Effects of Behavioral Psychophysiological Treatment on Schoolchildren with Migraine in a Nonclinical Setting: Predictors and Process Variables

Susanne O. L. Osterhaus

Vrije Universiteit, Amsterdam, the Netherlands

J. Passchier

Erasmus Universiteit, Rotterdam, the Netherlands


Vrije Universiteit, Amsterdam, the Netherlands

Received March 16, 1992; accepted February 28, 1993

Evaluated the outcome of a combined behavioral therapy, comprising relaxation training, temperature biofeedback, and cognitive training, administered in a school setting, at posttreatment, and 7-month follow-up, on a group of schoolchildren with migraine. Comparison between the experimental group (n = 32) and the waiting-list control group (n = 9) showed a treatment effect on headache frequency and duration but not on intensity. Using a 50% reduction in the headache activity as a criterion for clinical improvement, 45% of the children in the experimental group were clinically improved at the end of the treatment. The treated subjects were found to have maintained significant improvement at follow-up. Sex, headache history, age, and psychosomatic complaints before the training emerged as predictors of outcome. A decrease in state anxiety and an increase in the ability to relax during the sessions contributed to headache improvement. Finally, the acquired capacity to raise one’s finger temperature

1The study was supported financially by the Dutch Fund for Mental Health (NFGV) under Project Number 3191.

2All correspondence should be sent to Susanne O. L. Osterhaus, Department of Psychophysiology, Vrije Universiteit, De Boelelaan 1111, 1081 HV Amsterdam, The Netherlands.
during the biofeedback sessions was related to headache reduction after the training.

KEY WORDS: behavioral treatment; schoolchildren; migraine; setting.

The prevalence of migraine is considered to be as high as 5% in 10- to 15-year-old children (Bille, 1989). During the past decades, a substantial number of studies have reported on the success of nonpharmacological treatment for headaches, and have demonstrated that behavior therapy (in the form of relaxation, biofeedback, and cognitive training) can considerably relieve migraine in adults (Blanchard, Andrasik, Ahles, Tedes, & Keefe, 1980; Sorbi & Tellegen, 1988) and that this effect is even larger in younger patients (Helm-Hylkema, Orlebeke, Enting, Thijssen, & van Ree, 1990; Labbe & Williamson, 1984; Werder & Sargent, 1984). Long-term follow-up studies have provided evidence for the maintenance of these effects (Helm-Hylkema et al., 1990; Larsson & Melin, 1989; Sorbi, Tellegen, & Du Long, 1989).

Whereas psychological intervention is usually given in a clinical setting at a therapeutic institution or private practice, treatment in a daily-life setting has the advantage that it is highly accessible and generalizable. Larsson and Melin (1988) reported favorable outcomes in 12- to 18-year-old schoolchildren with headaches after progressive relaxation training was given in a school setting. Using a 50% reduction in the headache activity as a criterion for clinical improvement, the majority of children and in particular those with tension headaches were clinically improved at the end of treatment. The migraine subjects showed less improvements with 27% having improved clinically.

The result of Larsson and Melin (1988) showed that relaxation training in a nonclinical setting did not have any effect on a large proportion of the young migraine patients. This might be the consequence of the fairly narrow approach they used. Therefore, the present investigation was designed to evaluate the outcome of a more extensive training package, comprising not only relaxation training but also biofeedback and cognitive training, on a group of schoolchildren with migraine. As the study by Helm-Hylkema et al. (1990) has proved that this treatment package is an effective therapy for pediatric migraine in a clinical environment, we elected to apply and evaluate the training in a nonclinical school setting. In that study, 90% of the children (M age 13.7 years), showed a headache reduction of 50% or more. Other research has shown that the symptoms persist throughout adulthood in the majority of migraine patients (Bille, 1981). Therefore it is important to investigate a treatment package that is highly accessible for all young migraine sufferers. As such, a treatment presented at school provides the opportunity for larger participation. Because subjects who enter a highly accessible program might be different from those who enter a
clinic-based treatment, the clinical outcome study of Helm-Hylkema et al. (1990) should be replicated for this population.

After an effective psychological treatment, stress reduction and behavioral changes can be expected to have taken place. So far, it has not become clear whether and how behavioral changes take place after psychological headache treatment. In their review of studies on behavioral changes in children after treatment for headaches, Passchier and Van Knippenberg (1991) found that both stress and somatic complaints were changed positively. In the present study, behavioral changes as a result of therapy were analyzed by means of a series of stress-related behavioral variables: fear of failure, school problems, coping with stress, and psychosomatic well-being.

