

Behavioral Treatment of Migraine in Children and Adolescents

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Abstract

Behavioral interventions, particularly biofeedback and relaxation therapy, have demonstrated their effectiveness in the treatment of both adults and older children with migraine in controlled trials. The physiological basis for their effectiveness is unclear, but data from one trial suggest that levels of plasma β -endorphin can be altered by relaxation and biofeedback therapies. The data supporting the effectiveness of behavioral therapies are less clear-cut in children than in adults, but that is also true for the data supporting medical treatment. This is due in part to methodological issues, especially the lack of a specific test for migraine, which has hampered research and helped lead to an inappropriate de-emphasis on care for childhood headache. In addition, migraine headaches in children are often briefer and have a higher rate of spontaneous remission than those experienced by adults, making it difficult to separate effective from ineffective treatments.

While it is widely believed that stress is a major factor in childhood migraine, well-designed studies have had difficulty developing data to support this viewpoint. Many clinicians utilize 'confident reassurance', reassuring the family that the child is not seriously ill, in the belief that having migraine headaches can be stressful. They also modify behaviors that are believed to trigger migraine headaches, such as poor sleep habits or irregular meal times.

Relaxation therapies use techniques such as progressive relaxation, self-hypnosis, and guided imagery. Several studies have found relaxation therapies to be as effective, or more effective, in reducing the frequency of migraine headaches than modest doses of a β -blockade medication, although one study found relaxation therapy to be no more effective than a control program. Several studies have demonstrated that these therapies can be taught to children in a low cost but effective manner.

Biofeedback therapies commonly use an apparatus to demonstrate a physiological effect. Most commonly in pediatrics, children are taught to raise the temperature of one of their fingers. This can be done with or without a thermometer. Several groups have shown that these techniques can be taught to children and that their use is associated with fewer and briefer migraine headaches.

People who experience migraines can also experience episodic headaches throughout life. An important consideration is preparing children to deal with future headaches, allowing them to feel in control of their health. Behavioral therapies have the potential to do this, giving the child access to a technique that can be easily resumed without a medical visit or prescription.

Children with migraine can experience episodic, severe headaches for much of their lives. When treating these children, the achievement of short-term pain relief with prompt return to school and play is certainly important. Another goal, one that can be easily overlooked, is equipping the child to deal with future headaches. Behavioral therapies have the potential to provide both short- and long-term benefit – to give the child immediate access to effective therapies that will be easily resumed with any subsequent headache resurgence. This article discusses the behavioral treatment of migraine in children and adolescents, in-

cluding the methodological problems that can hamper efficacy studies, the roles of stress and stress management, evidence supporting various behavioral interventions, and suggestions regarding future research.

Childhood migraine has received less emphasis than other chronic disorders of childhood, such as asthma or epilepsy. Nevertheless, this is not a trivial disorder. Numerous studies have shown that episodic headaches are relatively common in childhood,^[1,2] and additionally, that these headaches can result in significant functional disability, as measured by missed school

days.^[3] There is also evidence that these headaches may result in curtailed social activities and place children at risk of developing associated psychopathology.^[4]

1. Methodological Issues

The lack of emphasis on pediatric migraine reflects multiple factors. Most important is the lack of a diagnostic laboratory test. The diagnosis of migraine requires the fulfillment of a variety of clinical criteria, yet there is no consensus on the clinical criteria necessary for diagnosing pediatric migraine. This issue has been resolved in adult headache by the use of the International Headache Society (IHS) criteria.^[5] There is controversy over whether these criteria are sufficiently sensitive to childhood migraine. Many pediatric specialists argue for a pediatric modification.^[6,7] The Pediatric Headache Committee of the American Association for the Study of Headache has proposed a pediatric classification for children <12 years of age that alters the diagnostic criteria.^[8] The pediatric criteria allow for a headache of shorter duration (minimum of 1 hour as opposed to 2 hours), and for a bifrontal or bitemporal location as opposed to a strictly unilateral location. Either photophobia or phonophobia would also be counted as a symptom; both together would not be required as they are now. In the hands of experienced clinicians this revision improved the sensitivity of diagnosis from 66 to 93% when used in pediatric headache clinics.^[8]

