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Pattern and Distribution of Accommodative and Non-Strabismic Binocular Dysfunctions among Pediatric Age Group (6-18 Years)

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ABSTRACT

Purpose: To determine the prevalence of accommodative and non-strabismic binocular dysfunction among pediatric age group (6-18 years).

Methods: It was an observational study of one year duration. Total 187 children, vision 6/6 in both eyes having headache and asthenopia symptoms were included in the study. Patients having ocular media opacity, inflammation & manifest misalignment were excluded. Measurement of visual acuity, pupillary reaction, cover test, extra ocular motility, near point of convergence (push-into-double), amplitude of accommodation (push-into-blur), MEM dynamic retinoscopy, accommodative facility (± 2.00DS flipper lenses), negative relative accommodation, positive relative accommodation, AC/A-ratio (Gradient-method), fusional vergence (step vergence with prism bar), Binocular single vision, stereopsis and funduscopy with cycloplegic refraction were done.

Results: Among 187 children; 34.2% were boys and 65.8% were girls. The percentage of accommodative anomalies were: accommodative insufficiency-10.6%, accommodative infacility-10.2% and accommodative excess-3.2%. Among the non-strabismic binocular dysfunctions were: Fusional vergence dysfunction 36.9%, convergence insufficiency 21.4%, convergence excess 2.1%, divergence excess 11.2%, divergence insufficiency 1.1%, basic exophoria 2.7% and basic esophoria only 0.5%. Percentage of refractive error estimates were: emmetropes 32.6%, simple myopia 17.6 %, simple hyperopia 18.2%, simple myopic astigmatism 14.4%, Simple hyperopic astigmatism 6.4%, Compound myopic astigmatism 4.3%, compound hyperopic astigmatism 5.9% and Mixed astigmatism 0.5%.

Conclusion: Occurance of Accommodative and Non-strabismic binocular vision problems is very high in children. Meticulous orthoptic evaluation, appropriate diagnosis and treatment may solve the problems in children.

Keywords: Refractive error, Prevalence, Accommodative anomalies, Non-strabismic binocular dysfunctions.

Introduction

Today in our changing environment and working pattern, the near and intermediate visual task have increased dramatically; consisting of work of computer and related gazettes, reading books, watching television. This needs lots of work to our external eye muscles which leads to eye fatigue.

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These also give rise to number of binocular anomalies in accommodation and convergence[1].

Accommodative anomalies and non-strabismic binocular dysfunctions are vision disorders that affect the clarity and binocularity, and impair comfort and efficiency of visual performance of subjects. Particularly when near tasks such as reading, writing and computer-based works are performed[2,3,4].

Accommodative anomalies are characterized by inadequate accommodative accuracy and sustain-ability, inadequate amplitude, flexibility and facility and are non-reactive and non-aging neuromuscular abnormalities of the visual apparatus[5,6,7].

According to accommodative anomalies, the classification includes the anomalies of accommodative insufficiency (AI), Accommodative excess (AE) and Accommodative infacility[4,8,9].

Nonstrabismic binocular disorders are classically defined by comparing phorias, or latent deviations of the visual axes, at near and far distances[10,11]. Although there have been several classifications to categorize binocular disorders[12,13], the most common classifications of nonstrabismic binocular dysfunctions are convergence insufficiency (CI), divergence insufficiency (DI), convergence excess (CE), divergence excess(DE), basic exophoria, basic esophoria and fusional vergence dysfunction[4,14].

Accommodative and nonstrabismic binocular dysfunctions anomalies results from imbalance between these functions and the anomalies are aggravated by prolonged visually demanding near tasks, resulting in symptoms[2,7,15,16]. Grisham et al., demonstrated that there was an increased in the number of asthenopic complaints during reading compared to when not reading. They suggested that visual symptoms are a factor in reducing reading performance in symptomatic individual[17,18]. These symptoms may include blurred far or near vision, headache, difficulty in reading and in many cases, impossibility to maintain clear vision for a reasonable period of time[4,19].

In a pediatric population, the prevalence of binocular (strabismic and nonstrabismic) vision have been found to be 8.5 times greater than the prevalence of any other ocular diseases in children 6 to 18 years of age[20]. Porcar and Martinez-Palomera et al[21], have reported that Prevalence of accommodative and nonstrabismic binocular vision problems has been found to be as high as 32.3% in pediatric age population. It is very common in ophthalmology and optometric practices and occasionally it is misdiagnosed.

