BINOCULAR VISION PROBLEM AND AMBLYOPIA CASES IN IIUM OPTOMETRY CLINIC: A RETROSPECTIVE ANALYSIS

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ABSTRACT

Aim: To analyze the prevalence of binocular vision (BV) problem and amblyopic cases in the International Islamic University Malaysia Optometry Clinic (IIUM-OC), Kuantan Pahang, Malaysia.

Methodology: The present clinical-based retrospective study was conducted, and 1229 patient files from IIUM-OC presented from January 2017 to September 2018 were evaluated. All new cases files with diagnosis of BV problem and amblyopia were recorded and analyzed.

Results: The prevalence of BV problem and amblyopia are respectively, 13.59% (167 patients) and 3.42% (42 patients). From the BV problem cases, the highest prevalence is accommodation insufficiency (AI) 26.3% (44 patients), followed by convergence insufficiency (CI) 23.4% (39 patients), accommodation excess (AE) 18.0% (30 patients), accommodation infacility (AF) 7.8% (13 patients), divergence excess (DE) 3.6% (6 patients), basic exophoria 3.6% (6 patients), convergence excess (CE) 3.0% (5 patients), basic esophoria 3.0% (5 patients), ill-sustained accommodation (ISA) 1.2% (2 patients), and divergence insufficiency (DI) 0.6% (1 patient); while the remaining are the combination of various BV problems at 9.6% (16 patients). For amblyopia cases, the unilateral refractive amblyopia recorded as the major type at 50.0% (21 patients). Other causes of amblyopia include strabismus with 16.7% (7 patients), and bilateral refractive with 2.4% (1 patient); while the remaining cases are the combination causes with 31.0% (13 patients).

Conclusion: BV problem and amblyopia are prevalent in IIUM-OC which warrant proper management to provide a better care for the patients.

KEYWORDS: binocular vision problem, amblyopia, prevalence.

INTRODUCTION

Binocular vision (BV) problems and amblyopia are common eye disorders especially among children. Disorders affecting children will eventually result in permanent visual impairment if left untreated. Binocular single vision (BSV) is a state of simultaneous vision, which is achieved by the coordinated use of both eyes, to appreciate separated and slightly dissimilar images arising in each eye, as a single image by the process of fusion (Joly & Frankó, 2014). Thus, any ocular abnormalities disturbing the function of BSV, either sensory or motor disorders, are considered as having BV problem including vergence and accommodation problems (Akhgary et al., 2011). Problems affecting accommodation and vergence systems commonly present with a variety of associated symptoms depending on the type of causative disorders. Symptoms may include blur vision, difficulty in focusing at different distances, headache and ocular pain (García-Muñoz et al., 2014). General BV dysfunction may be characterized by diagnostic findings such as restricted or imbalanced vergence ranges, asthenopia responses during testing, suppression of binocular vision, defective stereopsis, and abnormal accommodative-convergence relationship (Optometric Vision Therapy Reimbursement Packet, 2011). Even though many cases have been successfully managed by prescription of therapeutic lenses or prisms, most general BV dysfunctions require optometric vision therapy to optimize visual comfort and efficiency (Optometric Vision Therapy Reimbursement Packet, 2011).

Amblyopia is a developmental disorder of the entire visual system, including the extra-striate cortex,

which is due to the degradation of retinal images during the critical period of visual development, which is normally to be the first 7 years of life (Birch, 2013). It may be due to the organic pathology of the visual pathways, visual deprivation or functional abnormalities (Orssaud, 2014). Amblyopia manifests mainly by impaired visual acuity in the affected eye, and is associated with decreased contrast sensitivity and stereoscopic vision (Orssaud, 2014). Early detection and management such as home and clinic based amblyopic therapies are crucial to ensure better prognosis and better vision outcome (Pascual et al., 2014).

