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Can a brief Pain Neuroscience Education Lecture Influence Middle School Student's Beliefs about Pain Medication? A Pilot Study

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ABSTRACT

Beliefs regarding pain drive pain experiences, including attitudes and beliefs regarding treatment options. The purpose of this study was to determine if a brief, one-time pain neuroscience education (PNE) lecture to middle school students can alter their beliefs regarding pain and pain medication. Two hundred and sixty-three middle school students attended a 30-minute PNE lecture. Prior to and immediately following the lecture measurements regarding pain beliefs and pain medication were completed. Pain beliefs were measured with an adapted Health Care Provider's Pain and Impairment Relationship Scale (HC-PAIRS) and pain medication beliefs were measured using the Beliefs about Medicines Questionnaire (BMQ). Immediately following the lecture, all pain beliefs shifted positively, with two reaching significance - "You can control how much pain you feel" ($p < 0.001$) and "Your brain decides if you feel pain, not your tissues" ($p < 0.001$). Three pain medication beliefs shifted post-PNE, with students agreeing more with "People who take pain medicines should stop their treatment for a while every now and again" ($p = 0.002$) and "All pain medicines are poisons" ($p = 0.027$), whereas they disagreed more with "Most pain medicines are addictive" ($p = 0.015$). This study concluded that a one-time PNE lecture to middle school students positively influences student beliefs regarding pain, as well as some shifts in their beliefs about the use of pain medication. This is the first study to explore if a lecture on pain can alter beliefs in middle school children regarding pain medication. More research is needed to determine if these changes remain intact over time and can be replicated in other student populations.

Keywords

Pain Neuroscience, Education, Middle School Children, Beliefs, Pain Medication.

Introduction

Chronic pain is at epidemic proportions, with epidemiological data suggesting anywhere between one in three to one in five people in the world are affected by it [1,2]. Chronic pain is associated with significant suffering and disability for patients and economic challenges for healthcare systems, countries, and the global economy [3,4]. As data steadily emerges from underdeveloped and under-reported regions of the world, chronic pain is a global issue, affecting all cultures, ethnic groups, age groups, genders, socioeconomic groups, and more. In the United States (US), chronic pain additionally led to the now well-documented opioid crisis [5]. With increased awareness and political pressure, the opioid crisis plateaued for a short period, only to find it accelerating again amid and following the SARS-CoV-2 pandemic [6,7].

To date, very few interventions have shown any meaningful impact on either the chronic pain epidemic or the opioid crisis [8]. Large amounts of resources have been utilized to direct interventions towards those affected by, or presenting with, chronic pain with or without opioid dependence. This approach is

needed to ensure sufferers receive care for their afflictions and ease their burden. However, on a preventative level, strategies should also be developed and implemented when it comes to chronic pain [9]. It is well-documented that a human pain experience is powerfully affected by a person's beliefs, be it a belief regarding the underlying cause of pain, treatment options, diagnostic labels, imaging findings, and more [1,10]. In the biomedical model, for example, it is believed that the underlying health of a person's tissues correlates to the intensity and duration of a pain experience [11]. In this model, if a person experiences pain, there must be some underlying issues with the health of a person's tissues and conversely, if unhealthy tissues are found upon examination, pain is expected [11,12]. Modern pain science research, focusing on increased sensitization of the central and peripheral nervous system, neuroplastic changes in the nervous system and brain, alterations in neurotransmitters and ion channel expression, etc., have proven pain to be more complex than just the health of one's tissues [1]. More importantly, biomedical models often fuel powerful beliefs when it comes to tests and treatments [10,13]. For example, if pain is experienced, a battery of tests must ensure searching for answers, and treatments must be sought to ease the pain, often focusing heavily on medication, injections, and surgery to target the underlying unhealthy tissues [10,13].

In contrast to the biomedical model, the biopsychosocial model was proposed nearly 40-plus years ago to not only deemphasize the heavy tissue focus of the biomedical model but also to include the various psychological and social factors that drive a human pain experience [14,15]. Psychologically, fear and fear-avoidance, pain and pain catastrophizing, depression, anxiety, and more have been shown to impact pain powerfully [10,13]. Additionally, various social factors related to work, society, culture, relationships, etc., also impact a pain experience [16]. To this effect, strategies aimed at reducing fear or fear-avoidance, catastrophizing, etc. have not only been shown to impact pain powerfully, but also shift beliefs regarding pain [16]. One such strategy is pain neuroscience education (PNE), which teaches patients more about the underlying neurobiology and neurophysiology of their pain experience and, in essence, deemphasizes tissue health as the sole reason for pain, especially chronic pain [16,17]. To date, various systematic reviews and metanalyses have shown PNE to significantly decrease self-reported pain, disability, fear-avoidance, pain catastrophizing, limited movement, and healthcare utilization [18-20]. Regarding the opioid and chronic pain epidemic, recent research showed that middle school students taught modern pain science increase their knowledge of pain, develop healthier (biopsychosocial) beliefs about pain, decrease catastrophizing, decrease pain medication use during the school year and positively impact participation in sports, physical education, recess, and school attendance [9,21]. Upstream approaches such as these are needed to impact future generations when it comes to pain [22]. Even though these behavioral changes seen in middle school students after pain lectures are encouraging, it has never been tested to see if these pain lectures directly impact students' beliefs regarding pain medication [9,21]. This study aimed to see if a brief, one-time pain lecture delivered to middle school kids could change their beliefs regarding pain medication.