The lack of accepted diagnostic criteria and the lack of a sensitive and specific test impedes research.^[9] Many of the reported studies include children with more than one type of headache or without a clear delineation of their headache diagnosis. An additional factor is the apparent inability (or perhaps reluctance) of some children to report or fully describe headaches. As a result, some groups of non-migrainous control individuals may well include patients who actually have migraine;^[9] thus, many studies probably contain heterogeneous samples. It is well known that the inclusion of participants without the specific disorder of interest impedes the discovery of risk factors and is likely to mask the effects of treatment. The reader should keep this in mind even though this review is based upon studies in which the investigators endeavored to separate migraine from other headaches. Also favored, are studies which endeavor to examine a representative population and to evaluate proposed therapies in a randomized, controlled trial.^[4,10,11]

2. Stress and the Occurrence of Migraine Headaches

While it is widely believed that stress is a major precipitator of childhood migraine, it has been difficult to demonstrate that

this is actually true. Many of the studies that have examined the relationships between stress and headache in school children have not differentiated between migraine and other headaches.^[12,13] Even when headache type is well-defined, the exact role of general environmental stress, school stresses or home-related stresses in causing children to develop migraine remains unclear.^[14,15] If stress does aggravate pediatric migraine, does it mean that children with migraine headaches live in more stressful circumstances, are they more susceptible to common and widely experienced childhood stressors, or is it a combination of the two?^[16] In addition, there is little evidence to show that when relaxation or stress reduction therapies appear to be effective they directly ameliorate specific stressors.^[14]

An interesting population based study of children with headache compared children with and without migraine, and specifically examined the influence of general environmental stress.^[17] Studying predisposing and provoking factors in migraine headache, the authors compared 513 children whose headaches fulfilled the IHS criteria for migraine^[5] with 460 children whose headaches did not fit these criteria and thus were considered non-migrainous. The strongest difference between the groups in a stepwise logistic analysis was the occurrence of family paroxysmal headaches in the migraine group [odds ratio (OR) 3.4, 95% confidence interval (CI) 1.6 to 7.0], suggesting that the authors' criteria successfully separated the youngsters with and without migraine. The only positive finding was that children with migraine were found to be more likely to live in an unhappy family (OR 3.0, 95% CI 1.5 to 6.1). Neither school stress (measured through fear of failure at school), or environmental stress (measured as occurrence of chronic disease in a family member), had a significant association with migraine. The study did not include a headache-free group for comparison.

Analyzing epidemiological surveys of children entering school, this same group of investigators found a longitudinal increase in reported headache.^[2] School physicians questioned 2169 parents in 1974, and 1533 parents in 1992. They found the overall prevalence of headache in students starting school to have increased from 14.4 to 51.5% between 1974 and 1992, with the prevalence of migraine increasing from 1.9 to 5.7% between the two surveys. Postulating that this increase in headache reflected an increasingly stressful environment, the authors looked at indicators of environmental stress in the 1974 and 1992 populations. They were able to demonstrate that more children with than without migraine lived in lower socio-economic neighborhoods, but the difference was not statistically significant. They could not find other evidence of increased societal stress and could not prove their hypothesis that the increase in headache and migraine prevalence was due to an increase in social stress.

A previous study by this group^[18] examined stressors in three groups of children: those with migraine (by IHS criteria), those with non-migraine headaches, and those without headaches. This was a population of 3580 children aged 8 and 9 years. Data were obtained by questionnaire. For the preceding 6 months, 63% reported no headaches, 27% reported non-migraine headaches, and 3% had migraine headaches. The only statistically significant difference was found when comparing girls with migraine to girls without headache. There was a significantly higher rate of reported stress at school among the girls with migraine. This was not true for boys with migraine. There was no difference between boys or girls with migraine and children without headache in reported bullying or poor peer relationships. This is all by self-report. The school situation (special supervision, special classes) was not significantly different, nor did children with migraine have more difficulty in reading, writing, mathematics or sports.

Other studies have suggested that school-related problems may provoke migraine headaches but many of these studies have design limitations. For example, one study that found children with headache to be under significantly more psychological distress than control individuals^[19] only included patients who had requested psychological help. In another,^[20] a group of children referred for the treatment of recurrent migraine were found to exhibit an increased number of problems with psychological adjustment. It was unclear whether the psychological problems were the cause of, or the effect of their headaches.^[12,20] On the other hand, when 39 children who fulfilled specific pediatric migraine criteria were compared with their best friends,^[16] those with migraine were neither more anxious nor did they have more stressful life events than their friends. The only positive finding was that children with greater self-reported anxiety subsequently had more severe headaches (as revealed by prospectively completed headache diaries).