Generally, global estimates of the amblyopia and strabismus prevalence among children and teenagers range from 0.20% to 6.2% and 0.13% to 4.7%, respectively (Chia et al., 2010). Studies also showed that 22.3% of a clinic population diagnosed with accommodative or BV dysfunction requires refractive error correction and other specific treatment (Lara, Cacho, García, & Megías, 2001). It was reported that about 7.53% of pre-schooled children in Malaysia diagnosed with amblyopia (Chew Lee Min et al., n.d.). Nevertheless, data on BV problem has yet be reported for Malaysia, especially for the east coast peninsular region. This study was conducted to report the prevalence of BV problems and amblyopia taken from the attending patients in the International Islamic University Malaysia Optometry Clinic (IIUM-OC) from January 2017 to September 2018.

MATERIALS AND METHODS

This retrospective study was conducted by collecting and retrieving all patients files presented in IIUM-OC from January 2017 to September 2018. The study duration began from September 2018 to February 2019, where data were strictly collected in a designated room to uphold patients' confidentiality.

Ethical approval for this study had been acquired from KAHS Ethics Committee (KAHS 88/18). Consent from the patients were obtained prior of every eye examination in IIUM-OC, allowing data from the files to be extracted, in accordance of the tenets of Declaration of Helsinki.

All patients' files were reviewed thoroughly, and files with diagnosis of any BV problem and amblyopia were recorded. The data recorded include the demographic information, sex, race, age; and clinical information including visual acuity, refractive error, final diagnosis and management.

RESULTS

A total of 1229 patient files were reviewed. Two hundred nine patients have been identified with BV problem and amblyopia. From the 209 patients, 167 patients have BV problems (13.59%) and 42 patients have amblyopia (3.42%) (Table 1).

The highest prevalence for BV problem is accommodation insufficiency (AI) at 3.58% (44 patients), followed by convergence insufficiency (CI) at 3.18% (39 patients), accommodation excess (AE) at 2.44% (30 patients), accommodation infacility (AIF) at 1.06% (13 patients), divergence excess (DE) and basic exophoria at 0.49% each (6 patients each), convergence excess (CE) and basic esophoria at 0.41% each (5 patients each), ill-sustained accommodation (ISA) at 0.16% (2 patients), and divergence insufficiency (DI) at 0.08% (1 patient).

The highest prevalence of amblyopia is due to unilateral refractive amblyopia at 1.71% (21 patients), followed by combination of refractive and strabismic amblyopia at 1.06% (13 patients), strabismic amblyopia at 0.57% (7 patients), and bilateral refractive amblyopia at 0.08% (1 patient).

The prevalence of BV is higher in females at 74.9% (125 patients out of 167 patients) (Table 2). The prevalence of amblyopia is also higher in females at 59.5% (25 patients out of 42 patients) (Table 5). Nevertheless, statistical analysis shows no significance difference in sex for both BV problems (p = 0.06) and amblyopia (p = 0.27).

The mean age of total patients with BV problem and amblyopia is 20.81 ± 9.45 years. The mean age of patients with BV problems is 21.79 ± 8.41 years (Table 3) and with amblyopia is 16.90 ± 12.23 years (Table 5). 96.41% of patients with BV problems aged younger than 40 years (161 patients) (Table 3). Patients' age between 11-20 years old dominates the statistic with 80 patients, mostly due to AI (Table 3).

The prevalence of amblyopia in patients younger than 40 years is 3.17% (39 files) against 0.24% (3 files) in patients older than 40 years. Patients in 0-10 years age group dominates the statistic mostly due to unilateral refractive amblyopia (Table 6).

Monitoring is the most adapted management for BV problem at 35.52% cases, followed by BV therapy 34.13%, optical prescription 17.37%, and combination of optical prescription and BV therapy 8.98% (Table 4). Optical prescription on the other hand makes the majority for amblyopia cases management at 42.86%, followed by monitoring at 26.19%, anti-amblyopia therapy 14.29%, combination of optical prescription and anti-amblyopia therapy 14.29%, and referral 2.38% (Table 7).

