A study on refractive errors in school children with complaints of headache in a rural tertiary care hospital

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Abstract

Purpose: To evaluate refractive errors among school children with complaints of headache and to compare it with children without headache.

Methods: This is a prospective cross-sectional study of 414 school children with complaints of headache, aged between 12 and 18 years and 414 children of same age group without headache as control group. Headache complaints were measured by a structured questionnaire. All children underwent a comprehensive ophthalmological examination. Both subjective and objective refraction was done for all children. They were classified into three groups according to refractive errors; myopia, hypermetropia and astigmatism.

Results: The study included 252(60.87%) girls and 162(39.13%) boys with headache and 227(54.83%) girls and 187(45.17%) boys without headache as control group. Mean age of the participants was 13.71± 2.21 years in headache group and 14.45±1.96 years in control group. Among 228(55.1%) children in headache group with refractive errors, 28(12.3%) had myopia, 61(26.8%) had hypermetropia and 139(60.9%) had astigmatism. Out of 72(17.39%) children in control group with refractive errors, 48(66.7%) had myopia, 14(19.4%) had hypermetropia and 10(13.9%) had astigmatism. We observed that refractive error is a risk factor for headache among children with odds ratio 5.38 in comparison to control group and difference was statistically significant ($p<0.05$).

Conclusions: This study enhances our understanding of the relationship of headache and refractive errors to improve opportunities for its treatment and prevention. An ophthalmologist can play a vital role in the control of headache complaints in school children.

Keywords: Astigmatism, Headache, Hypermetropia, Myopia, Refractive errors.

Introduction

Headache has been defined as the pain located above orbitomeatal line.(1) The Global Burden of Disease Study 2010 (GBD2010) has placed headache disorder among the top ten causes of disability worldwide. Headaches are often associated with significant drop in quality of life, absenteeism from school among children.(2) Considering the high prevalence and negative impact on life, headaches are currently considered as a public health problem.(3) It can be divided into two categories; primary and secondary headaches. Primary headaches are migraine and tension–type headache. Secondary headaches include conditions of other etiologies.

Primary headaches are not associated with any structural, metabolic or other lesion of the body whereas secondary headaches have some exogenous disorders. Diagnosis and treatment of the headache is often difficult without knowing correctly the etiology.

According to Headache Classification Committee of the International Headache Society (HIS)(1) the criteria for Headache Associated with Refractive Errors (HARE) are described as.

1. Uncorrected refractive errors or mis-correction of refractive errors in one or both eyes,
2. Evidence of causation demonstrated by at least two of the following:
   - Headache has developed and/or significantly worsened in temporal relation to the onset or worsening of the refractive errors
   - Headache has significantly improved after correction of the refractive errors
   - Headache is aggravated by prolonged visual tasks at an angle or distance at which vision is impaired
   - Headache significantly improves when the visual task is discontinued.

The worldwide epidemiological studies have reported attack of headache at least once a year in 57-82% school children. By the age of 15, chronic recurrent headache occur in 75% children. In previous studies, the prevalence of refractive errors reported varies substantially from 13 to 80% in general population depending on geographical area and age group.(4,5) Refractive error was considered to be a possible cause for headache in some previous reports.(6,7,8)

The children comprise one third of the total population of our country and play a vital role in social and economical aspect of the society. Headache hampers their productivity and thereby it has a serious impact on the society. A child undergoes various physical and mental changes for their growth. Headache and refractive errors are common health related

complaints in India. Headaches in them lead to a poor quality of life and decease success in academic carrier. It is one of the common reasons to seek health care practitioner consultations by the school children. The assessment of headache in children is challenging and an accurate assessment is essential for its diagnosis and treatment. Uncorrected refractive errors in children have a considerable impact on their physical and mental development. So, corrective measures have to be taken at the earliest. The school children are frequently referred to eye clinics for headache. Pain is typically mild, behind the eyes, absent in the morning and relieved with eye rest. Proper refractive correction can improve headache in over 70% related to refractive error.[9]

In India, the prevalence of primary headache varies 9-11% in school children and uncorrected refractive errors in children vary from 2.63% to 14.7%.[2,10,11] Headache is common in girls. Its prevalence rate decreases at the advanced age.[3] Previous ophthalmological studies have reported ocular conditions like refractive errors, accommodative and vergence deficiencies,[12] acute glaucoma, ocular inflammation[8] as an etiology of headache.