Very few studies have attempted to predict therapy effects in young patients. Larsson and Melin (1988) identified baseline headache severity as the strongest positive indicator of therapy outcome, followed by students' baseline levels of somatic symptoms, school satisfaction, and (general) disease within the family. The present study included the above-mentioned stress-related behavioral variables and a series of background variables (age, sex, nationality, duration of migraine history, and motivation for the treatment) to predict treatment effect. As stress is the most frequently mentioned cause of headaches in children at elementary and secondary schools (Passchier & Orlebeke, 1985), in this study we assumed that the effect of treatment would be mediated by stress reduction during the sessions. Therefore, we also investigated the predictive capacity of stress reduction during the sessions, which has not been studied before.

Research has revealed that there is a positive relationship between the ability to increase finger treatment during biofeedback and headache reduction (Blanchard & Andrasik, 1985). According to Mathew, Beng. Kralik, and Claghorn (1979) it is likely that the therapeutic effect of finger temperature biofeedback can be attributed to relaxation. In the present study we also investigated the relationship between finger temperature biofeedback and headache reduction in schoolchildren suffering from migraine. In summary, a group of youngsters with migraine received a short course of behavior therapy, in the form of individual therapy and group therapy, in order to address the following questions:

1. Does combined behavioral treatment lead to a significant migraine reduction and, if so, in how many children?
2. Do behavioral changes take place as a result of combined behavioral treatment?
3. Do behavioral and background variables predict treatment outcome?
4. Does subjective stress reduction during the sessions predict treatment effect?
5. Is there a relationship between the ability to raise the finger temperature during the sessions and treatment effect?
METHODS

Subjects

The principals of 42 secondary schools in the Netherlands were approached regarding participation of their students in this project and 19 of them (45%) agreed to cooperate. The children at these schools and their parents were informed about the purpose of the research and 60 children volunteered as headache sufferers during the screening. Approximately 8,000 children attend these 19 schools, which means that less than 1% of the children volunteered to participate in the study. All 60 children were screened by two clinical psychologists experienced in headache research and an independent neurologist. To be included in the study, the children had to meet the following criteria: (a) at least a 1-year history of headaches, (b) headaches at least twice a month, (c) able to understand the Dutch language. The children were then diagnosed by a neurologist to assess headache type. Study subjects were selected on the basis of Vahlquist's (1955) criteria for childhood migraine: (a) headache episodes separated by symptom-free intervals and (b) at least two of the following symptoms: visual or motor aura at the onset of the headaches, throbbing and pulsatile quality of the pain, nausea and/or vomiting. These criteria were used rather than the IHS (Firenze, 1987) headache classification which concerns only adults and is less suitable for diagnosing children (Guidetti et al., 1991). Of the initial group of 60 self-referred children 41 (ages 12–19 years) fulfilled the criteria for migraine and were recruited for the project.

These 41 children were assigned to one of two groups: 32 to an experimental group and 9 to a waiting-list or control group. The waiting period of 4 months for the control group was similar to the duration of the treatment of the experimental group. For practical reasons, the control group was recruited later. However, measurement periods of the control group occurred in the same phase of the school year as those of the experimental group. The control group consisted of fewer subjects than the experimental group because the main aim of this project was to evaluate the treatment process variables and determine whether it was possible to predict treatment outcome. Roughly this number of subjects can be expected to be sufficient to establish a definite and clinically relevant treatment effect (Kraemer, 1981). In addition, none of the previous studies reported any changes in the control group (Larsson & Melin, 1988; Richter, 1984).

Procedure

Assessments took place at the start of the training, during the training, after the training, and for the experimental group also at follow-up, 7 months after the end of training.
Pretraining. After the selection, all the children received behavioral questionnaires (see Measurement), which they returned immediately after completion, and a headache diary, which they returned by mail after 5 weeks of self-monitoring. The motivation for the treatment was assessed before the first session.

Training. The training was given after school and consisted of eight sessions: four group sessions and four individual sessions. During the training, the children completed questionnaires about their moods in the first group session, the last group session, and in the last individual session, each time both before and after the session.