There is limited study published in Bangladesh on pattern of accommodative and nonstrabismic binocular dysfunctions among pediatric age group. Hence the present study will help to find out how much children's are affected and also give us baseline information about possible diagnosis of the condition and decision regarding the process to be followed. The objective of this study were to determine the pattern of accommodative and nonstrabismic binocular dysfunctions among pediatric age group along with the demographic profile of the study population as well as too evaluate visual and refractive status of those children.

Methodology

The study was a hospital based cross sectional study. It was conducted for one year at the orthoptics clinic of Chittagong Eye Infirmary and Training Complex (CEITC). Total 187 symptomatic subjects were examined who were children from 6 to 18 years and diagnosed with accommodative or non-strabismic binocular dysfunctions. The subjects who had any previous ocular surgery or treatment for those symptoms, who had amblyopia, nystagmus or any horizontal or vertical manifest deviation were excluded from the study.

The eye examinations were done according to the need of the individual. All necessary investigations such as visual acuity assessment, refractive status assessment, binocular vision assessment, near point of convergence, amplitude of accommodation, negative and positive relative accommodation, accommodative facility, accommodative convergence by accommodative ratio (AC/A-ratio) were recorded. Gradient method for the measurement of AC/A-ratio was used. Fusional vergence and binocular single vision (BSV) and stereopsis were assessed also. All collected data were analyzed with computer program SPSS (version 16.0). Frequencies tables were used to describe the data; mean with standard deviation and ranges were determined. All data were assessed for normality using the one sample Kolmogorov- Smirnove Test. Graphical presentation of data was done with Microsoft Office excel data sheet.

Results

Total 187 children with complaining of asthenopic symptoms were included in this study; the mean age of patients was 13.27±2.96 years, ranging from 6 to 18 years. Out of 187 subjects; male was 34.2% and female was 65.8% (Table: 01). The number of female patient is more in increased age group in our study.

Table-01: Age and gender distribution

Contents		Percentage (%)
Age	6 -10 Years	21.90
	11-15 Years	55.10
	16 – 18 Years	23.0
Gender	Male	34.20
	Female	65.80

Visual status

Unaided Distance Visual acuity of the study patients:
Out of 187 subjects, most frequent range of unaided visual acuity in Right eye and Left eye had 0.00 LogMAR (Snellen's 6/6) and the percentage were 74.9% in right eye and 71.4% in left eye (Figure-1).