The uncorrected refractive errors are often associated with frontal and /or occipital headache and can also exacerbate headache symptoms.[13,14] Eye strain as a direct cause of headache has been well documented in the literature.[7,8] A careful ocular examination and a possible correction of the refractive errors have been observed to reduce the symptoms of headache. In the literature various authors have claimed that spectacles for correction of low degree of refractive errors are effective to relieve headache symptoms.[15] One hypothesis is that low degree of astigmatism makes some changes in the visual perception to alter the hyper excitability in the visual cortex of the brain in subjects of headache.

Thomas et al[16] observed that 21% of patients with headache consult ophthalmologist and Whittington et al[17] reported that 45% patients attending for refraction had complaint of headache. Gordon et al in 1966 observed that minor refractive errors often cause more headache and symptoms of eyestrain than major errors.[18] Gil-Gouveia and Martins in 2002 reported an association between hyperopia and HARE in healthy subjects with uncorrected or mis-corrected refractive error compared to a control group.[7] The ciliary muscle over action has been suggested as possible cause of headache. Another possible mechanism is brow furrowing to maintain a clear image, can also causes headache.

In the literature, the evidence of strong association between oculovisual problems and headache is lacking.[13] Therefore, considering headache is a serious burden to children, this study was aimed to determine the relation between refractive errors and headache among children of 12 to 18 years old attending the ophthalmology outpatient department (OPD) in a rural tertiary care hospital of eastern India.

Materials and Methods

This is a cross-sectional study of 414 school children with complaints of headache, aged between 12 and 18 years was conducted over a period of one year from January 2016 to December 2016 in the ophthalmology OPD. We included school children who were referred from the medical, neurology, otorhinolaringology or psychiatry OPD with complaints of headache. We included 414 children of same age group without headache complaints in the study as control. The diagnosis of secondary headache was done according to International Classification of Headache disorders: 3rd edition (Beta version), based on physical and neurological examinations, relevant investigations, CT and/or MRI scan of brain. This research protocol was approved by the Institutional ethics committee. All the investigations were done according to Helsinki declaration. The full informed consent was taken from guardians of all participants after explanation of the study procedures and participants were allowed to abstain or withdraw from the research at any point without having to give any reason. The identity of the study group and those excluded from the study were masked from the clinician so that all the tests can be performed with equal emphasis to every patient.

At first, every child was asked whether they usually suffered from headache or not. If the answer was negative, he/she was considered as a control. We included subjects with positive response in our study. The subjects were interviewed with structured questionnaires about demographic data (age, sex) and to identify the subjects having headache associated with refractive errors (HARE) according to current HIS diagnostic criteria. Those having other types of headache were excluded from the study. The participants in the study group were then asked about frequency, location, time of onset, duration, severity and intensity of headache. It also included presence of any aggravating factors, family history and history of trauma, medical history, dental caries, sinusitis, features of raised intracranial pressure, menstrual disturbances, previous ocular surgeries and use of medicines.

School children with systemic diseases like migraine, tension-type headache, sinusitis, and intake of medicines, dental caries that cause headache or ocular conditions like amblyopia, squint, acute glaucoma, uveitis optic neuritis were excluded from the study.

Visual acuity was measured in each eye at 6 meter distance with internally illuminated Snellen's chart and near vision was recorded at 33 cm with Jagger's chart under good illumination.

Refractive error was measured by subjective and objective refraction. Retinoscopy was done with steak retinoscope without cycloplegics the working distance of 50 cm to estimate refractive status of the patient

objectively by a single observer without knowing the result of headache questionnaire. Thereafter, subjective refraction was done with appropriate corrective lenses. The spherical and astigmatic deviations were measured to the nearest 0.50 Dioptres (D). They were classified into three groups according to spherical equivalent refractive error (SERE). No SERE was considered as emmetropic whereas SERE +0.50 D or more was considered as hypermetropia and SERE -0.50D or more was considered as myopia. Myopia was categorized into mild (upto -3.0 D), moderate (upto -6.0 D) and severe (more than -6.0 D) subgroups. Hypermetropia was categorized into mild (upto +3.0 D), moderate (upto +6.0 D) and severe (more than +6.0 D) subgroups. The children with bilateral myopia or hypermetropia were classified into subgroups according to the more myopic or hypermetropia eye respectively. Astigmatism was considered when cylindrical component of the refractive error was ±0.50 Dcyl or more. The axes of astigmatism were measured to the nearest five degrees and negative cylinders being used for all measurement. The astigmatism was categorized into three groups according to the axis of corneal astigmatism as with the rule, against the rule and oblique type.

Slit lamp biomicroscopy and fundus examination were done to rule out any anterior or posterior segment ocular pathology. Ocular motor functions were evaluated in six cardinal gazes. Intraocular pressure was measured with Goldman tonometer.

