: Cronbach's $\alpha = .92$; T1: Cronbach's $\alpha = .95$; T2: Cronbach's $\alpha = .94$).

Pain intensity

Participants were asked to rate their maximum and average headache intensity over the past 4 weeks using the 11-point numeric rating scale (NRS-11), which has been validated with Spanish schoolchildren (Miró et al., 2009). This measure demonstrates sound psychometric properties, including convergent, discriminant, and predictive validity (Miró et al., 2009). Responses ranged from 0 = *no pain* to 10 = *the worst pain imaginable*.

Pain interference

Pain interference describes the degree to which pain impairs participation in physical, social, and leisure activities (Palermo et al., 2021). We assessed this using the short form of the Spanish PROMIS Pediatric Pain Interference Questionnaire 8a (Ceniza-Bordallo et al., 2022), which consists of eight items (e.g., "I had trouble doing schoolwork when I had pain") rated on a 5-point scale (1 = *never* to 5 = *almost always*). Total sum scores ranged from 8 to 40, with higher scores indicating greater pain interference. This questionnaire exhibits strong internal consistency and convergent validity (Ceniza-Bordallo et al., 2022); in this study, the internal consistency was good (Cronbach's α = .77–.78 across assessments).

Headache and pain characteristics

Participants reported their headache frequency, location, onset, and frequency. Pain location was assessed using a checklist where children could indicate their different pain locations. Pain prevalence was reported for both the past 3 months and the past 4 weeks. Recurrent headaches were defined as occurring: (1) at least once a week, (2) for 3 months or longer, and (3) within the past 4 weeks (Wager et al., 2020). Children with headaches who did not meet these criteria were considered to have non-recurrent headaches.

Data analysis

Statistical analyses were conducted using R (v4.2.2; R Core Team, 2022), utilizing RStudio (Posit Team, 2023). Participants who were absent at T0 but attended subsequent sessions were excluded from the analyses. However, partially completed questionnaires were included if data were available for at least one outcome. Attrition between the in-school assessments at T0 and T1 was 8.6%, primarily due to illness-related absences and mismatched questionnaires. As the T2 assessment was done at home on a voluntary basis, it had a lower participation rate (69.5%) (see Figure 1). Missingness analyses showed that attrition was significantly associated with age and classroom, with older children being less likely to participate. No associations with primary outcome variables were observed. Missing data at follow-up assessments were addressed using linear mixed-effects multilevel models, which preserve estimate accuracy, efficiency, and reduce bias in longitudinal studies (Black et al., 2011). To the authors' knowledge, no harm, adverse events, or other unintended consequences occurred during the pilot trial. Multilevel models were used to investigate changes in headache-related outcomes across measurement points for each outcome, with observations nested within participants. The primary model included time as a fixed effect and a random intercept for each participant. Time was integrated as a continuous variable to investigate main effects, and as a categorical variable in post hoc analyses to explore pairwise differences between measurement points. Analyses of pain self-efficacy, pain intensity, and pain interference were limited to participants who met the criteria for recurrent headache at T0.

An autocorrelated covariance structure was applied to account for the longitudinal nature of the data. Model assumptions of normal distribution and homoscedasticity were examined using visual inspection of residual versus fitted values and quantile–quantile (Q–Q) plots. Violations of normality and heteroscedasticity, particularly in the knowledge analyses, led to the application of the Satterthwaite correction. Accordingly, standardized coefficients and robust standard errors are reported. Coefficients were estimated using restricted maximum likelihood, which, along with the Satterthwaite correction, has been shown to yield the least biased estimates in mixed linear models, particularly with small sample sizes (Luke, 2017). ICCs for headache-related outcomes ranged from 0.44 to 0.60, supporting the use of multilevel models. A Wald *t*-distribution approximation was used to compute the uncertainty intervals (equal-tailed) and two-tailed *p*-values. Statistical significance was defined as $p < .05$, and effect sizes were interpreted using Cohen's *d*, with values of 0.15, 0.36, and 0.65 representing small, medium, and large effects, respectively (Lovakov & Agadullina, 2021).

Further exploratory analyses examined changes in participants' knowledge based on headache frequency. Participants with *no* headaches at baseline (reference category) were compared to participants with *non-recurrent* and *recurrent* headaches, focusing on outcome trajectories (time × frequency interaction).