Treatment Procedure. The training was identical to that described by Helm-Hylkema et al. (1990) for treating young migraine patients in a clinical setting. It consisted of eight sessions: four group sessions of 90 minutes each and four individual sessions which lasted 45 minutes each. The groups consisted of a maximum of eight children. Treatment was given by an experienced clinical psychologist and an experienced physiotherapist. The children in the waiting-list control group received the same training after the experimental group had completed the total training program. In the group session, information was given about pain, migraine, and pain-coping strategies. Furthermore various methods of physical relaxation, including progressive relaxation, autogenic relaxation, and relaxation based on self-hypnosis procedures, formed part of the group training. Home practice was required at least twice a day. Emphasis was put on the need to practice one of these techniques when early signs of increased body tension and headaches occurred in daily life. During these group sessions, the children also received Rational Emotive Therapy (RET; Ellis, 1956) to reduce tension. By means of the RET principles, irrational thoughts were made conscious to challenge them and to turn them into rational thoughts, which produce more pleasant feelings and less stress. The 1-hour individual sessions consisted of 40 minutes of biofeedback, with the remainder devoted to discussion of home practice of one of the above-mentioned physical relaxation techniques, discussion about situations that the children found difficult to cope with by means of RET principle training, the use of biofeedback as a coping response to stressful life situations, and homework assignments. The biofeedback consisted of three phases: the adaptation phase (to diminish the influence of the room temperature on the finger temperature), the self-control phase (during which feedback was withheld from the subjects), and the biofeedback phase. In the adaptation phase, the child was seated with an electrode on the index finger of his/her nondominant hand for 10 minutes. In the self-control phase, the child performed one of the physical relaxation exercises, without any biofeedback. In the biofeedback phase, the child received feedback on the finger temperature via a visual display and was instructed to raise the temperature by means of the feedback.

Posttraining. The above-mentioned pretraining measurements also took
place after the training: The children received the same behavioral questionnaires and a 5-week headache diary. In addition, they were asked to complete an evaluative questionnaire of the treatment.

Follow-Up. The posttraining measurements were repeated in the experimental group at follow-up 7 months after the training.

**Measurement**

*Headache Diary.* The headache diary was adopted from a previous study (Passchier et al., 1990) and based on Budzynski (1973). Previous research has shown that the headache diary is a valid and reliable indicator of headache complaints in children and adolescents (Andrasik, Burke, Attanasio, & Rosenblum, 1985; Richardson, McGrath, Cunningham, & Humphreys, 1983). Headaches were rated on a daily basis, for 5 weeks. In the headache diary, the children registered the following data: number of attacks, duration of attacks in hours, intensity of the attacks (on a 5-point scale), days ill (for other reasons than a headache), and frequency of medication intake. None of the children reported taking prescription medication during the time they participated in the study. Many stated that they had tried prescription medication without any success and had consequently discontinued it. Three migraine variables were analyzed: frequency (number of attacks per month), average duration per attack, and average intensity per attack. Our duration variable differed from that used by Larsson and Melin (1988). In their study, duration was counted as blocks of about 6 hours, whereas in our study it was rated in hours. The latter method was considered to be preferable because migraine attacks in youngsters are usually of short duration (Guidetti et al., 1991). The weekly average headache score (headache index) was calculated from the diary by adding the product of the duration and intensity of every single headache attack. This headache score was divided by five (the diary consisted of 5 weeks), which resulted in a weekly average or the “headache index.” This index was comparable to that of Larsson and Melin (1988), but more exact because duration was measured in hours. For each child, the percentage of headache change was further computed according to the following formula:

$$\text{Overall Headache Improvement} = \frac{\text{posttreatment headache index} - \text{pretreatment headache index}}{\text{pretreatment headache index}} \times 100\%$$

Headache improvement was calculated in a similar way for frequency, duration, and intensity.
Stress-Related Behavioral Variables. The Utrecht Coping List (UCL; Schreurs, Van de Willige, & Brosschot, 1988) was used to measure strategies the children employed to manage stress in everyday life. It has seven scales: active coping, palliative coping, avoidance, social support, depressive reaction, comforting cognitions, and the expression of emotions and/or anger. The validity of this questionnaire is satisfactory and the reliability is high. Hermans’s (1970; Hermans & Smit, 1969) subscales for Debilitating Anxiety of the Achievement Motivation (PMT-k) were used to measure fear of failure. The PMT-k has good reliability and has been well-validated for the population under study. The Hopkins Symptom Checklist (HSCL; Luteyn, Hamel, Bouwman, & Kok, 1984) was used to measure psychic, somatic, and total psychosomatic symptomatology. It deals with health as experienced by the subject. This list has been sufficiently validated for the current age group. Both internal consistency and stability over time are high. School problems were assessed with a short list developed for this study. It covered school problems: difficulties with lessons, concentration, homework, and worrying about school marks and about being promoted to the next class at the end of the school year. The answer alternatives ranged from none (1) to many (4). A total score for school problems was calculated. The validity and reliability of this list have not yet been investigated. Days ill (for other reasons than a headache) were assessed by the above-mentioned headache diary. The children registered daily if they had suffered from symptoms or complaints other than headaches.