Statistical analysis of headache and control groups were done by calculating t-test to compare means of two groups, chi-square test for non-parametric data, odd ratio (OR) and 95% confidence intervals(CI) were calculated to compare the relative risk of the groups for categorical variables Statistical significance was set at $p < 0.05$. Statistical software SPSS version 20.0 was used to analyze the data of the study.

Result

A total of 414 School children with complaints of headache and 414 School children without headache as control normal group participated in the study. It included 252(60.87%) girls and 162(39.13%) boys in headache group and 227(54.83%) girls and 187(45.17%) boys in control group (Table 1).

Table 1: Age, sex and previous examination in headache (n=414) and control (n=414) group

Study groups	Mean age (years)	Sex (%)		Previous examination (%)	
		Male	Female	Yes	No
Headache	13.9± 2.09	162 (39.13%)	252 (60.87%)	236 (57%)	178 (43%)
Control	14.02± 1.96	187 (45.17%)	227 (54.83%)	94 (22.71%)	320 (77.29%)

Minimum age of a child was 10 years and maximum age was 18 years in both the groups. Mean age of the participants was 13.71± 2.21 years in headache group and 14.45±1.96 years in group without headache. Most of the children in headache group (238) and control group (208) were aged between 13 to 15 years. Two study groups were age matched with two-tailed P value <0.05, considered very significant and 95% confidence interval (CI) 1.22 TO 1.71.

Two hundred thirty six children (57%) had previous eye examination in headache group in contrast to only 94(22.71%) in control group and it was observed to be a risk factor for refractive error; OR 4.514 with 95% CI 3.339 to 6.100 and Fischer Exact test showed two sided p value was <0.0001.

Out of the 414 children with headache complaints, 124(29.95%) reported the frequency of headache as once or more in a week, 281(67.87%) reported intensity as mild and 164(39.61%) had average duration of headache of more than an hour.

All the children were tested with retinoscope for the refractive errors and appropriate corrections were prescribed. Most of the children, 302 (72.9%) in headache group had near normal visual acuity and 228 (55.15%) had refractive errors in contrast to 72(17.39%) in control group (Table 2).

Table 2 Frequency of ocular morbidity in headache and control groups

Ocular morbidity	Frequency (%) in headache group	Frequency (%) in control group
Visual acuity	414(100)	414(100)
6/6-6/9	302(72.9)	298(71.98)
6/12-6/60	109(26.3)	104(25.12)
<6/60	03(0.8)	12(2.90)
Refractive error	228(55.1%)	72(17.39%)
Myopia	28(12.3%)	48(66.7%)
Hypermetropia	61(26.8%)	14(19.4%)
Astigmatism	139(60.9%)	10(13.9%)

Among children with headache complaints, 28 (12.3%) had myopia, 61(26.8%) had hypermetropia and 139(60.9%) had astigmatism. Out of 72(17.39%) children with refractive errors in control group 48 (66.7%) had myopia, 14(19.4%) had hypermetropia and 10(13.9%) had astigmatism. To quantify the association between refractive errors in headache and control groups we had calculated OR with 95% CI as 5.38(3.90 to 7.41).The prevalence of refractive errors were higher in children with headache group than in controls and difference was statistically significant ($p<0.05$) (Table-3).

Table 3: Comparison of the prevalence of refractive errors between headache and control groups

Refractive errors	School Children		p-value	Odds ratio	95% confidence interval
	Headache group(n=414)	Control group (n=414)			
Astigmatism	139	10	<0.0001	19.10	9.87-36.98
Hypermetropia	61	14	<0.0001	4.61	2.53-8.40
Myopia	28	48	0.0096	0.51	0.31-0.83
Total	228	72	0.001	5.38	3.90-7.41

The prevalence of myopia in headache group (12.3%) was less than the control group (66.7%) and hypermetropia was significantly more prevalent in headache group (26.8%) than the control group (19.4%). The relative risk of these two refractive errors was significant between the two groups. Astigmatism was significantly more prevalent in headache group (60.9%) compared to the control group (13.9%). The relative risk of astigmatism and myopia between two groups are statistically significant. Prevalence of different types of refractive errors in headache and control groups with p value, OR and 95% CI are summarized in Table 3. Chi square test (112.51) also showed significant association between refractive errors with headache. The classification of refractive errors was divided into mild, moderate and severe myopia or hypermetropia among children with headache and control groups are tabulated in Table 4.

