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Implicit Motor Imagery Performance in Childhood Recurrent Headaches

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Abstract

This study aims to investigate the implicit motor imagery capacities in children with recurrent headaches. 47 children with recurring headaches and 33 children of a comparable typically developing peers age group were included in the study. The dominant hand, headache localization, intensity, and symptoms accompanying the headache were all determined, in addition to implicit motor imagery abilities and the demographic features of the children participating in the study. These results were compared by measuring the patients' and control groups' right and left lateralization accuracy percentages and response times. According to the study's findings, the group with recurrent headaches had the worse right and left discrimination accuracy percentages and decision-making times, notably in implicit motor imagery performances, than the control group. As a result, whereas children with recurrent headaches have high implicit motor imagery decision-making rates linked to proprioception, they may have impaired accurate decision-making capabilities.

Key Words: Children; Headache; Implicit motor imagery; Left/right judgements

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Introduction

Headache is one of the most common complaints of children. The prevalence of headache complain in children has grown dramatically in recent years (1). Frequency of headaches in children vary with age (3 - 51.5%), and the prevalence rises with age (2,3). The complaint of headache is frequently accompanied by other symptoms such as nausea, vomiting, vision abnormalities, and sore throat (4). While migraine was reported as 4% and non-migrainous headache rate as 24% in elementary school-aged children, this rate was determined as 16% for migraine and 60% for non-migrainous headaches in adolescence (5). It is more frequent in boys at a young age, but it is more common in girls as they become older (6). Children with recurring headaches are less likely to participate in social activities, are more absent from school, and have inferior academic achievement than children who do not have recurrent headaches (7,8).

The chronic pain in children occurs more frequently than expected (9). Approximately 5% to 8% of childrens with chronic pain have a considerable pain-related disability (10). One of the most common causes of chronic pain in children is headaches (11). Patients with chronic pain have been observed to exhibit a variety of peripheral characteristics (cortical disinhibition, the change of motor cortex excitability). These peripheral changes include changes in proprioceptive senses (the sense of where your body is located in space) (12). This peripheral changes are deterioration in proprioception, decrease in tactile acuity, and lateralization decision-making ability (13). Impaired awareness of one's own body form and organs can be caused by a lack of proprioception and motor imagery (lateralization) (14). Motor imagery is also known as the mental simulation of movement without exhibiting any genuine motor activity (15). The capacity to engage with projection and manipulation of the body diagram from a first-person perspective is known as implicit motor imagery (16). In implicit motor imagery, movement imagery is done subconsciously (17). Implicit motor imagery indicates some functional equivalence between observed, imagined, and actual movement (18). When a person sees a photograph of a hand in an unusual posture, he/she automatically visualizes the hand motions and enters the motor imagery pattern to determine which side the hand belongs to (19).

No study has been found that specifically examines the motor imagery performances of children with headache problems. For these reasons, the current study was planned to investigate the implicit motor imagery performance of children with recurrent headaches and compare them with their typically developing peers.

Materials and Methods

Participants

This descriptive study included 33 children with typically developing and 47 children with recurring headaches (headache that recurs at least 3 times and aged between 8 and 16). The study was approved by Gaziantep Islam Science and Technology University, the non-interventional clinical research ethics committee (Protocol ID: 2021.47-47). Written informed consent was obtained from all parents of children who participated in the study. All participants provided informed consent, as per the Declaration of Helsinki. Parents and children were inquired about headache complaints and socio-demographic characteristics and the answers were recorded. The study was completed between December 2021 - April 2022. Participants with headache that recurs at least 3 times and volunteering to participate in the study were chosen for the study (Children with headache diagnosed by a pediatric neurologist who is an expert in the field). Patients who had an organic reason for their headache etiology, any other chronic diseases and with complex medical problems other than headache were excluded from the study. The typically developing control group is generated with similar demographic features who don't have any sign or symptom of active infection and chronic disease and also who don't have headache. The children with typically developing were chosen from among the children of the colleagues of the researchers who carried out the study and the children of the close friends of the employees who volunteered to participate in the study.

Assessment of headache severity

Patients were given a visual analog scale (VAS) to score their headaches (0=no pain, 10=unbearable pain). Pain severity was graded as follows: 1-2 was considered mild, 3-4 was considered moderate, 5-6 was considered severe, 7-8 was considered very severe, and 9-10 was considered unbearable (20).

Left/right judgement tasks

Implicit motor imagery capacity was evaluated as a laterality task, that is, choosing which side the hand belonged to. In this regard, right-left discrimination was tested using the Recognise App Recognise Hand software developed and designed by the NOI group (Neuro Orthopaedic Institute, Adelaide, Australia) (http://www.noigroup.com/ Recognize).