3. Stress Management

Though it has been difficult to demonstrate a relationship between stress and migraine, in clinical practice, it is often assumed that such a relationship exists. Certainly, many children with migraine are concerned that they may have a life-threatening illness.^[21] Many practitioners believe that 'confident reassurance', reassuring children and their parents that no serious illness is causing the child's migraine headaches, leads to amelioration of the headache.^[22] It is recommended that this reassurance be combined with an explanation of the cause of the headache, a plan of treatment, and an optimistic prognostic prediction.^[23] Though this therapeutic approach has not been systematically studied, it is widely used.^[23,24] The belief that such reassurance is effica-

cious reflects the common experiences of many clinicians. Nevertheless, it is difficult to know whether this is an effective therapy or simply reflects the natural history of childhood migraine with a high rate of remission.^[25]

Stress reduction or cognitive therapy tries to teach patients to deal with the affective component of headache,^[26] in contrast to relaxation and biofeedback, which focus on self-regulation of physiological responses. With cognitive therapy there is an emphasis on dealing with the stresses that could trigger a headache, the stress and anxiety that comes from experiencing a headache, and on limiting the behavioral consequences of experiencing repeated headaches. Stress reduction is practiced in its simplest form as 'confident reassurance'.

A widely used technique in stress management is to have the child (or for a young child, the parents) keep a daily log (or diary) of headaches, stressors, and headache-associated activities to look for circumstances which seem related to headaches.^[22,27] Initially, the diary is reviewed with a counselor to help the child and parents obtain insight into the child's life style and to modify what are perceived as adverse behaviors. After several sessions these activities are turned over to the family.

Many of the studies involving biofeedback and relaxation also have a stress management component since this form of therapy is widely viewed as valuable. In one trial where stress management was independently evaluated, it proved to be effective. Fifty-one children aged between 9 and 18 years, with physician diagnosed migraine, were divided into three groups: (i) relaxation training; (ii) cognitive coping ('thinking straight'^[28,29]); and (iii) a control group. Both the relaxation and cognitive coping groups had significant improvement in overall headache activity and frequency (but not in duration or intensity) when compared with the control group. This difference was significant at the end of treatment and at a 16-week follow-up. There were no significant differences in outcomes between the two treatment groups.^[30]

4. Behavioral Triggers of Migraine

It is widely believed that certain behaviors can trigger migraine headache. A corollary to this is the belief that avoiding these behaviors can decrease or prevent migraine headaches.^[23] The target behaviors include missing sleep or meals, exposure to bright lights or odors, over activity or sleeping too much, and eating specific foods.^[31-33] There are few data from pediatric studies, although it is common for children, as it is with adults, to describe the association between these behaviors and the occurrence of migraine headaches.^[34] Most data are anecdotal and have not always been substantiated by controlled tests of dietary manipulation^[35] or dietary challenge.^[36] While the observations

may be correct, it is unclear if these behaviors cause migraine or are associated problems.^[36-38] It is common for pediatric practitioners to suggest the avoidance of these behaviors.^[39,40] In the one pediatric study,^[39] children aged between 5 and 15 years (mean age 10.6 years) with migraine and poor sleep behaviour (bedtime later than 11pm, wake-up later than 8am, daytime napping, irregular sleep schedule, consumption of caffeine-containing drinks close to bedtime) were divided into control and intervention groups. The intervention consisted of instruction on how to improve sleep hygiene with weekly reminders. The intervention group improved in sleep behaviour and had fewer and briefer headaches, although headache severity was unchanged.^[25,41,42]

5. Relaxation Therapies

There is a body of related therapies that can be grouped together under the term 'relaxation therapies'.^[42] They do not employ feedback apparatus and have conceptual and practical similarities with an emphasis on progressive relaxation. Some of these therapies involve progressive relaxation while others involve guided imagery and are related to self-hypnosis. The child is instructed in age-appropriate techniques that can be used to abort or ameliorate a headache.^[43] Daily practice is often encouraged as a preventative technique. There is a large body of literature examining the effectiveness of these treatments in children with headache, but most of these studies include children with poorly defined or several different types of headaches. Overall, this literature indicates that these techniques are effective.^[4]