Table 1

The frequency of BV problems and amblyopia, and their subdivision of causes. Frequency is calculated from the total file number of 1229, while categorical percentage is calculated from the total BV problem (167 files) and amblyopia (42 files) cases.

CASES	FREQUENCY N (%)	PERCENTAGE BY CATEGORY (%)
BINOCULAR VISION PROBLEM		
Convergence Insufficiency (CI)	39 (3.18)	23.4
Convergence Excess (CE)	5 (0.41)	3.0
Accommodation Insufficiency (AI)	44 (3.58)	26.3
Accommodation Excess (AE)	30 (2.44)	18.0
Ill-sustained Accommodation (ISA)	2 (0.16)	1.2
Accommodation Infacility (AF)	13 (1.06)	7.8
Divergence Insufficiency (DI)	1 (0.08)	0.6
Divergence Excess (DE)	6 (0.49)	3.6
Basic Esophoria	5 (0.41)	3.0
Basic Exophoria	6 (0.49)	3.6
AI + CI	13 (1.06)	7.8
AF + CI	2 (0.16)	1.2
CI + Basic Exophoria	1 (0.08)	0.6
Total	**167 (13.59)**	**100.0**
AMBLYOPIA		
Unilateral Refractive Amblyopia	21 (1.71)	20.0
Bilateral Refractive Amblyopia	1 (0.08)	2.4
Strabismus	7 (0.57)	16.7
Combination	13 (1.06)	31.0
Total	**42 (3.42)**	**100.0**

Table 2

The frequency of BV problems by sex. Percentage is calculated from total BV problem of 167 cases.

TYPES	SEX		TOTAL N (%)
	FEMALE N (%)	MALE N (%)	
Convergence Insufficiency (CI)	33 (19.76)	6 (3.59)	39 (23.35)
Convergence Excess (CE)	5 (2.99)	0 (0.00)	5 (2.99)
Accommodation Insufficiency (AI)	28 (16.77)	16 (9.58)	44 (26.35)
Accommodation Excess (AE)	25 (14.97)	5 (2.99)	30 (17.96)
Ill-Sustained Accommodation (ISA)	2 (1.20)	0 (0.00)	2 (1.20)
Accommodation Infacility (AF)	9 (5.39)	4 (2.40)	13 (7.78)
Divergence Insufficiency (DI)	0 (0.00)	1 (0.60)	1 (0.60)
Divergence Excess (DE)	4 (2.40)	2 (1.20)	6 (3.59)
Basic Esophoria	5 (2.99)	0 (0.00)	5 (2.99)
Basic Exophoria	5 (2.99)	1 (0.60)	6 (3.59)
AI + CI	6 (3.59)	7 (4.19)	13 (7.78)
AF + CI	2 (1.20)	0 (0.00)	2 (1.20)
CI + Basic Exophoria	1 (0.60)	0 (0.00)	1 (0.60)
TOTAL	**125 (74.85)**	**42 (25.15)**	**167 (100.00)**
p-value (chi-square test)		**0.06**	

Table 3

The frequency of BV problems in different age groups. Percentage is calculated from total BV problem of 167 cases.