Materials and Methods

Participants and Recruitment

To align with the objectives of this study and the findings from previous middle school PNE research, approval was secured from a middle school to carry out the research. The school selected was chosen for convenience, as it provided easy access for the primary investigator. Institutional Review Board (IRB) approval was granted by the University of South Dakota (IRB-19-149). School administrators were informed of the study's objectives, provided with an outline, and given examples of the proposed lecture and outcome measures. After receiving approval, teachers were briefed on the study's purpose and familiarized with the plan for the 45-minute session (comprising 30 minutes of PNE and 15 minutes for data collection), which was incorporated into their class schedules. Parents were notified about the study and asked to give their consent on behalf of their children. Participation was voluntary. The PNE lecture took place in each assigned classroom, with class sizes averaging around 30 students. The primary aim was to present the PNE material to a representative group of 6th grade students [23]. The only exclusions applied were students who chose not to participate, those whose parents declined consent, or those who were not proficient in reading and writing English, as assessed by the teacher.

Intervention

The content of PNE is extensively documented and aligns with other middle school studies [9,22,23]. Given the brief class duration, a condensed 30-minute, 32-slide PowerPoint™ presentation was created, ensuring enough time for students to complete surveys before and after the PNE lecture. The presentation focused on key themes such as peripheral sensitization, central sensitization, bio-psycho-social factors related to pain, the brain's threat appraisal, nociception, stress and endocrine responses to pain, and various therapeutic endogenous pain-relief strategies. To effectively communicate PNE to the students, the presentation included a range of images, metaphors, and examples. After the primary investigator's formal presentation and the completion of the post-PNE surveys, students were encouraged to ask questions. The presentation did not directly address or target any specific questions from the outcome measures.

Outcome Measures

Before completing the formal outcome measures, students filled out a demographic survey that gathered information on their age, gender, grade, and involvement in sports. The survey also asked about various personal aspects related to pain, including whether they were currently experiencing pain, their past pain experiences, and whether any family members had persistent pain. No personally identifiable information was collected, and the pages were coded to allow for matching pre- and post-education surveys. Two outcome measures were used to assess the students' attitudes and beliefs about chronic pain, as well as their views on pain medication:

Pain Beliefs: The attitudes and beliefs of healthcare providers regarding chronic low back pain are often assessed using the

Health Care Provider's Pain and Impairment Relationship Scale (HC-PAIRS) [24,25]. In earlier middle school PNE studies, this scale was modified to measure students' beliefs about chronic pain [9,22,23]. The scale uses a numeric rating system, ranging from 0 (strongly disagree) to 10 (strongly agree). Five questions were designed to ensure surveys could be completed before and after the PNE session within the given time frame. The belief statements were as follows:

- Pain is normal; without being able to feel pain you will not survive
- Pain means something is wrong with your tissues
- Pain always means you must stop what you are doing
- You can control how much pain you feel
- Your brain decides if you feel pain, not your tissues

(Pain) Medicine Beliefs: The Beliefs about Medicines Questionnaire (BMQ) was developed to measure patients' beliefs about their medicines [26]. The BMQ comprises two sections, which has been validated for use in various chronic conditions [27-29]. The BMQ-Specific assesses representations of medication prescribed for personal use and the BMQ-General assesses beliefs about medicines in general. To align with the aims of this study, the second section (beliefs about medicines) was used. The BMQ has been adapted to various patient populations, and in this study, medicine statements were clarified to refer specifically to "pain" medication versus medication in general. Respondents indicate their degree of agreement with each individual statement about medicines on a five-point Likert scale, ranging from 1=strongly agree to 5=strongly disagree. Scores obtained for the individual items within each scale are summed up to give a total score. Higher scores indicate a stronger disagreement with the statement regarding pain medication, whereas lower scores indicate more agreement with the statement regarding pain medication. The eight statements were:

- Doctors use too many pain medicines
- People who take pain medicines should stop their treatment for a while every now and again
- Most pain medicines are addictive
- Natural remedies are safer than pain medicines
- Pain medicines do more harm than good
- All pain medicines are poisons
- Doctors place too much trust in pain medicines
- If doctors had more time with patients, they would prescribe fewer pain medicines

Given that the BMQ has not specifically been used in a middle school study, teachers were on hand to explain the questions to students.