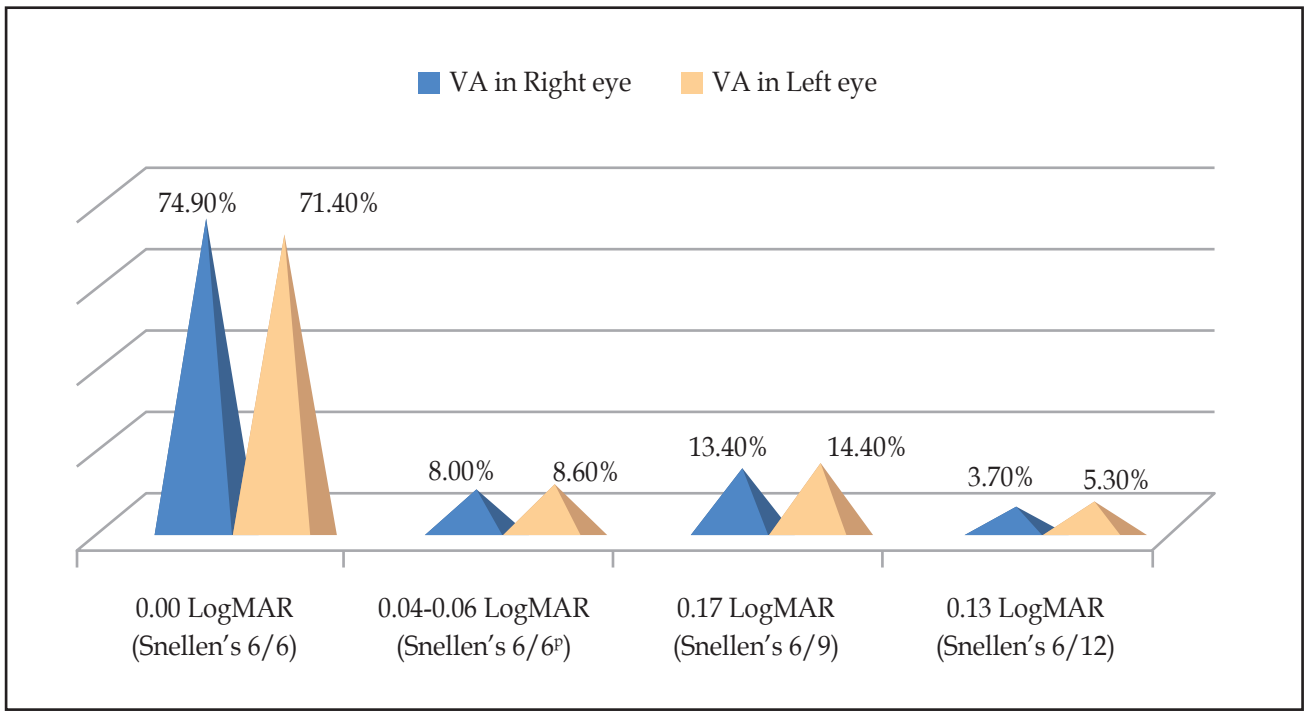

Figure-01: Percentage distribution of unaided distance visual acuity in Right and Left eye

Aided Distance Visual acuity of study patients:

In this study, all patients acquired best corrected vision in both eyes LogMAR 0.00 (Snellen's 6/6).

Diagnosis of Refractive Error:

The prevalence of refractive error were: 32.6% emmetropia, 17.6% simple myopia,18.2% simple hyperopia, 14.40% simple myopic astigmatism, 6.4% simple hyperopic astigmatism, 4.3% compound myopic astigmatism, 5.9% compound hyperopic astigmatism and 0.50% mixed astigmatism (Figure-2).

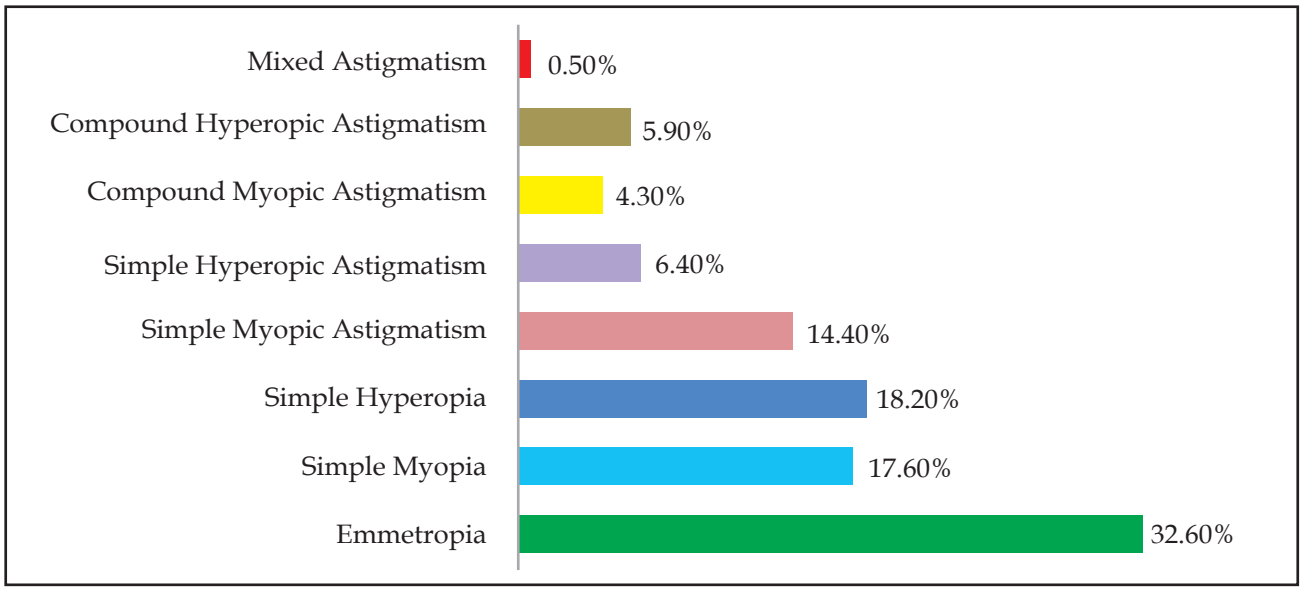

Figure-02: Percentage distribution of Refractive Error

Diagnosis of Accommodative and Non-Strabismic Binocular dysfunctions:

The prevalence of accommodative insufficiency was 10.70%, accommodative infacility 10.20% and accommodative excess 3.20%). The prevalence of fusional vergence dysfunction was 36.90%, convergence insufficiency 21.4%, convergence excess 2.10%, divergence excess 11.20%, divergence insufficiency 1.1%, basic exophoria 2.70% and basic esophoria 0.50% (Figure-3).