TYPES	AGE GROUP N (%)							Total	MEAN AGE (±SD)
	0-10	11-20	21-30	31-40	41-50	51-60	71-80		
Convergence Insufficiency (CI)	1 (0.60)	15 (8.98)	16 (9.58)	2 (1.20)	4 (2.40)	1 (1.20)	0 (0.00)	39 (23.35)	
Convergence Excess (CE)	0 (0.00)	2 (1.20)	3 (1.80)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	5 (2.99)	
Accommodation Insufficiency (AI)	5 (2.99)	24 (14.37)	12 (7.19)	3 (1.79)	0 (0.00)	0 (0.00)	0 (0.00)	44 (26.35)	
Accommodation Excess (AE)	1 (0.60)	13 (7.78)	16 (9.58)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	30 (17.96)	
Ill-sustained Accommodation (ISA)	0 (0.00)	2 (1.20)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (1.20)	
Accommodation Infacility (AIF)	0 (0.00)	7 (4.19)	4 (2.40)	2 (1.20)	0 (0.00)	0 (0.00)	0 (0.00)	13 (7.78)	
Divergence Insufficiency (DI)	0 (0.00)	1 (0.60)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.60)	21.79 (±8.41)
Divergence Excess (DE)	0 (0.00)	2 (1.20)	4 (2.40)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	6 (3.59)	
Basic Esophoria	0 (0.00)	4 (2.40)	1 (0.60)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	5 (2.99)	
Basic Exophoria	0 (0.00)	3 (1.80)	1 (0.60)	1 (0.60)	0 (0.00)	1 (0.60)	0 (0.00)	6 (3.59)	
AI + CI	0 (0.00)	7 (4.19)	5 (2.99)	1 (0.60)	0 (0.00)	0 (0.00)	0 (0.00)	13 (7.78)	
AF + CI	0 (0.00)	0 (0.00)	1 (0.60)	1 (0.60)	0 (0.00)	0 (0.00)	0 (0.00)	2 (1.20)	
CI + Basic Exophoria	0 (0.00)	0 (0.00)	1 (0.60)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.60)	
TOTAL	**7 (4.19)**	**80 (47.90)**	**64 (38.32)**	**10 (6.00)**	**4 (2.40)**	**2 (1.20)**	**0 (0.00)**	**167 (100.00)**	

Table 4
The management given in IIUM-OC for BV problems. Percentage is calculated from total BV problem of 167 cases.

TYPES	MANAGEMENT N (%)				TOTAL
	THERAPY	OPTICAL	OPTICAL+ THERAPY	MONITOR	
Convergence Insufficiency (CI)	18 (10.78)	5 (2.99)	3 (1.80)	13 (7.78)	39 (23.35)
Convergence Excess (CE)	0 (0.00)	2 (1.20)	0 (0.00)	3 (1.80)	5 (2.99)
Accommodation Insufficiency (AI)	19 (11.37)	6 (3.59)	5 (2.99)	14 (8.38)	44 (26.35)
Accommodation Excess (AE)	5 (2.99)	10 (5.99)	0 (0.00)	15 (8.98)	30 (17.96)
Ill-Sustained Accommodation (ISA)	0 (0.00)	0 (0.00)	0 (0.00)	2 (1.20)	2 (1.20)
Accommodation Infacility (AIF)	6 (3.59)	1 (0.60)	2 (1.20)	4 (2.40)	13 (7.78)
Divergence Insufficiency (DI)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.60)	1 (0.60)
Divergence Excess (DE)	1 (0.60)	1 (0.60)	0 (0.00)	4 (2.40)	6 (3.59)
Basic Esophoria	0 (0.00)	0 (0.00)	0 (0.00)	5 (2.99)	5 (2.99)
Basic Exophoria	2 (1.20)	0 (0.00)	2 (1.20)	2 (1.20)	6 (3.59)
AI +CI	4 (2.40)	3 (1.80)	3 (1.80)	3 (1.80)	13 (7.78)
AF + CI	1 (0.60)	1 (0.60)	0 (0.00)	0 (0.00)	2 (1.20)
CI + Basic Exophoria	1 (0.60)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.60)
TOTAL	**57 (34.13)**	**29 (17.37)**	**15 (8.98)**	**66 (39.52)**	**167 (100.00)**

Table 5
The frequency of amblyopia by sex. Percentage is calculated from total amblyopia of 42 cases.