Both the pain beliefs and pain medication beliefs surveys were administered before and after the PNE lecture. To avoid influencing answers to the outcome measures, any questions that arose during the completion of these forms were addressed by the attending teachers and not the presenter of the PNE. Upon completion of the surveys, the surveys were placed into envelopes, sealed, and sent to an independent research assistant who entered the data into an Excel document for analysis.

Statistical Analysis

The results of the study were evaluated using SPSS (version 22.0, IBM Corporation). Descriptive statistics of means, standard deviations, and percentages were reported on student group characteristics. Within-group repeated measures and between-group analyses for pain beliefs and pain medication beliefs were done using a two-way mixed ANOVA on complete-case analysis. The level of significance was set at $p<0.05$.

Results

Students

Two hundred and sixty-three students attended the PNE lectures (Table 1).

Table 1: Demographics.

Variable	Result
Age - years (Mean and SD)	13.3 (0.46)
Gender: – Male (%) – Female (%)	 147 (55.9) 116 (44.1)
Currently experiencing pain (%)	93 (35.4)
Have experienced pain > 3 months (%)	66 (25.1)
Know someone personally with chronic pain (%)	214 (81.3)

Pain Beliefs

Table 2 shows the various pain beliefs prior to and following the PNE lecture. All beliefs shifted positively following the PNE lecture, but only two reached significance - "You can control how much pain you feel" ($p < 0.001$) and "Your brain decides if you feel pain, not your tissues" ($p < 0.001$).

Pain belief	Before PNE	After PNE	Significance
Pain is normal; without being able to feel pain you will not survive	6.66	7.02	0.16
Pain means something is wrong with your tissues	4.53	4.06	0.052
Pain always means you must stop what you are doing	2.83	3.04	0.351
You can control how much pain you feel	3.69	5.65	<0.001*
Your brain decides if you feel pain, not your tissues	5.48	7.93	<0.001*

Pain Medication Beliefs

Figure 1 showcases the before and after PNE pain medication beliefs with $p \leq 0.05$ indicating a significant difference. Following the PNE lecture, students agreed more with:

- Doctors use too many pain medicines ($p = 0.053$)
- People who take pain medicines should stop their treatment for a while every now and again ($p = 0.002$)
- Natural remedies are safer than pain medicines ($p = 0.145$)
- Pain medicines do more harm than good ($p = 0.143$)
- All pain medicines are poisons ($p = 0.027$)
- Doctors place too much trust in pain medicines ($p = 0.584$)

Following the PNE lecture, students disagreed more with two

statements regarding pain medication:

- Most pain medicines are addictive (p = 0.015)
- If doctors had more time with patients, they would prescribe fewer pain medicines (p = 0.654)

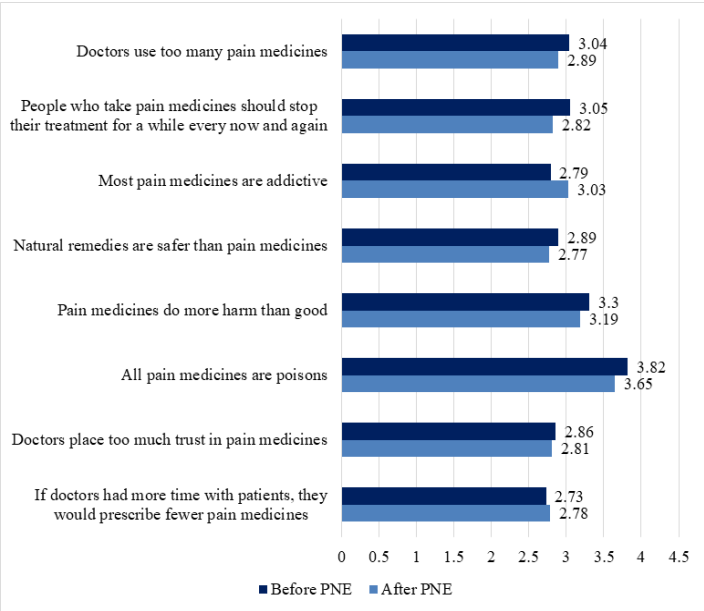

Figure 1: Before and after PNE scores for the pain medicine beliefs.