Table 4: Classification of different types of refractive errors in two groups

Group	Number of children								
	Myopia			Hypermetropia			Astigmatism		
	Mild	Moderate	Severe	Mild	Moderate	Severe	With the rule	Against the rule	Oblique
Headache	15	13	0	53	08	0	31	82	26
Control	26	10	12	11	03	0	07	03	0
Total	41	23	12	64	11	0	38	85	26

Discussion

Our hospital covers about five million mostly rural population of low socio-economic status who don't have access to the well facilitated health care services nearest to their residence. The children are referred from various primary and secondary health care institutions, departments of our hospital with complaints of headache are challenging to manage because most of the time they are not satisfied due to recurrence of headache.

In the present study the prevalence of refractive errors was higher in headache group 228(55.1%) compared to control group 72(17.39%). The difference between two groups was significant, similar to observations in the previous studies. Mean age of the participants in this study was 13.71± 2.21 years in headache group and 14.45±1.96 years in group without headache. In both the groups, number of girls was more than the boys.

Because of psychological stress of education in the teaching institutes and family for better career, in our study 236(57%) children had previous eye examination within last six months in comparison to 94(22.71%)in control group. The children with headache complaints had more previous eye examinations than control group due to the fact that their parents thought that their eyes are the source of headache. Most of children consulted more than one ophthalmologist as they were not satisfied with headache management by the consultant for a longer period.

In this study, the prevalence of refractive errors was 55.1% in headache group compared to 17.39% in normal subjects. The difference between two groups was significant which corroborates with the observations of previous reports. The prevalence of refractive errors was higher in our study among the children with headache complaints comparing to the study of Cameron et al and Jain at al[19] and the study of Biswas J et al,[20] Ghosh S et al[11] in urban children of eastern India. These discrepancies are due to the fact children in our study mostly resides in a geographical area marked as one of the backward districts of India and most of them were reluctant to receive medical care services for the health problem.

Jain S et al (2015) reported 36% ocular etiology for headache complaints cases, of which 65% were due to refractive errors and out of which 41%, 22%, 12% was due to astigmatism, hypermetropia, myopia respectively.[19] In our study, we also found 55.1% children had refractive errors with complaints of headache out of which 60.9%, 26.8%, 12.3% was due to astigmatism, hypermetropia, and myopia respectively.

In our study, 28 (12.3%) of the school children in headache group and 48 (66.7%) of control group had myopia. The number of students with myopia in headache group was lower than student with hypermetropia and astigmatism in that group. Therefore, myopic subjects had lower headache complaints in comparison with hypermetropia and astigmatism type of refractive errors.

In this study, prevalence of hypermetropia in 61(26.8%) children was more in the headache group compared to 14(19.4%) children in control group and the difference was statistically significant ($p<0.0001$). The ciliary muscle contraction and increase accommodation effort in hypermetropic subjects might result in higher rate of headache complaints in these subjects.[21] Eye brow furrowing, prolonged contraction of muscles of brow, neck and scalp is another possible explanation of headache in them.

In this study 139(60.9%) children in headache group and 10(13.9%) children in control group had astigmatism. Out of 139 children in headache group with astigmatism, 31 had with the rule, 82 had against the rule and 26 had oblique type of astigmatism. The changes of astigmatism from infants to adolescents have been documented in various studies.[22] There is a gradual change of astigmatism from against the rule towards with the rule from infancy to young adulthood. Astigmatism with the rule is less symptomatic in comparison to with against the rule.[23] In previous studies, the higher risk of headache in school children was explained by the fact that they usually have against the rule astigmatism.[24]

In our study, regarding the severity of refractive errors among headache group, our children had mild and moderate myopia, mild and moderate hypermetropia and all types of regular astigmatism. So, no subjects in this study had severe myopia, severe hypermetropia and irregular astigmatism.

Conclusion

In this study, headache complaints show statistically significant association with refractive errors among children. The association between refractive error and headache indicate that refractive error might be a risk factor for headache in children. This study enhances our understanding of the relationship of headache and refractive errors to improve opportunities for its treatment and prevention.

Possibility of refractive errors as an etiology of headache should be kept in mind. An ophthalmologist can play a vital role in the control of headache complaints in school children.

In the study, children were recruited from hospital OPD. So, we were selective in our case selection and excluded any child with headache of known etiology. A small sample size and inadequate masking is the probability of high prevalence of refractive errors among the children with headache complaints in our study. Therefore further investigations on refractive errors with its severity and type of astigmatism among children are needed to establish a definite correlation with headache.

Based on the findings in our study, it can be concluded that the different types of refractive errors and headache are linked very closely. Therefore, thorough evaluation of refractive errors should be done for appropriate management and to relieve headache in children for better quality of their life.

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