Additional analyses included mean-centered age and its interaction terms as predictors in each multilevel model to explore whether age moderated the association between time and outcome measures.

Results

Descriptive statistics

Out of the total sample ($N = 210$), 160 participants (76.2%) reported experiencing pain in the past three months. Headaches were the most commonly reported pain type, experienced by 139 participants (66.2%). In accordance with the criteria defined above, 26 participants (12.4%) were classified as having recurrent headaches. For further details on demographic and pain characteristics, see Table 1.

Analyses of time trajectories

For an overview of all parameters of outcome variables, see Table 2 and Figure 3. Results from the post hoc analyses are provided in Supplementary Table S1.

Headache knowledge

Multilevel models for headache knowledge included all participants ($N = 210$). A significant effect of time emerged ($p < .001$, $d = 0.65$), indicating participants had higher knowledge scores following the headache education. At T0, participants answered an average of 6 out of 12 questions correctly ($M = 5.6$, $SD = 2.1$). Performance improved to an average of seven correct answers at both follow-up assessments (T1: $M = 7.0$, $SD = 2.9$; T2: $M = 7.0$, $SD = 3.0$). When time was included as a categorical predictor, significant increases were observed between T0 and the follow-up assessments.

In exploratory analyses, we examined whether headache frequency (non-recurrent or recurrent) was associated with changes in headache knowledge, using children with no headaches as the reference group. Participants with recurrent headaches had higher knowledge scores across assessments than participants without headaches (p = .007). However, children with non-recurrent headaches and children without headaches did not differ significantly (p = .086). No significant time × frequency interaction emerged (non-recurrent

Table 1. Sample characteristics at T0.

Variables	All participants		Non-recurrent headache		Recurrent headache	
	N = 210 *N* (%)/*M* (*SD*)		*n* = 113 *N* (%)/*M* (*SD*)		*n* = 26 *N* (%)/*M* (*SD*)	
Age (10–14 years)	11.8	(1.2)	11.8	(1.2)	11.6	(0.9)
Gender						
Girl	96	(45.7%)	57	(50.4%)	16	(61.5%)
Boy	108	(51.4%)	53	(46.9%)	10	(38.5%)
Non-binary	6	(2.9%)	3	(2.7%)	0	(0.0%)
Headache onset						
<3 months			56	(49.6%)	—	—
3–6 months			23	(20.4%)	10	(38.5%)
6–12 months			6	(5.3%)	4	(15.4%)
1–2 years			9	(8.0%)	2	(7.7%)
>2 years			19	(16.8%)	10	(38.5%)
Headache frequency						
Once a month or less			52	(46.0%)	—	—
Several times per month			44	(38.9%)	—	—
Once a week			7	(6.2%)	9	(34.6%)
Several times per week			6	(5.3%)	12	(46.2%)
Once a day			1	(0.9%)	2	(7.7%)
Several times per day			1	(0.9%)	3	(11.5%)
All the time			2	(1.8%)	0	(0.0%)

Note. Recurrent headaches are defined as occurring at least once per week for 3 months or longer and at least once in the past 4 weeks. Non-recurrent headaches refer to those not meeting these criteria.

Table 2. Results of multilevel models for headache outcomes.

Outcome	*n*	ICC	Coefficient (SE)		Standardized coefficient (RSE)		95% CI	*t*	*df*	*p*	*d*
Headache knowledge[a]	208	0.45	0.68	(0.12)	0.20	(0.12)	0.13 to 0.27	5.83	325	**<.001**	0.65
Pain self-efficacy[b]	26	0.60	4.06	(1.14)	0.22	(2.15)	0.09 to 0.34	3.57	43	**<.001**	1.09
Maximum pain intensity[b]	26	0.48	−1.03	(0.32)	−0.27	(0.33)	−0.43 to −0.10	−3.23	43	**.002**	−0.99
Average pain intensity[b]	26	0.50	−0.95	(0.27)	−0.27	(0.28)	−0.43 to −0.12	−3.48	43	**.001**	−1.06
Pain interference[b]	26	0.44	−2.91	(0.90)	−0.30	(0.95)	−0.49 to −0.11	−3.25	43	**.002**	−0.99