Biofeedback Variables. In the individual sessions, finger temperature feedback was provided by a Davicon temperature training unit. This unit provided a continuous digital readout of the finger temperature. The children were seated with an electrode placed on the index finger of their nondominant hand and the finger temperature was measured at five different times during each biofeedback session: (a) at baseline, (b) after 10 minutes of adaptation, (c) before, and (d) after the 15 minutes of self-control or relaxation, in which feedback was not given, (e) before, and (f) after the 15 minutes biofeedback phase, in which feedback was given. For each individual session differences were calculated between the beginning and end of the self-control phase (c–d), the beginning and end of the biofeedback phase (e–f), and between the end of the adaptation phase and the end of the biofeedback session (b–f). In addition, these differences were averaged across the sessions and these averages were used as biofeedback variables too.

Process Variables. State anxiety was assessed by a Dutch version of the state scale from the State-Trait Anxiety Inventory (STAI; Ploeg, Defares, & Spielberger, 1981). In addition, moods were assessed by a Dutch version of the Profile of Mood States (POMS; Wald & Mellenbergh, 1990; McNair, Lorr, & Droppleman, 1971), which consists of six scales: fatigue, tension, anger, depression, vigor, and friendliness. The validity and reliability of both lists are ade-
quate (McNair et al., 1971; Ploeg et al., 1981; Wald & Mellenbergh, 1990). Differences in these measures between the beginning and the end of each individual session were calculated and averaged across the sessions. These averages were used as process variables.

Motivation and Evaluation Questionnaires. Before the training, all the youngsters completed a motivation questionnaire which addressed their motivation for participating in the training. It comprised three questions with answer alternatives ranging from 1 to 5. The questions were about whether they would recommend the training to a friend with headaches; whether they were motivated for the training, and how much time they wanted to spend on the training. A total score was calculated as a measure of motivation. This questionnaire was translated from Larsson and Melin, (1988). After the training a questionnaire was completed by the children to assess their evaluation of the training, based on Larsson and Melin (1988). The questionnaire comprised four questions with answer alternatives ranging from 1 to 4 and from 1 to 5. The questions were about how often they had practiced the relaxation exercises at home, whether they thought the training had been successful, whether they thought they would practice often at home in the future, and how positive they felt about the training. A total score was calculated to measure their evaluation. The validity and reliability of these lists have not yet been investigated.

RESULTS

The characteristics of the subjects in both groups are presented in Table I. The pretraining group differences on background variables and on stress-related behavioral variables were assessed by two-tailed t tests for independent groups. There was no significant difference between the characteristics of the experimental group and the control group.

Treatment Effect

The mean values and standard deviations of the headache variables are presented in Table II. First, a MANCOVA analysis, using Pillai’s criterion, was conducted on the difference between the groups for the postheadache measures in general. This statistical approach has been advocated as preferable alternative to ANOVAs on change scores (Cronbach & Furby, 1970). The posttreatment measurements (frequency, duration, and intensity) were used as dependent measures, and the corresponding pretreatment headache measurements were included as covariates in the analysis. The effect was significant, $F(3, 36) = 6.04, p = .002$. Next, ANCOVAs were used to test differences between the groups on specific headache variables. This yielded an effect on headache frequency and headache
Table 1. Characteristics of the Children and Differences Between the Experimental Group and the Control Groups at Pretraining