Regarding the identification of the hand's laterality and implicit imagery capacity, two points were evaluated. The first point is decision discrimination accuracy (the percentage of accurate responses), which is the capacity to recognize whether a part of the body belongs to the right

or the left, and the second is the response time of the participants when performing the discrimination task. The participants were asked to judge whether the hand images of the right and left hands from various angles presented on the phone screen belonged to the right or left hand while sitting comfortably. See Fig. 1 for sample images. Each person was shown a total of 20 photos at 5-second intervals. Children were instructed to push the right-side button with their right index finger if they considered the image to belong to the right side and the left side button with their left index finger for the left side. The application computed and logged response times and accuracy percentages. Data from pictures having a reaction time of less than 500 ms were excluded from the study because they were deemed too short to provide the right response (21). Furthermore, if the participant's response time exceeded 5 seconds in eight consecutive images and he or she was unable to answer, the images were deemed failed and were not evaluated.

Statistical Analysis

In descriptive statistics, numerical variables were given mean and standard error mean, whereas categorical variables were given number and percentage values. The Shapiro Wilks test was used to evaluate the normality assumption. The independent sample t-test was performed to see if there was a difference between the two groups. The paired difference test was used to discover which group or groups created the difference when there were differences between the groups. The Spearman correlation coefficient was used to see if there was a difference between numeric variables. Statistical significance level was taken as $p<0.05$ IBM SPSS Statistics (Version 19.0. Armonk, NY: IBM Corp.) was used for statistical analysis.

Results

In the study, there were 28 boys (59.6 %) and 19 girls (40.4 %) in the headache group. The median age of the headache group was 11.4 ± 0.37 years. Forty (85.1 %) of these children were using right-handed dominant and 7 (14.9 %) of them were left-handed dominant (Table 1). Headache duration lasted less than an hour in 22 (46.8 %) of the children, 1-6 hours in 20 (41.6 %) of the children, and 6-24 hours in 5 (10.4 %) of the children. Headache was accompanied by nausea-vomiting in 8 (17 %) patients, dizziness in 4 (8.4 %) patients, loss of appetite in 2 (4.2 %) patients, and visual impairment in 2 (4.2 %) patients. There were no

accompanying findings in 31 (65.9 %) patients. The pain intensity was determined as 3-4 (mild) in 24 (51 %) patients, 5-6 (severe) in 4 (8.4 %) patients, and 9-10 (unbearable) in 19 (40.4 %) patients. The pain location was found in the lateral area in 24 (51 %) patients, in the occipital area in 13 (27.6 %) patients, and in the front area and diffuse in 5 (10.6 %) patients. There were 19 boys (57.6 %) and 14 girls (42.4 %) in the control group. The median age of this group was 11.3 ± 0.4 years. In this group, 29 children (87.9 %) were right-handed and 4 of them (12.1 %) were left-handed. In terms of laterality task motor imagery right-left discrimination respond times, a significant difference was determined between the groups ($p<0.05$). A statistically significant difference was found between the right-left accuracy percentages between the groups ($p<0.05$). Comparison of laterality task evaluations between groups are shown in Figures 2 and 3. No statistically significant connection was found in the headache group in terms of accompanying findings and right-left lateralization findings ($p>0.05$). The effect of headache duration and severity on lateralization findings was not statistically significant ($p>0.05$). Right-left response times and accuracy percentages according to the dominant hand are shown in Table 2. The increase in right and left accuracy percentages showed a statistically significant correlation with age in both groups.

Table 1. The physical and sociodemographic characteristics

	Headache Group	**Control Group**
Male	28 boys (59.6 %)	19 boys (57.6 %)
Years	11.8 ± 0.27 years	11.1 ± 0.6 years
Heights	137 ± 4.1 cm	141 ± 6.5 cm
Female	19 girls (40.4 %)	14 girls (42.4 %)
Years	10.9 ± 0.63 years	11.7 ± 0.27 years
Heights	143 ± 8.7 cm	145 ± 4.21 cm
Right handed	40 (85.1 %)	29 (87.9 %)
Left handed	7 (14.9 %)	4 (12.1 %)

Table 2. Comparison of right-left respond times and accuracy rates according to handedness between groups

		Right Accuracy Percent (%)	Right Respond Time (s)	Left Accuracy Percent (%)	Left Respond Time (s)
Headache Group	Right-Handed (n=40)	46.75 ± 2.3	1.88 ± 0.03	44 ± 1.7	2.02 ± 0.07
	Left-Handed (n=7)	35.7 ± 2.97 $^{\beta}$	1.9 ± 0.07	51.4 ± 4 $^{\beta}$	1.62 ± 0.11 $^{\beta}$
Control Group	Right-Handed (n=29)	67.5 ± 1.96	2.56 ± 0.09	67 ± 1.91	2.63 ± 0.15
	Left-Handed (n=4)	65 ± 2.88	2.5 ± 0.35	75.3 ± 0.5 $^{\alpha}$	2.25 ± 0.3 $^{\alpha}$

n = number of patients, Data are reported as means ± SEM
α: Comparison of left-handed control group and right-handed control group $p < 0.05$
β: Comparison of left-handed headache group and right-handed control group $p < 0.05$.