Note. Ratings were collected at baseline (T0), 1-month (T1), and 2-month (T2) follow-up assessments. Restricted maximum likelihood estimation (REML), Satterthwaite approximation, and robust standard errors were implemented via the R packages *nlme, parameters*, and *clubSandwich*. An autocorrelated covariance structure was employed. CI = confidence interval; *n* = number of participants with complete data per variable; *RSE* = robust standard errors; *SE* = standard error.
[a] Analyses include all participants ($n = 210$).
[b] Analyses include only participants with recurrent headaches ($n = 26$).
$p < .05$ are set in bold.

headaches: $p = .651$; recurrent headaches: $p = .869$), suggesting that the gains in knowledge over time were similar across groups regardless of baseline headache frequency.

Pain self-efficacy

The linear multilevel models for pain self-efficacy included only participants with recurrent headaches ($n = 26$). The effect of time on pain self-efficacy was significant ($p < .001$, $d = 1.09$), indicating that participants improved in pain self-efficacy over time (T0: $M = 24.3$, $SD = 13.9$; T1: $M = 26.2$, $SD = 14.4$; T2: $M = 32.9$, $SD = 16.0$). Post hoc comparisons showed that the change from T0 to T2 was statistically significant ($p < .001$, $d = 1.13$), but the change from T0 to T1 was not ($p = .521$, $d = 0.20$).

Pain intensity

Pain intensity analyses were restricted to participants with recurrent headaches ($n = 26$). Regarding maximum pain intensity, the effect of time was statistically significant ($p = .002$, $d = -0.99$). Participants reported lower maximum pain intensity from T0 ($M = 6.5$, $SD = 2.0$) to the T2 assessment ($M = 4.5$, $SD = 3.8$; $p = .001$, $d = -1.06$). Changes were not significant between T0 and T1 (T1: $M = 6.2$, $SD = 3.2$; $p = .625$, $d = -0.15$).

For average pain intensity, the effect of time was also significant ($p = .001$, $d = -1.06$). Specifically, participants with recurrent headaches reported lower average pain intensity at T2 ($M = 3.5$, $SD = 3.3$) compared to baseline ($M = 5.5$, $SD = 2.1$; $p = .001$, $d = -1.08$). The reduction in average pain intensity from T0 to T1 (T1: $M = 4.7$, $SD = 2.7$) was not statistically significant ($p = .183$, $d = -0.42$).

Pain interference

In the multilevel models for pain interference, only participants with recurrent headaches ($n = 26$) were included. A statistically significant effect of time on pain interference emerged ($p = .002$, $d = -0.99$). Post hoc analyses indicated that participants reported less headache disability at T1 ($M = 20.8$, $SD = 7.5$) and T2 ($M = 18.7$, $SD = 9.7$) compared to T0 ($M = 24.0$, $SD = 5.5$). Changes between all measurement points were significant.