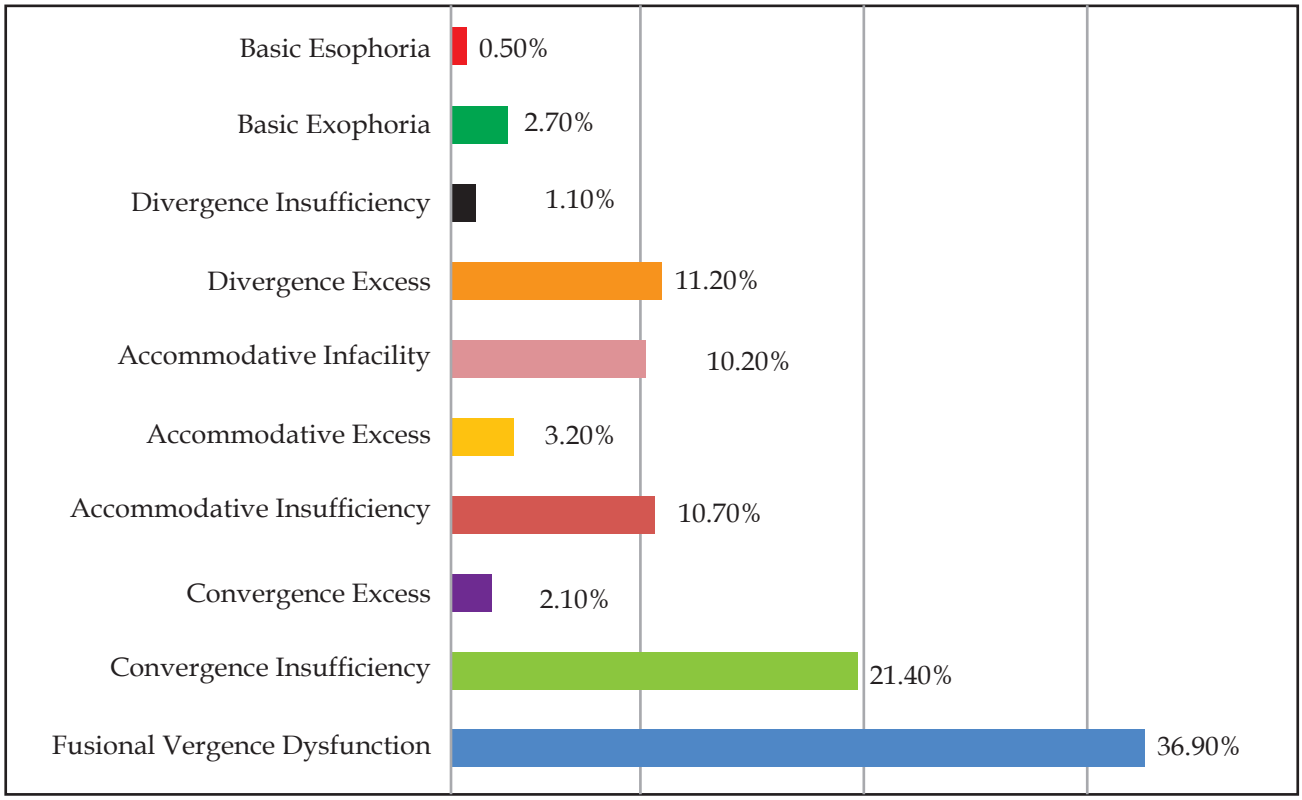

Figure-03: Percentage distribution of Accommodative and Non-strabismic Binocular Dysfunctions

Management:

Among total study patients, 2.7% were treated with only spectacles; 12.8% with only convergence exercise; 13.9% only fusional vergence exercise; 4% only with accommodative exercise; 23.5% with spectacles along with convergence exercise; 23% with spectacles along with fusional vergence exercise; 19.3% with spectacles along with accommodative exercise (Figure-4).