One carefully designed study compared propranolol, a standard medication of demonstrated efficacy,^[44-46] with self-hypnosis.^[47] All 28 patients aged between 6 and 12 years had migraine with aura, as diagnosed by a child neurologist. In a randomized, double-blind, placebo-controlled single crossover design, children were treated with propranolol (3 mg/kg/day) or placebo for 3 months and then switched to the other treatment. At the end of 6 months of propranolol and placebo the children were taught a standard progressive relaxation exercise and subsequently also learned to focus on a pleasant image. They used this technique for 3 months. The mean number of headaches for each 3-month period was 13.3 for placebo, 14.9 for propranolol, and 5.8 for self-hypnosis. This difference in headache frequency between self-hypnosis and other therapies was significant ($p = 0.045$). There was no difference in headache intensity. A criticism of such a study where the behavioral treatment comes last is that the apparent beneficial effect of self-hypnosis could simply reflect spontaneous remission of the migraine over time.^[25] Unfortunately, using behavioral therapy in a routine crossover study design can also be difficult. It is not possible to guarantee that a child will not use these

techniques once they have been taught, even though the child may be switched into a medicine-only arm of the study.

Another study compared progressive relaxation, cephalic vasomotor feedback and metoprolol (β -blocker) medical therapy.^[48] The cephalic vasomotor training utilized a photoplethysmograph on the temporal artery to measure the amplitude of each pulse. This was aided by visual imagery. Children were trained to decrease the amplitude of the temporal artery pulse. Both psychological therapies were combined with instruction in stress management. All 43 children, aged between 8 and 16 years, had migraine by IHS criteria, and utilized a headache diary. Metoprolol was begun at one-half dose for 1 week and then increased to a single daily dose of 50mg for children <40kg, and 100mg for the others. When measured by a headache index (frequency multiplied by an intensity score), relaxation therapy was found to be the most effective, vasomotor feedback was intermediate and metoprolol was the least effective therapy. The only statistically significant difference using the overall headache index was between relaxation therapy and metoprolol for children with a 50% or better reduction in the headache index. There was a significant decrease in headache frequency and duration for both behavioral therapies when these factors were examined independently, but only relaxation significantly reduced intensity. There was no control group.

In another randomized, controlled trial, 87 adolescent children (aged between 11 and 18 years), all of whom were diagnosed with migraine by a child neurologist, were divided into a control group and two treatment groups.^[41] One treatment group was taught relaxation therapy techniques and coping strategies in the clinic by a therapist. A second treatment group learned the same techniques by home study using audio cassette tapes. The control group received information about headache triggers and brainstorming techniques they could use to help themselves develop techniques to deal with stress. Each group was either seen in the clinic or contacted by telephone weekly for 8 weeks. As measured by 3 months of four times daily recording in headache diaries, the self-administered and clinic instruction groups showed similar reductions in headache frequency and were significantly improved compared with the control group. The improvement was maintained at 1-, 3- and 12-month follow-ups. The high cost, high intensity relaxation training appeared no better than the home study course. The authors have published the details of their home training system.^[49,50]

Not all carefully conducted studies have demonstrated the effectiveness of relaxation therapy. In a randomized study of 99 children aged between 9 and 17 years with neurologist-diagnosed migraine and four times daily recording in a headache diary, 6 weekly sessions teaching relaxation therapy was not significantly different from 6 weeks of nonspecific therapy related to emotions

or a single session discussing headache diaries and headache triggers.^[51] The authors were careful to keep all elements of relaxation therapy out of the single session with the control group. Perhaps either a high rate of spontaneous remission^[25] depleted this study of adequate power to detect a difference, or it included a group of patients refractory to this approach.

Overall, there is good evidence that relaxation techniques are effective and can be taught at home.

6. Biofeedback

In thermal biofeedback, the patient is taught to raise the temperature of a body part, typically a finger, with the temperature expressed by a visual display or auditory signal. Other techniques use electromyography, where contractions of the frontalis muscles are made evident by converting the electrical impulses into a visual or sound display. In this technique, the patient is taught to decrease the impulses. Biofeedback has been utilized alone or with relaxation and stress management.

The first study^[52] limited to children with migraine headaches, that compared biofeedback to an untreated group, enrolled 28 children aged between 7 and 16 years, all of whom, in retrospect, appear to have met the IHS criteria for migraine. They recorded events in a headache diary four times daily. During 10 treatment sessions over a 7-week period the patients were taught to raise the temperature of a finger and were asked to practice twice daily at home. They were also taught to warm their finger without the feedback of a thermometer (autogenic training). They were compared with a waiting list control group. The treated group had significantly fewer headaches, shorter headaches, and less intense headaches than the control group. Ninety-three percent of treated patients, compared with 7% of waiting list control individuals, had a 50% or greater decrease in symptoms. When the waiting list control group received training the combined 50% symptom reduction rate was 88%, and the effect was unchanged at 1 month but decreased to 62% at 6 months.