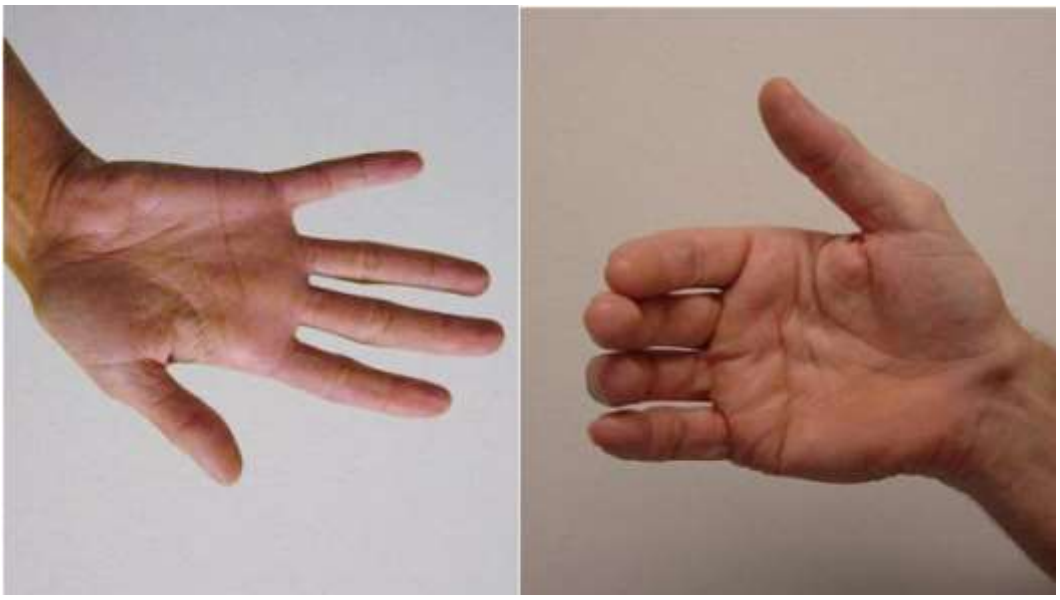

Fig. 1. Sample images used in the left/right judgement tasks

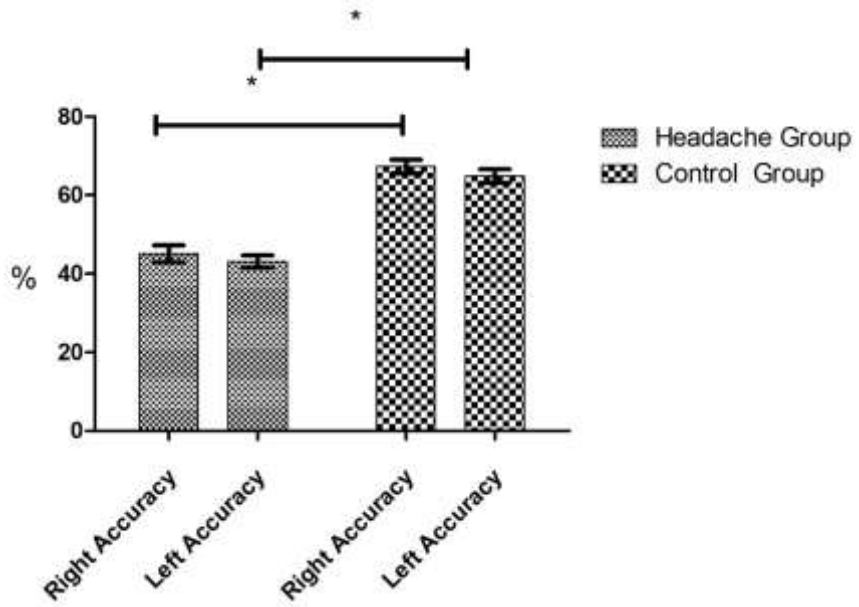

Fig. 2. Comparison of accuracy rates between groups

*P < 0.05

Data are reported as means ± SEM

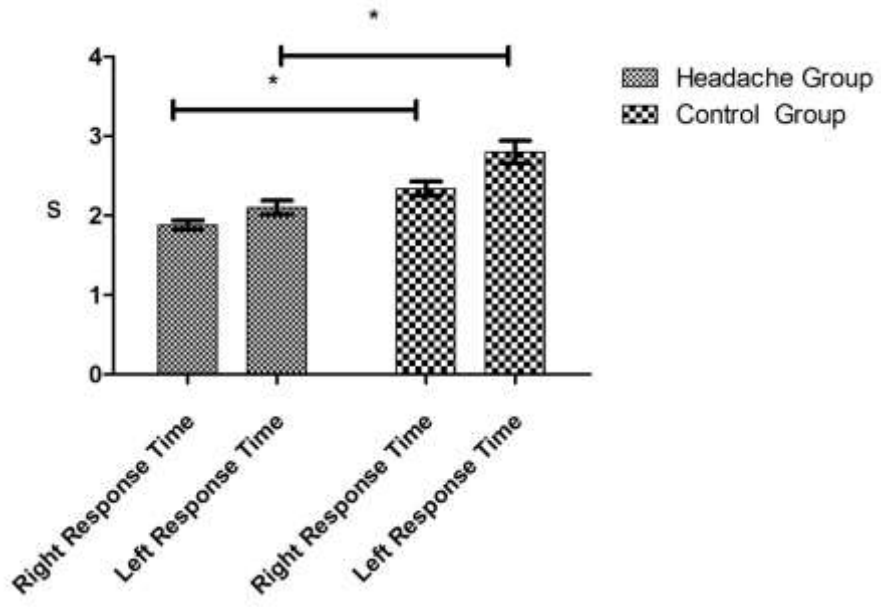

Fig. 3. Comparison of response times between groups

*P < 0.05

Data are reported as means ± SEM

Discussion

We assumed in this study that children with recurrent headaches might have impaired laterality task decision-making times and lower implicit imagery capacity. The data we obtained partially supported our hypothesis. Today, a significant portion of the rate of admission to the emergency department is children with headache complaints, and this rate is increasing. Headache can cause significant disruptions in the daily routine and social life of children (22). Other than organic causes such as migraine, intracranial mass, hypertension, visual impairments, and intracranial infections, tension-type headaches caused by psychosocial stress constitute the majority of causes (23,24). Recurrent headaches affect the way of thinking of children and may cause decreases in academic success (22,25). In this study, when the decision-making times for laterality tasks were examined, the accuracy level of the answers given was found to be significantly lower than in the control group, despite the fact that the decision-making times were relatively fast. When the existing literature was examined, it was discovered that in patients with diseases affecting motor functions such as cerebral palsy, implicit imagery capacities were significantly reduced on the affected side (16). In fact, it has been reported that there is a significant increase in this capacity with motor imagery training in these patients. Furthermore, the imagery capacities of adult patients with chronic pain complaints were examined, and it was discovered that chronic pain have a negative impact on their implicit imagery capacity (26). Also, some studies have reported that localization of pain is ineffective in reducing imagery capacity (26). Since no correlation was found between headache localization and accuracy rate in this study, it was assumed that headache localization did not affect the decision-making