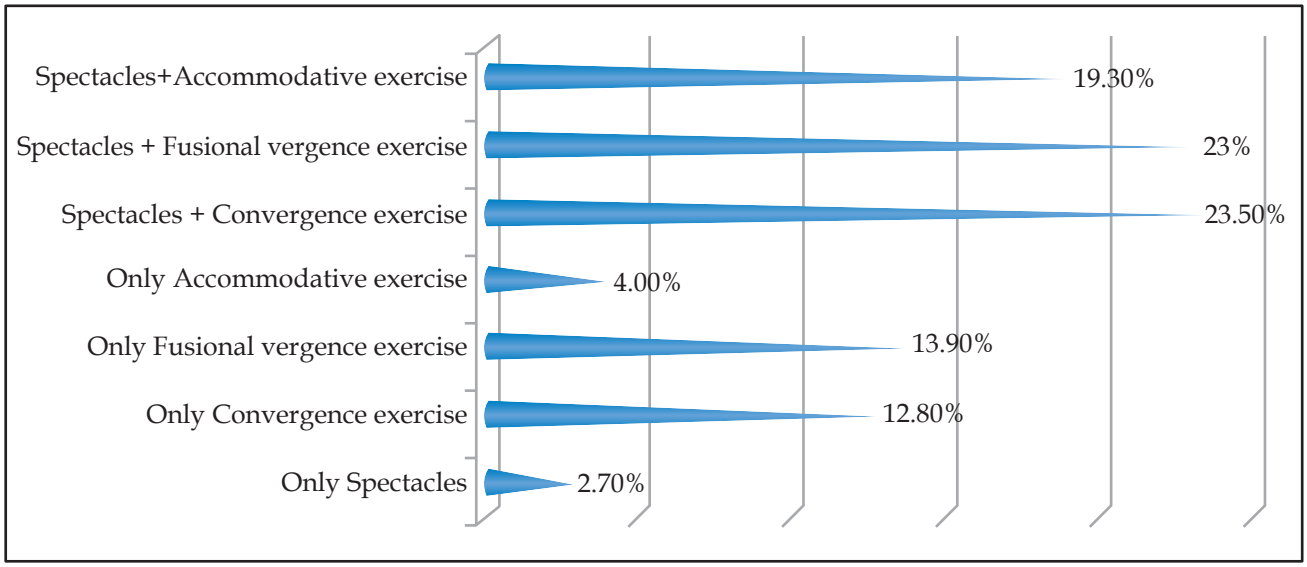

Figure-04: Percentage distribution of management protocol

Discussion

This prospective study was conducted using clinical diagnostic criteria and comprehensive optometric evaluation of the distribution accommodative and non-strabismic anomalies in pediatric population in CEITC. An important result of this study is that other than refractive errors such as hyperopia, myopia and astigmatism, the eye care practitioners most likely encounter binocular and accommodative dysfunctions in pediatric population. The high percentage determined here gives credence to previously published literature indicating that besides refractive error, binocular and accommodative anomalies will be the most frequent source of visual complains in pediatric population[3-7].

In this study, out of 187 patients, 24.1% (N=45) were accommodative dysfunctions and 75.9% (N=142) nonstrabismic binocular dysfunctions. Overall nonstrabismic binocular dysfunctions were more prevalent than accommodative dysfunctions especially Fusional Vergence Dysfunction (FVD) (36.9%) which was more prevalent than accommodative anomalies 24.1%. This study used same dianostic criteria as in the studies of Stefania et al[1], Porcar et al[12] and Pilar-cacho-martinez[13].

In our study, the prevalence of accommodative and nonstrabismic binocular dysfunctions was distinguished from other studies. Porcar E st. al, Shin HS et al, Hokoda SC et al , Garcia A et al and Montes- Mico[12,16,17,19-20] showed that accommodative dysfunctions were more prevalent than nonstrabismic binocular dysfunctions which is not consistent with our studies. This is because of in this study, the total participants included only those with binocular dysfunctions, similar in Shin et al[16] and Garcia et al[19] where as other studies, the total participants included those with normal, refractive error and general binocular dysfunctions. In terms of accommodative dysfunctions, there was a higher prevalent of accommodative insufficiency (10.7%) than accommodative infacility 10.2% and accommodative excess 3.2%. The 10.7% prevalence of accommodative insufficiency is similar to 10% reported by Metsing and Ferreira et al[5] but lower than 39% reported by Stefania et al1, with Benzoni and Rosenfield et al[31] repoting 36%, Diwakar Rao[3] reporting 30.2%, Moodley[29] reporting 24%, Shin et al[16] reporting 18.3%, Abdi and Rydberng et al[25] reporting 24.2%, Sterner et al[24] reporting

34% and Borsting et al[22] 17%, where as our result of accommodative insufficiency were significantly higher than the other authors[2-3,9,12-13,23,27-28].