<table>
<thead>
<tr>
<th></th>
<th>Experimental group (n = 32)</th>
<th>Control group (n = 9)</th>
<th>( \chi^2(1) )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td><strong>Associated symptoms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>22</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Dizziness</td>
<td>20</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Hypersensitivity to light</td>
<td>22</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Reduced visual acuity</td>
<td>11</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>15.2</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td><strong>Headache history (in years)</strong></td>
<td>4.2</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td><strong>Fear of failure</strong></td>
<td>8.1</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td><strong>School problems</strong></td>
<td>10.6</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td><strong>Psychosomatic complaints</strong></td>
<td>43.1</td>
<td>27.1</td>
<td></td>
</tr>
<tr>
<td><strong>Psychological complaints</strong></td>
<td>13.9</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td><strong>Somatic complaints</strong></td>
<td>6.5</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td><strong>Coping</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active coping</td>
<td>14.5</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Palliative coping</td>
<td>17.8</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>Comforting cognitions</td>
<td>10.0</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>Social support</td>
<td>13.6</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Depressive reactions</td>
<td>12.5</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>14.9</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>Expression of emotions</td>
<td>7.6</td>
<td>2.9</td>
<td></td>
</tr>
</tbody>
</table>

\[
M \quad SD \quad M \quad SD \quad t(39)
\]

\[
15.2 \quad 2.1 \quad 14.3 \quad 1.7 \quad 1.1
\]

\[
4.2 \quad 3.3 \quad 3.0 \quad 1.7 \quad 1.1
\]

\[
8.1 \quad 3.8 \quad 10.3 \quad 4.8 \quad -1.3
\]

\[
10.6 \quad 3.6 \quad 8.3 \quad 2.0 \quad 1.7
\]

\[
43.1 \quad 27.1 \quad 42.3 \quad 23.2 \quad 0.1
\]

\[
13.9 \quad 8.6 \quad 11.4 \quad 10.2 \quad 0.7
\]

\[
6.5 \quad 4.4 \quad 5.7 \quad 3.5 \quad 0.5
\]

\[
14.5 \quad 3.8 \quad 13.9 \quad 3.1 \quad 0.4
\]

\[
17.8 \quad 4.1 \quad 15.6 \quad 2.4 \quad 1.4
\]

\[
10.0 \quad 2.7 \quad 9.9 \quad 1.5 \quad 0.1
\]

\[
13.6 \quad 4.7 \quad 12.7 \quad 3.9 \quad 0.5
\]

\[
12.5 \quad 3.5 \quad 12.9 \quad 3.8 \quad -0.3
\]

\[
14.9 \quad 3.7 \quad 14.7 \quad 1.8 \quad 0.1
\]

\[
7.6 \quad 2.9 \quad 6.1 \quad 1.7 \quad 1.3
\]

duration, indicating that the experimental group had improved more than the control group on both headache measures from preassessment to postassessment. Moreover, the effect for the overall headache index was also significant: the children in the treatment group showed significantly more overall headache improvement than those in the control group. No effect was found for headache intensity (Figure 1).

**Stability of Headache Reduction**

To investigate the stability of headache reduction in the experimental group, the headache scores, obtained at posttraining and at 7-month follow-up were compared using two-tailed \( t \) tests for dependent groups. Significant posttraining follow-up improvement was found for duration, \( t(29) = 12.9, p = .008 \); intensity \( t(29) = 2.5, p = .02 \); and the headache index, \( t(29) = 2.4, p = .03 \).

According to the results presented in Figure 1 there was a 41% decrease in
migraine frequency in the experimental group. This decrement extended to the 7-month follow-up assessment at which time a 47% decrease was present compared to the pretraining assessment. For migraine duration, a 13% decrease was established and at follow-up, this improvement was extended to 37%. The migraine intensity increased 4% at posttraining, but showed a reduction of 17% at the 7-month follow-up compared to pretreatment. Finally, the overall headache improvement was 44% at posttraining and this effect was increased to 54% at the 7-month follow-up.

**Clinical Significance**

In accordance with previous studies (Helm-Hylkema et al., 1990; Larsson & Melin, 1988; Sorbi et al., 1989), a 50% reduction in the headache activity was used as a criterion for clinical improvement. Each headache improvement measure was further tested by analyzing the distribution of children who were clinically improved, slightly improved, and unimproved (defined as more than 50%, between 25 and 50%, and less than 25% improved, respectively) across the experimental group and the control group using chi-square analysis. Behavioral changes were analyzed in a similar way to the headache measures. Table III shows the analysis of the distribution of children across outcome groups. Of the children in the experimental group, 45% achieved a clinically meaningful reduction in overall headache activity; this improvement was significantly better than that in the control group (11%), \( \chi^2 = 5.48, p = .05 \).