process, and this data was found to be compatible with the current literature. In this study, it was determined that the accuracy rate of decision-making process in children with recurrent headache independent of headache localization was lower than in the typically developing group. It is thought that more studies are needed to investigate the related factors affecting motor imagery abilities in children with recurrent headache.

Motor imagery ability follows a process that develops with age. For this reason, age can be an important factor in tests related to motor imagery. In this study, motor imagery accuracy percentages increase with age and show us a certain correlation, and offer us data compatible with the literature (27). According to the results of the present study the data obtained from children with recurrent headache complaints suggest that not only the age factor, but also

other factors affecting the general condition of the child may be effective in determining the motor imagery ability.

Handedness is another effective factor in the evaluation of motor imagery capacity. It has been reported that it gives better results in the evaluation of motor imagery laterality tasks, especially in left-handed children (20). With the data obtained in this study, the results in left-handed patients were determined as significantly better in both groups.

It has been stated that with more severe pain were reported to have more impaired implicit motor capacity than those with less severe pain (28). There was no significant correlation between pain severity and implicit motor capacity according to the data obtained in this study. The likely reason for this is that headaches last for a shorter period in children, although their severity is excruciating.

Conclusion

In conclusion, children with recurrent headaches were found to have a lower implicit motor capability in our study. Age and handedness are two factors that have an affirmative impact on this. We consider that the motor imagery skills of children with recurrent headaches and the factors affecting their skills should be examined in detail by conducting more comprehensive studies.

Conflict of interest

The authors declare no competing interests.

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