In this study accommodative infacility was 10.2% more than accommodative excess 3.2%. Similarly, Stefania et al[1] reported that accommodative infacility 39% were more than accommodative excess 5.1% but was higher than in our study. The findings of accommodative infacility 10.2% is lower than the 12.3% reported by Metsing and Ferreira et al[5] even though Shin et al[16], Moodley[29], wick and Hall[33] and Daum[21], which is comparable to our findings of 20% for poor accommodative infacility, although they studied younger children aged between 6 and 13 years. In our study, the findings of accommodative excess 3.2% was lower than the 5.1% reported by Stefania et al[1], with Diwakar Rao[3] reporting 16.9%, Pilar cacho-Martinez et al[13] reporting 15%, E.Porcar[12] reporting 10.8% and Lara et al[18] reporting 6.4% but higher than the other authors[2,9,16].

In terms of nonstrabismic binocular dysfunctions, the fusional vergence dysfunctions was most prevalent 36.9% compared to the convergence insufficiency 21.4% and the divergence excess 11.2%. According to Stefania et al[1], the prevalence of fusional vergence dysfunctions was 4.7%, with Diwakar Rao[3] reporting 5.6%, Scheiman et al[9] reporting 0.6%, Pilar cacho-Martinez et al[13] and E.porcar[12] were reporting a same result 1.5% repectively, whereas in our study the prevalence of fusional vergence dysfunction was higher but J.U. Jang et al[2], S.O. Wajuihian and R.Hansraj et al[7] and Lara et al[18] were no found any fusional vergence dysfunction. For convergence anomalies the convergence insufficiency 21.4% was most prevalent than the convergence excess 2.1%. This is much higher compared to 12.6% reported by Stefania et al[1], J.U. Jang et al[2] reporting 10.3%, S.O. Wajuihian and R. Hansraj et al[7] reporting 17.6%, Diwakar Rao3 reporting 16.9%, Abdi and Rydberg et al[25] reporting 18% also reporting other authors[4,9,15,18,22-23,26] but lower than the other authors[13,16]. Although numbers vary considerably between studies, it is important to note that commonality amongst them is that convergence insufficiency accounts for a significant percentage of non-strabismic binocular anomalies in the pediatric clinical population.

In this study, convergence excess 2.1% which was less prevalent than the Stefania et al[1] reporting 9.1%, with S.O. Wajuihian and R. Hansraj et al[7] reporting 3.2%, Diwakar Rao[3] reporting 7%, G.O. Ovenseri-Ogbomo et al[4] reporting 6% and also reporting other authors[9,15-16,18,27-28] but higher than J.U. Jang et al[2] and Borsting et al[22].

In this study, divergence excess 11.2% which was more prevalent than divergence insufficiecy 1.1%. Diwakar Rao[3] reporting divergence insufficiency 11.6% and divergence excess 5.2% that was almost opposite in our study. Stefania et al[1] reporting divergence insufficiency 2.7% higher than divergence excess 1.3%. G.O. Ovenseri-Ogbomo et al[4] reporting divergence excess and divergence insufficiency were same in 2% respectively. We found in our study, basic exophoria 2.7% was more prevalent than basic esophoria 0.5%. According to Stefania et al[1] basic esophoria 5.1% was more prevalent than basic exophoria 3.5% which was higher than in our study. Diwakar Rao[3] reporting basic exophoria and basic esophoria were same 2.1% respectively. J.U. Jang et al[2] reporting 1% basic exophoria but no found any basic esophoria, similarly Pilar Cacho-Martinen et al[13] which was lower than in our study. In our study, 19.30% patients were treated with Spectacles and accommodative exercise. Convergence insufficiency was 12.8% which were treated by convergence exercise with pencil push-up exercise and dot-card. 23.50% patients were treated with spectacles along with convergence exercise. Fusional insufficiency was 13.9% and treated were given by cat-stereogram.

Conclusion

The result of this study demonstrating the high percentage of accommodative and nonstrabismic binocular dysfunctions in a clinical pediatric population are significant for Opthalmologist, Optometrist, Clinicians, health care providers and academic institutions. In addition to the necessity for proper and complete visual evaluations, children are often misdiagnosed as having learning or reading disorders when, in fact, they may be suffering from an accommodative or nonstrabismic binocular dysfunctions.

Limitation: The sample size was limited for this study and stereopsis only recorded for near due to lackings of required clinical instruments.

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