**Stress-Related Behavioral Change at Posttraining**

Behavioral changes were analyzed in a similar way to the headache measures. The average baseline scores did not differ significantly between the groups (see Table I). The ANCOVA on the posttreatment scores did not show any effects, except for “days ill,” \( F(1, 38) = 9.6, p = .004 \). The children in the
Fig. 1. Headache frequency (a), duration (b), intensity (c), and index (d) as a function of group and measurement occasion.
experimental group \((M = 3.3, SD = 7.3)\) appeared to be ill less often at post-training than the children in the control group \((M = 9.0, SD = 9.4)\).

**Prediction of Treatment Outcome by Behavioral and Background Factors**

Pre-to-post changes in headache frequency, duration, and intensity and corresponding pre-to-follow-up changes were used as dependent measures for predicting treatment outcome. Stepwise multiple regression equations were performed separately for each headache variable. Only the behavioral and background predictor factors that appeared to be significantly related to one of the headache variables, based on their zero-order correlations, were included in the regression equation of the corresponding headache variable. It should be noted that “self-motivation for the training” and “home-practice during the training” were not significantly related to any of the headache variables. Therefore they were not included in the regression equations as relevant predictor factors. Table IV summarizes the outcome of these regression equations.

Regarding headache frequency, sex, \(F(30) = 4.8, p < .04\), emerged as the most important factor for predicting pre-post change, followed by the length of the migraine history, \(F(29) = 4.9, p = .04\). These factors explained 27% of the total variance of the pre-post changes in headache frequency. Girls seemed to benefit more from the training than boys. There was a negative relationship for migraine history: the longer the migraine history, the smaller the reduction in headache frequency after the training. With regard to duration, age, \(F(30) = 4.1, p = .05\), and somatic complaints, \(F(29) = 4.1, p = .05\), accounted together for 23% of the variance in pre-post improvement. The older children showed more reduction in headache duration than the younger children, whereas the number of somatic complaints was a negative predictor of improvement in headache duration.

Prediction of the long-term treatment effect based on pre-to-follow-up differences, yielded the following results: Regarding headache frequency, avoid-
Table IV. Predictors of Treatment Effect*  

<table>
<thead>
<tr>
<th>Headache outcome</th>
<th>Predictor variable</th>
<th>$b$</th>
<th>$R^2$-change</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-to-post change</td>
<td>Frequency</td>
<td>Sex</td>
<td>.45</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Migraine history</td>
<td>-.36</td>
<td>.13</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>Age</td>
<td>.36</td>
<td>.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Somatic complaints</td>
<td>-.33</td>
<td>.11</td>
</tr>
<tr>
<td>Pre-to-follow-up change</td>
<td>Frequency</td>
<td>Avoidant coping</td>
<td>-.48</td>
<td>.20</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>Active coping</td>
<td>-.72</td>
<td>.19</td>
</tr>
</tbody>
</table>

* $n = 32$ for all analyses.
* None of the predictor variables approached significance.
* $p < .05$.

Ant coping, $F(28) = 6.7, p < .02$, emerged as the only significant factor for predicting pre–follow-up change. Higher levels of avoidant coping were a negative predictor of long-term improvement in headache frequency. This variable explained 20% of the variance. With regard to duration, active coping, $F(28) = 6.1, p = .02$, accounted for 19% of the variance in baseline follow-up improvement: Higher levels of active coping were a negative predictor of long-term improvement in headache duration.

Process Variables as Predictors of Therapy Outcome

Similar regression analyses were performed on the process variables as potential mediators. The process factors were entered into separate stepwise regression equations for the three headache pre–post change measures. To admit a factor into the equation, the level of significance was set at $p = .05$; to remove it, the level was set at $p = .10$.

Few of the process variables were predictive of pre–post changes in headache variables. However, the average decrease in state anxiety during the sessions appeared to be an important predictor of improvement in headache frequency due to training, $F(27) = 9.1, p < .01$. This accounted for 28% of the variance. For the improvement in duration, an increase in fatigue during the sessions, $F(27) = 8.5, p < .01$, emerged as the only significant predictor; 21% of the outcome variance was accounted for. None of the process variables was a significant predictor of improvement in intensity.