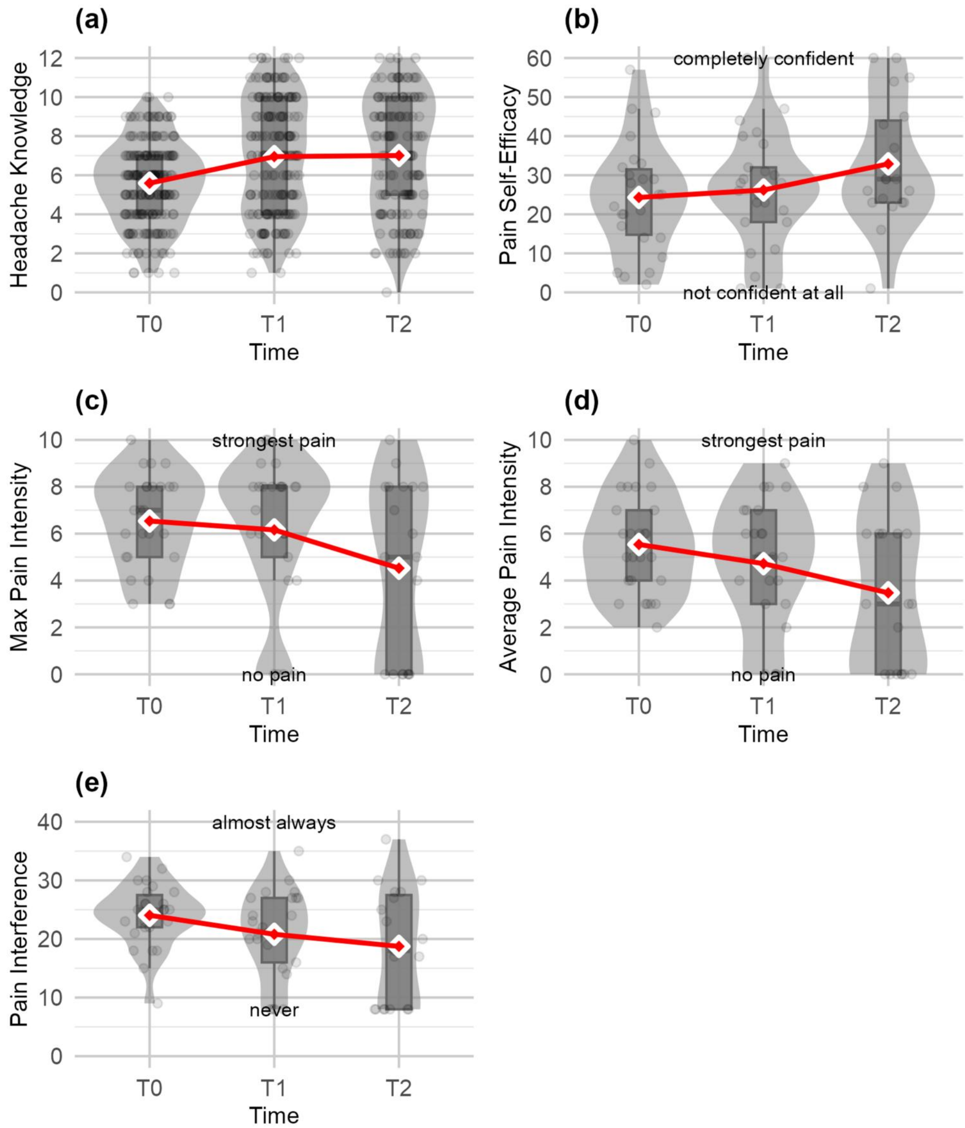

Figure 3. Violin and box plots for headache-related outcomes over time. *Note*. Violin and box plots illustrate the distribution, spread, means, and trendlines for each outcome across the three assessments (T0 = baseline, T1 = 1-month follow-up, T2 = 2-month follow-up). Means are indicated with diamonds and connected by atrendline. Dots represent individual participant values. (A) Violin and boxplot headache knowledge scores for all participants ($N = 210$). (B)–(E) The respective violin plots for pain self-efficacy, maximum and average pain intensities, and pain interference. Only participants with recurrent headaches are included ($n = 26$).

Interaction with age

To assess whether age influenced outcome trajectories, we included mean-centered age and its interaction with time (time × age) in each multilevel model. The main effects of time remained significant across models. No significant interactions between time and age emerged for headache knowledge ($p = .182$), pain self-efficacy ($p = .393$), pain intensity (maximum: $p = .352$; average: $p = .834$), or pain interference ($p = .172$). These results suggest that improvements following headache education were consistent across age groups. For an overview of all coefficients related to main effects and interactions, see Supplementary Table S2.

Discussion

The goal of this pilot study was to examine changes in headache-related outcomes following a guided, website-based headache education in Spanish schoolchildren. We hypothesized that all headache-related outcomes would improve over the three measurement points. In line with our hypotheses, all participants with and without headaches showed significant gains in headache knowledge after the headache education. Furthermore, children with recurrent headaches demonstrated marked improvements in pain self-efficacy, pain intensity, and pain interference at the follow-up assessments compared to baseline. At the 1-month follow-up, significant improvements were observed in headache knowledge and pain interference only, whereas by the 2-month follow-up, all outcomes had significantly improved. No interactions between age and outcome changes were observed. Given the pilot nature of the study and the small sample sizes, results should be interpreted with caution.

Receiving headache education was positively associated with increased headache knowledge at both measurement points, with a large effect size and consistent improvements across age groups. This finding aligns with previous research suggesting that web-based pain education effectively increases knowledge (Goldstein et al., 2025; Martí et al., 2021). In this study, children with recurrent headaches showed significantly greater knowledge across measurement points, a pattern identified also in prior studies (Kisling et al., 2021). This may indicate that children with recurrent headaches may have had more prior exposure to headache-related information at baseline. Exploratory analyses suggested that knowledge gains were similar across participants, regardless of headache frequency, demonstrating the broad applicability of the pediatric website.