SEX	CAUSES				TOTAL	*p*-value (chi-square test)
	UNILATERAL REFRACTIVE AMBLYOPIA	BILATERAL REFRACTIVE AMBLYOPIA	STRABISMUS	COMBINATION		
FEMALE	10 (23.81)	1 (2.38)	6 (14.29)	8 (19.05)	25 (59.52)	0.27
MALE	11 (26.19)	0 (0.00)	1 (2.38)	5 (11.90)	17 (40.48)	
TOTAL	**21 (0.50)**	**1 (2.38)**	**7 (16.67)**	**13 (30.95)**	**42 (100.00)**	

Table 6
The frequency of amblyopia in different age groups. Percentage is calculated from total amblyopia of 42 cases.

AGE GROUP (YEARS)	CAUSES N (%)				TOTAL	MEAN AGE ±SD
	UNILATERAL REFRACTIVE AMBLYOPIA	BILATERAL REFRACTIVE AMBLYOPIA	STRABISMUS	COMBINATION		
0-10	16 (38.10)	0 (0.00)	1 (2.38)	2 (4.76)	19 (45.24)	16.90 ± 12.23
11-20	2 (4.76)	0 (0.00)	3 (7.14)	5 (11.90)	10 (23.81)	
21-30	2 (4.76)	1 (2.38)	2 (4.76)	5 (11.90)	10 (23.81)	
31-40	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	
41-50	1 (2.38)	0 (0.00)	1 (2.38)	0 (0.00)	2 (4.76)	
51-60	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	
61-70	0 (0.00)	0 (0.00)	0 (0.00)	1 (2.38)	1 (2.38)	
TOTAL	**21 (50.00)**	**1 (2.38)**	**7 (16.67)**	**13 (30.95)**	**42 (100.00)**	

Table 7
The management given in IIUM-OC for amblyopia. Percentage is calculated from total amblyopia of 42 cases.

MANAGEMENT	CAUSES N (%)				TOTAL
	UNILATERAL REFRACTIVE AMBLYOPIA	BILATERAL REFRACTIVE AMBLYOPIA	STRABISMUS	COMBINATION	
Referral	0 (0.00)	0 (0.00)	1 (2.38)	0 (0.00)	1 (2.38)
Anti-amblyopic Therapy	1 (2.38)	0 (0.00)	2 (4.76)	3 (7.14)	6 (14.29)
Optical Prescription	12 (28.57)	0 (0.00)	3 (7.14)	3 (7.14)	18 (42.86)
Optical Prescription +Anti-amblyopic Therapy	3 (7.14)	1 (2.38)	1 (2.38)	1 (2.38)	6 (14.29)
Monitoring	5 (11.90)	0 (0.00)	0 (0.00)	6 (14.29)	11 (26.19)
TOTAL	**21 (50.00)**	**1 (2.38)**	**7 (16.67)**	**13 (30.95)**	**42 (100.00)**

DISCUSSION

BV anomalies and amblyopia are frequently encountered in a clinical setting. However, the precise number of these clinical problems are inconsistent in the literatures. Prevalence studies that have been reported used different diagnostic criteria, and were on different populations and geographical locations, which in turn deduces to different figures (Jang & Park, 2015). This current study was conducted based on the diagnoses presented in the patients' files in the IIUM-OC from January 2017 to September 2018. A total of 1229 patients files were reviewed and 17% of the patients have been identified to have BV problem and amblyopia. BV problem is recorded at 13.58% prevalence. Our findings reverberated with the study by Garcia-Munoz et al. (2016) which reported a 13% prevalence of accommodative and BV dysfunction from a small sample of 175 university students in Spain. Lara et al. (2001), on the other hand reported a 22.3% prevalence of accommodative or binocular dysfunction from 265 symptomatic patients. Their study was conducted also in Spain. Meanwhile a study on ethnic Indians school children (mean age of 12.7±2.7 years) in Tamil Nadu, India reported a 31.5% and 29.6% of non-strabismic BV problems in urban and rural areas respectively (Hussaindeen et al., 2016).