Relationships Between Temperature Feedback and Treatment Effect

Changes in finger temperature within the sessions and differences in finger temperature change between the sessions, were assessed by one-tailed $t$ tests for
Table V. Temperature (in °C) at Two Points for Each Individual Session

<table>
<thead>
<tr>
<th>Session</th>
<th>End adaptation</th>
<th></th>
<th>End biofeedback</th>
<th></th>
<th>( t(29) )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M )</td>
<td>SD</td>
<td>( M )</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>30.9</td>
<td>4.2</td>
<td>32.2</td>
<td>4.5</td>
<td>-4.1^a</td>
</tr>
<tr>
<td>Second</td>
<td>30.8</td>
<td>3.3</td>
<td>32.4</td>
<td>3.5</td>
<td>-6.2^a</td>
</tr>
<tr>
<td>Third</td>
<td>30.4</td>
<td>4.6</td>
<td>32.2</td>
<td>4.4</td>
<td>-3.8^a</td>
</tr>
<tr>
<td>Fourth</td>
<td>30.2</td>
<td>4.9</td>
<td>33.1</td>
<td>3.4</td>
<td>-5.7^a</td>
</tr>
</tbody>
</table>

^a\( p < .001 \).

Dependent measures. Mean temperature values within the sessions are presented in Table V. A highly significant rise in finger temperature was present in each of the four biofeedback sessions (\( p < .001 \)). In addition, the increments in finger temperature increased significantly, \( t(29) = -2.8, p < .01 \), from the first session (\( M = 1.3, SD = 0.9 \)) to the fourth session (\( M = 2.9, SD = 1.0 \)). We also calculated Pearson's product-moment correlations between the finger temperature measures and the three headache pre-post measures. Only the relationship between the rise in finger temperature in the last session and the pre-to-post changes in headache frequency was significant (\( r = .42, p < .05 \)).

**DISCUSSION**

The results of this study support previous research findings on the effectiveness of a combined therapeutical package, consisting of relaxation, biofeedback, and cognitive training, for juvenile migraine patients, when administered in a nonclinical school setting. The treatment had an effect on headache frequency and duration but not on headache intensity. Furthermore, there was an effect for overall headache improvement, which can largely be attributed to the improvement in headache frequency, as the effect of the treatment on duration was modest, and there was no effect on intensity. The treatment effects were maintained and there was an even greater improvement at 7 month follow-up.

Larsson and Melin (1988) also reported favorable outcomes of headache therapy administered in a nonclinical setting, but this treatment consisted of relaxation training only. Their results indicated that there was less improvement in the migraine subjects than in the subjects with tension headaches. In our study, 45% of the children, all of whom had migraine, improved by more than 50%. In Larsson and Melin's study, only 27% of the migraine subjects improved considerably. McGrath et al. (1991) also reported a positive effect of a behavioral package without biofeedback on juvenile migraine. Helm-Hylkema et al. (1990), using the same training program used in the current study, but administered in a clinical setting, found that 90% of the young migraine patients improved by more than 50%.
Various factors can explain the difference in therapy effect between our study and these other studies. First, the mean age was different: In the study by Helm-Hylkema et al. (1990) the mean age was 13.7 years (range 10–19 years), whereas in our study, the mean age was 15.0 years (range 12–19 years). Furthermore, only 5% of the population in Helm-Hylkema et al.’s investigation suffered from classical migraine (with prodromata), while in our group 46% did. Also the setting may have contributed to the different therapy outcomes. It is noteworthy that the training seemed to have had more impact in a clinical setting than in a school setting.

It was expected that psychological disturbances would also diminish after effective psychological treatment. However, only the number of “days ill” diminished significantly, which was consistent with the study by Helm-Hylkema et al. (1990). No significant effects were found on the measures of coping, fear of failure, school problems, or psychosomatic complaints. Nonetheless, it is premature to infer from these findings that no behavioral changes take place following training. The idiosyncratic nature of the behavioral problems of migraine patients may not be reflected by the standard measures chosen and can probably better be monitored using idiosyncratic measures more tailored to the problems of juvenile migraine sufferers, instead of interindividual instruments.

A major concern for clinicians employing behavioral treatment for headaches is identifying predictors of clinical applicability. When we analyzed possible predictors of outcome for improvement in headache frequency, sex emerged as the strongest predictor, followed by the length of headache history. This profile of predictors may indicate that girls benefit more from the training than boys do, even if the predifferences in headaches are taken into account and that the longer the migraine exists, the smaller the reduction in frequency is to be expected. Treatment effect on headache duration was best predicted by age and somatic complaints. The older children and those who exhibited fewer somatic complaints, apart from their headaches, showed a greater reduction in headache duration after the training.