Other outcomes, such as pain self-efficacy, pain intensity, and pain interference, also improved significantly over time, with large effect sizes. Notably, improvements in pain self-efficacy and pain intensity did not emerge until the 2-month follow-up (T2). This delayed effect is consistent with research suggesting that interventional improvements in a child's functioning typically precede noticeable reductions in pain (Zeltzer & Schlank, 2009). Similarly, self-efficacy is believed to increase through mastery experiences and repeated behavioral adaptations over time (Jackson et al., 2014). The natural progression of these underlying mechanisms may explain the delay in observed improvements.

The improvements in pain-related outcomes align with adult studies showing that web-based pain education can significantly reduce chronic pain intensity (de Oliveira Lima et al., 2021) and improve self-efficacy through multicomponent interventions (e.g. education, psychotherapy, exercise; Martinez-Calderon et al., 2020). Other studies have observed reductions in pain intensity and pain-related disability comparable to those achieved through internet-based cognitive behavioral therapy (de Oliveira Lima et al., 2021; Law et al., 2015).

Finally, age-related interactions were not observed. Given the relatively young and homogenous sample (age: 10–14 years; $M = 11.8$, $SD = 1.2$), it is possible that this sample was too uniform to detect age-related effects, thus its generalizability is limited. Nevertheless, the non-significant results suggest that children within this age group similarly reported improvements in headache-related outcomes after the website-based education regardless of age. Future studies should also include older children to increase generalizability.

However, existing pediatric research has yielded inconsistent findings, often reporting only descriptive, non-significant improvements in pain-related outcomes (Andias et al., 2018; Goldstein et al., 2025; Kisling et al., 2021) or the superiority of other established therapies, such as CBT (Powers et al., 2013). This inconsistency may result from the variability in format, duration, and frequency of pain education programs (Rezende et al., 2024). While adult web-based pain education interventions often last 4–26 weeks (de Oliveira Lima et al., 2021), pediatric interventions are often shorter and school-based (Andias et al., 2018; Kisling et al., 2021). However, preliminary results on internet-based CBT interventions show that interventions over a course of 8 weeks have shown to reduce the number of headache days, pain intensity, and activity limitations (Law et al., 2015). The variability in pediatric studies complicates the assessment of overall effectiveness. Given the limited number of pediatric studies, future research should examine longer, more intensive interventions with larger sample sizes.

A possible explanation for the improvements in pain-related outcomes after the guided website-based pain education detected in our study could be that, in addition to providing educational content, the website also imparts active headache management strategies. What remains unclear, however, is how gains in knowledge translate into health behavior change (Feil et al., 2023). According to the Integrated Theory of Health Behavior Change, knowledge improves self-regulation skills, subsequently enhancing self-management behaviors and improving symptoms (Ryan, 2009). Pain knowledge has been inversely correlated with pain intensity (Lee et al., 2016) and pain interference (Pate et al., 2021), and recent work has shown that the positive impact of knowledge on pain intensity may be fully mediated by engagement in dysfunctional behavior (Kisling et al., 2021). Another study found that web-based headache education led to decreased reliance on passive coping strategies, such as medication use or resting (Goldstein et al., 2025), which are associated with greater pain-related disability (Blyth et al., 2005). Consequently, one possibility could be that the observed improvements in pain interference and pain intensity in our study may be attributed to children applying the website's active headache management strategies (e.g., distraction, movement). Due to the small subsample of children with recurrent headaches, mediation analyses could not be conducted. Future research should explore how these variables interrelate.