Autogenic hand warming is often considered a form of relaxation therapy since it does not involve feedback from a thermometer. In 1995 Labbe^[53] tried to separate the therapeutic effect of the autogenic component of the combined therapy. In a study of similar construction to the study described above, 30 children aged between 8 and 18 years were divided into three groups: waiting list control group, combined autogenic and biofeedback finger warming group, and autogenic warming alone group. Headache frequency and duration, but not intensity, were significantly improved in both treatment groups when compared with the control group on the basis of a 50% or greater reduction. The children with combined biofeedback and autogenic training

seemed to do a bit better than the autogenic warming alone if only those who became 100% headache free are counted (8 of 10 versus 5 of 10 – not a statistically significant difference).

The previously mentioned study by Sartory et al.^[48] compared relaxation therapy, cephalic vasomotor feedback and a β -blocker medication. When measured by a headache index (frequency \times intensity of headache episodes) the order of effectiveness was: relaxation, vasomotor feedback, and metoprolol. Only relaxation therapy significantly reduced headache intensity.

Several groups have demonstrated that biofeedback can be taught to children using a brief instructional period in the clinic followed by structured practice sessions at home.^[54-56] This approach can decrease costs as well as decreasing the demands on professionals whose services may be in short supply.

7. Conclusions and Research Issues

There is a substantial body of evidence demonstrating that nonpharmacological treatments are effective for childhood migraine. The physiological basis for their effectiveness; however, is unclear, but one study suggests that these therapies can alter levels of β -endorphin (although these changes were not associated with the observed treatment outcomes). A Dutch study examined the effects of a combination of the three behavioral therapies on plasma β -endorphin using patients with pediatric migraine and control individuals.^[57] This study included 40 children aged between 10 and 19 years, with and without migraine. Half of the children with migraine received behavioral therapy. The behavioral training included relaxation and biofeedback, as well as stress management. The level of plasma β -endorphin was unchanged over time in both the control individuals and the untreated children with migraine. In contrast, the level of plasma β -endorphin decreased significantly in the migraine group who received treatment. The authors speculated that stress releases catecholamines, which in turn cause the release of β -endorphins and thus affect the occurrence of migraine. It should be noted that all of the patients with migraine showed a decrease in headache frequency and duration (though not intensity) regardless of whether or not they received treatment. For example, duration of headache was reduced by $\geq 70\%$ for 45% of the children. This observation probably reflects a small sample size and lack of power, as well as confirming earlier observations on the high rate of spontaneous remission in migraine.^[25]

Other suggested approaches such as 'confident reassurance' may not have demonstrated effectiveness in controlled trials but doubtlessly reflect skillful use of the physician-patient relationship and represent good medical practice. Similarly, recommendations to eat regular meals, obtain enough sleep, and other pos-

itive lifestyle advice are in the child's best interest whether or not they are demonstrated to make headaches less frequent or less severe. On the other hand, it is important to recognize that there are not sufficient data for the physician to be overly aggressive in making lifestyle recommendations. This is an especially important issue where physician and patient come from differing cultural backgrounds, where adolescents are exerting their independence, and in some stressful school situations where long hours and a high level of effort are required for academic success.

The literature provides little guidance about when and how to choose between drug and behavioral therapies or how to integrate the two.^[10] While in small studies, relaxation therapy has been superior to biofeedback, this may not be true for all children.^[48,53] In addition, many of the published studies mix prepubertal and adolescent children with the number of patients too small to analyze the different age groups independently. It would be useful to examine prepubertal children separately since they are in the minority in most studies and may respond differently to therapy than adolescents. Certainly, their headaches are less like adult migraine when compared with older children. In several studies, younger children have had a higher withdrawal rate from behavioral therapy than older children in the same program.^[4] It is unclear if this means that they received less relief from the behavioral measures, had shorter attention spans, or required more parental supervision, with withdrawal reflecting a lack of parental involvement or interest.

Why are behavioral techniques not used more widely for the treatment of childhood migraine? While many factors have been enumerated, the most important reason is the lack of large scale field trials demonstrating that these techniques are practical and effective.^[4,58] Field trials are necessary to show that these techniques can be successfully applied to large groups of children in routine practice settings. Such trials could demonstrate whether the potential benefits of behavioral therapy, including the lack of drug adverse effects and interactions, and the feeling of being in control, can be made available to the average child with migraine along with relief from pain.

Acknowledgments

No sources of funding were used to assist in the preparation of this manuscript. The author has no conflicts of interest that are directly relevant to the content of this manuscript.

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