Discussion

The result from this study shows that a one-time lecture on the neuroscience of pain to middle school students positively influences student beliefs regarding pain, as well as some small shifts in their beliefs about the use of pain medication. This is the first study to explore if a lecture on pain can alter beliefs in middle school children regarding pain medication.

In this study, only three of the eight beliefs regarding pain medication shifted significantly. This may indicate that there may be some ability to shift beliefs regarding pain medication with a pain science lecture versus any specific and direct education regarding pain medication. This is troubling since the US Centers for Disease Control and Prevention reported in January 2023 that drug overdose deaths among adolescents aged 10–19 years increased by 109% between July–December 2019 and the same months in 2021 [30]. The current study showed that students, following the PNE lecture did agree with stopping the use of pain medicine for a while and even agreeing more that pain medications may be poisons, indicating a relative understanding or belief as to the potential harm of taking pain medication. This is a good initial shift and likely a potential building block for future studies since it mirrors smoking cessation studies [31,32]. In smoking cessation studies, the dangers of prolonged use of nicotine form a foundational part of the educational strategy, which removes ambivalence towards smoking [31,32]. Ambivalence is a key part of the precontemplation phase of behavior change, which does not drive behavior change [33]. In this study, students clearly showed a shift towards a negative view of pain medication use, which may, in turn, foster decreased use of pain medication over time. This assumption concurs with a previous PNE study, which showed that middle school children who are taught PNE use 30% less pain medication during a school year [21]. What is truly intriguing about this finding is that it's been shown that youth's beliefs that drug use is wrong may be the largest factor to shift behavior when it comes to drug use [30], more so than any identified school or family issues. Targeting beliefs would thus seem key when it comes to building a pain education program for middle school students to alter the potential path of adult-opioid use. A recent systematic review evaluating substance abuse prevention programs showed a large gap when it comes to current programs used, outcome measured, etc., underscoring the current gap in this area of study [34]. In this study, students disagreed more after the PNE lecture that pain medicines are addictive. This is contrary to the current research. This finding, again, is not unexpected since the lecture did not discuss or mention specifically how medicine works, their effects and their harm. This result would imply that future design of pain curriculums for children focusing on pain medication should ensure it includes not only the dangers of the prolonged use of pain medication but also the addictive nature of these medications, especially narcotics. For example, it's been reported that approximately one in seven patients who are given a narcotic for 8 days will still be using the opioid one year after starting it, whereas 30% of patients who use a narcotic for thirty-one days will still be using it one year later [35].

The result of this study shows that a brief, one-time educational session on pain neuroscience shifts middle school students' beliefs regarding pain. This result concurs with previous middle school PNE studies [9,22,23]. Intriguingly, this study showed that two statements shifted significantly – "you can control how much pain you feel" and "your brain decides if you feel pain, not your tissues," which aligns with the same results in the previous studies. By strengthening the belief that one can control one's own pain experience, it facilitates self-efficacy, which has been shown to powerfully drive pain behaviors [10]. Self-efficacy is tied to decreased healthcare utilization, decreased fear-avoidance and pain catastrophizing – all key elements in behavior change [10,33]. Classic fear-avoidance research has shown that decreased threat appraisal leads to better recovery during and following a pain experience [10,13]. The second significant belief shift that pain is an experience by the brain versus tissues allows students to deemphasize tissues as the sole factor in a pain experience. It can thus be argued that students shift away from a biomedical viewpoint of pain, which is in line with current pain literacy education [1]. The biomedical model has been tied to increased utilization of imaging, diagnostic tests, surgery, injections, and pain medications, and by shifting this belief, it may in fact also be tied to the shifts observed in this study regarding the use of pain medications [1,12,16].

This study contains various limitations. First, this is a simple pre- and post-education study with no control subjects or long-term outcomes. Second, and very important, is that the BMQ was not adapted for this population and is open to interpretation

and explanation by the teachers of the students in the study occasionally. Future studies should adapt, test, and validate a BMQ for children to measure their beliefs regarding medication. Third, in this study, we did not correlate pain beliefs with pain medication beliefs. Future studies should explore whether changing certain pain beliefs can alter medication beliefs. Finally, the results from this study can only be applied to this sample, and additional research is needed to see if these results can be replicated in other student populations with different age, gender, ethnic, language, geographic locations, etc.

Conclusion

A one-time lecture on the neuroscience of pain to middle school students positively influences student beliefs regarding pain, as well as some small shifts in their beliefs about the use of pain medication. This is the first study to explore if a lecture on pain can alter beliefs in middle school children regarding pain medication. More research is needed to determine if these changes remain intact over time and can be replicated in other student populations.

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