Implications and outlook

The improvements in headache knowledge and the pain-related outcomes highlight the potential of web-based education tools for pediatric pain management. In this study, approximately 66% of schoolchildren reported headaches in the past 3 months, and one in eight experienced recurrent headaches. Taking into account that recurrent headaches show high persistence (Kroener-Herwig & Carasco, 2016), there is a clear demand for accessible education and specialized care. No specialized pediatric treatment centers for chronic pain or evidence-based online resources exist in Spain; *Los Cabezudos* is the first Spanish-language website providing evidence-based information on pediatric headaches. Primary healthcare providers could incorporate this website into consultations, thereby optimizing limited clinical time while supporting families in managing headache-related issues more effectively. Additionally, the website offers prevention tips and strategies suitable for children with and without headaches. Our results demonstrated that children improved their headache knowledge regardless of age or headache frequency. Comparable results from an RCT in New Zealand showed that early education was associated with fewer primary occurrences of lower back pain (Hill & Keating, 2015), highlighting the preventive potential of such interventions. Implementing headache education in schools could help reduce the risk for recurrent headaches, particularly by reaching children of diverse ages and backgrounds (Torres-Ferrus et al., 2019).

Strengths and limitations

This study is the first to evaluate a pediatric headache education website in a Spanish school sample. Despite small subsamples, significant improvements were observed across all outcomes, highlighting the website's value in pediatric pain management and addressing a critical gap in specialized pain treatment in Spain. However, the following limitations should be considered when interpreting the results. First, due to its pilot single-arm intervention design, causal inferences cannot be drawn; alternative explanations such as regression to the mean or spontaneous remission cannot be ruled out. During the intervention, the website, videos, and in-school guided pain education were delivered together. Future studies could randomize these components to participating classes to disentangle their individual effects. Second, modulating variables such as individual engagement with the website were not tracked, and usage likely varied across participants. Also, no parallel or past headache treatments (e.g., psychological therapy, medication management) were recorded, which could have also potentially influenced the changes in headache-related outcomes. Third, subsample power calculations were based on $n = 50$ schoolchildren; instead, only 26 children reported experiencing recurrent headaches. This relatively low prevalence could be explained by the young age range of participants (10–14 years), since headache prevalence increases with the course of adolescence (Abu-Arafeh et al., 2010). This small subsample renders subgroup analyses underpowered, overestimates effect sizes, and limits generalizability, warranting a cautious interpretation. Additionally, attrition was associated with age, indicating that follow-up participation was not completely random, which may limit generalizability and highlights the need for tailored retention strategies for older children in future studies. Fourth, the Spanish translations of the Headache Knowledge Questionnaire and the PSEQ have not been independently validated, potentially limiting the reliability of these findings. Finally, the education intervention was delivered in a state-subsidized private school, which may not reflect the broader population due to differences in digital literacy and sociodemographic background (Escardíbul & Villarroya, 2009). The children's high computer proficiency in this context may have facilitated the successful implementation of the intervention. Future studies should include various school types (public, state-subsidized, private) to assess the generalizability of outcomes in a more diverse sample (e.g., age, sociodemographic background) and should investigate the modulating role of engagement and treatment factors.

Conclusion

This pilot study demonstrated the potential of implementing website-based headache education in a school setting and explored its association with headache-related outcomes among Spanish schoolchildren. This is the first study in Spain to implement pediatric headache education in a school using a dedicated website. Significant improvements were observed in headache knowledge, pain self-efficacy, pain intensity, and pain interference, underscoring the suitability of educational websites for both headache prevention and management. As no age-related differences emerged, the website seems useful for children aged 10 and older. Given its pilot nature, future RCTs should evaluate its effectiveness in larger, more diverse samples of different age groups and explore the mediators and mechanisms underlying the observed effects.

Supplementary material

Supplementary material is available online at *Journal of Pediatric Psychology* (http://jpepsy.oxfordjournals.org/).

Author contributions

Antonia Dörnemann (Conceptualization [equal], Data curation [lead], Formal analysis [supporting], Investigation [lead], Methodology [equal], Resources [equal], Writing—original draft [lead], Writing—review & editing [equal]), Adrián F. Gonzalez (Conceptualization [equal], Investigation [supporting], Methodology [equal], Resources [equal], Writing—review & editing [equal]), Rocío de la Vega (Conceptualization [equal], Methodology [equal], Project administration [equal], Resources [equal], Writing—review & editing [equal]), Lisa-Marie Rau (Conceptualization [equal], Data curation [supporting], Formal analysis [supporting], Methodology [equal], Writing—review & editing [equal]), Elena R. Serrano-Ibáñez (Conceptualization [equal], Resources [equal], Writing—review & editing [equal]), and Julia Wager (Conceptualization [equal], Methodology [equal], Project administration [equal], Writing—review & editing [equal])

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