The most common BV problem encountered in this current study is AI with a prevalence of 3.58%. The second most common BV problems recorded is CI with 3.18%. Our finding echoed other studies such that of Hokoda and associates (1985) and Montes-Mico and colleagues (2001) which reported AI cases as their main BV problem at 16.8% and 11.4% respectively. Both studies argued that the observation was true due to their study population consists of workers and students who deal with a lot of near work. We reverberate their notion as the population of patients in IIUM-OC are mostly university students at the age of early 20s. On a different note, Lara et al. (2001) reported AE as the most prominent BV problem among their population which data were gathered from 265 optometry clinic files of symptomatic patients aged 10 years to 35 years. Their different study design and study population may have resulted to the different finding. Hussaindeen and associates (2016) reported CI as the highest prevalence of about 17% among their study population

which comprise of school children age 7 to 17 years.

We also observe that BV problem is 3 times more prevalent in females than males. Generally, female students dominate the enrollment in university which translated into more female patients getting treatment in IIUM-OC. This factor may lead to higher percentage of female patients, and hence patients with BV problems. Our result echoed the findings by Abdul-Kabir et al. (2014) which found that BV problem was higher in female compared to male. We also found that the prevalence of binocular anomalies is the highest in the 11-20 years age group where they constitute 47.9% of the BV problem cases, followed by 21-30 years age group, and 31-40 years age group. Our observation is similar to that of Lara et al. (2001) where the they found that BV problem mostly occurs in the age group of 10-35 years with mean age of 20.75 ± 5.78 years.

Majority of the BV problem and amblyopia cases in IIUM-OC were monitored before taking any other form of management. About 5% of the cases in IIUM-OC were managed by monitoring, which may be due to the fact that we have considered only new patient files in this study. The management by monitoring suggests that optometrists in IIUM-OC may have managing BV cases in a few visits. Other forms of management in the first visit include BV therapy, optical prescription and combination of optical prescription and BV therapy. Opoku et al. (2014) reported that optical prescription and BV therapy was the most common management for BV problem from questionnaire they gathered from 86 eye care centres. It is to note that monitoring was not in the questionnaire they have used.

Amblyopia may be contributed by three causal factors, which are unilateral refractive amblyopia (i.e. in anisometropia cases), bilateral refractive amblyopia (i.e. in isoametropic cases), and strabismic amblyopia. We showed that the leading factor contributing to amblyopia is the unilateral refractive or anisometropia and followed by combination of the two factors; refractive and strabismus. Our findings are supported by Akhgary et al. (2011) and Yekta et al. (2010) where both studies showed unilateral refractive amblyopia as the leading cause of amblyopia with the prevalence of 10.67% and 2.31% respectively. Another study by Chew Lee Min et al. (n.d.) reported about 7.53% of pre-school children in Malaysia are diagnosed with amblyopia.

We found that females constitute a higher cases for amblyopia. Nevertheless, this observation may possibly be due to gender bias, as elaborated above, as the patient population in IIUM-OC are predominantly females. Our observation is in line with the study by Akhgary et al. (2011) which revealed a higher prevalence of amblyopia in females at 56 % compared to men at 44%. We also showed that the highest prevalence of amblyopia is in the age group of 0-10 years, followed by the age group of 11-20 years and 21-30 years. These results are consistent with the study conducted by Xiao et al. (2015) where they reported the highest prevalence of amblyopia also in the age group of 8-10 years at 33.3% (n=39321). Amblyopia cases in IIUM-OC were usually managed using optical correction, followed by monitoring, and anti-amblyopia therapy. Our observation fits the expectation where the mainstay of management for amblyopia is optical correction followed by anti-amblyopia therapies (de Zárate & Tejedor, 2007).

CONCLUSION

In conclusion, it was evaluated that BV problem and amblyopia have a significant prevalence in IIUM-OC. It was also observed that BV problems and amblyopia are more prevalent in females compared to males. BV problem and amblyopia, in general, affects the younger population.

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