The finding that somatic complaints were a negative predictor of treatment effect disagrees with the data published by Larsson and Melin (1988), in which a positive relationship was found between these variables. However, it is in accordance with Adler and Adler’s (1987) statement that the therapy has little effect on headache patients with many somatic complaints. The contrasting results of Larsson and Melin’s study and our investigation may be explained by the difference in age between the experimental groups of these studies and the difference in assessment methods. In Larsson and Melin’s study the somatic score was based on both the parents’ and children’s ratings on the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983). Our somatic score was based only on self-ratings on the HSCL (Luteyn et al., 1984). Since our impression is that the parents’ perception of the child’s somatization behavior is important, this might
be an interesting point to explore in further research. According to Pennebaker (1982), reporting many somatic complaints is related to depressed feelings. Haag (1982) found that the tendency to show depressive reactions in individuals with migraine is likely to predict poor therapy effects. This may indicate why somatization was a negative predictor in our study.

Self-motivation for the training and home practice during the training did not appear to predict headache improvement. The former finding can be attributed to small interindividual differences in reported self-motivation, whereas the latter possibly has another cause. On retrospective inquiry, the children reported that they often employed the relaxation skills spontaneously in daily life, but did not practice very often. This suggests that home practice and skill-employment should be assessed separately, rather than through a global measure.

Changes in several of the stress process variables during the sessions predicted treatment outcome. This supported our assumption that the effect of the training was mediated by stress reduction. A decrease in state anxiety during the sessions predicted a reduction in headache frequency while an increase in fatigue during the sessions predicted a reduction in headache duration. A post hoc interview revealed that the fatigue, measured by the POMS, was synonymous with a pleasant kind of lassitude and was used by the children to indicate relaxation.

The rise in finger temperature increased in each successive session, which suggested that a learning effect had taken place. In view of the adaptation period and the use of difference scores for analyzing a finger temperature effect, it is unlikely that room temperature or seasonal temperature changes influenced the outcome. Furthermore, the rise in finger temperature in the last session, was related to improvement in headache frequency. Thus the acquired capacity to raise one’s finger temperature at the end of training seemed to play an important role in reducing the headache frequency after training. Our results indicate that temperature biofeedback is a worthwhile element in the treatment of migraine. This is in contrast to Burke and Andrasik (1989). Although they found a highly significant clinical effect for headache symptoms, the results provided only minimal support for temperature changes as its mediator. The difference in results might be explained by the smaller number of participants in Burke and Andrasik’s study and by the higher mean age of our subjects.

Finally, it should be mentioned that none of the background and behavioral variables that predicted the posttreatment outcome also predicted outcome at the 7 month follow-up. This shows some concordance with Larsson and Melin’s (1989) finding that only one indicator (baseline headache severity) predicted short- as well as long-term outcome. In our study, two other indicators emerged as powerful predictors of a favorable long-term outcome. Children who showed more avoidance and used predominantly active coping strategies to deal with stress, generally had a less favorable prognosis at follow-up. Maybe, the equilib-
rium between these coping strategies is optimal to obtain long-term profit from this treatment package.

Some limitations of the results need to be emphasized. (a) The children were not randomly assigned to the conditions and the control children were selected at a later date. Nevertheless seasonal influences and influences of vacations can be ruled out because both groups were recruited in the same seasons and the self-monitoring periods never occurred during the vacations. (b) Other relevant treatment process variables, such as skill practice, skill employment, therapist factors, and a general measure for external life stress and quality of life (including school problems, fear of failure, satisfaction with home life, satisfaction with autonomy, etc.) might also have contributed to predicting treatment outcome. (c) It was striking that our pure migraine patients also mentioned having tension headaches. These tension headache periods were not recorded differently in the present headache diaries. (d) The control group was relatively small, but the distribution of all the included variables was comparable in the two groups. (e) As the treatment consisted of a combination of various elements (relaxation, biofeedback, and cognitive training), we cannot comment on the effect of the separate therapeutic strategies, but this would make an interesting focus for future research. (f) The results can only be generalized to schoolchildren with migraine who participate voluntarily in a therapy project. In addition, the program is only applicable to schools where the principals are willing for their students to participate. (g) In view of the small percentage of variance explained by our results and the modest size of the study population, longer term research is needed to cross-validate our findings.

REFERENCES


lijst: UCL. Omgaan met problemen en gebeurtenissen. Handleiding. Lisse: Swets & Zeitlinger B. V.


