

The Management of Binocular Vision Anomalies by Eye Care Facilities in the Accra and Kumasi Metropolises (Ghana)

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ABSTRACT: This study sought to determine the state of management of binocular vision anomalies by eye care facilities in two major cities in Ghana: Accra and Kumasi. Using the snow balling technique, 86 eye care centres were sampled from the two cities from January to February, 2014. Well-structured questionnaires, verbal interviews and in most cases observational check-ups were employed in the data collection process. Out of the 86 clinics, 51 (59.3%) were located in the Accra metropolis. Binocular Vision Anomalies were reported to be managed by 63 (73.3%) clinics. Majority of the clinics (69.8%) managed accommodative dysfunction with added lenses (69.8%) being the most-employed method. Overall, 79 (91.9%) clinics reported that they referred unmanaged cases and mostly to the ophthalmologist (55.7%). It was found that reports of adequate training in management of binocular vision anomalies and number of instruments owned by the clinics were positively associated with management of binocular vision anomalies (p value =0.001 and p value =0.000 respectively). Based on the report of the clinics, it could be concluded that although some form of binocular vision anomalies are managed by most clinics, there is possibly lack of efficient provision of services as most clinics lacked instruments that are required in detecting, measuring and managing Binocular vision anomalies. It is therefore recommended that to ensure provision of more efficient and quality binocular vision services to clients, eye clinics in the country should endeavour to obtain the equipment that are necessary for managing Binocular vision anomalies.

KEYWORDS: binocular vision anomalies, management, eye care centres, services, instruments.

1 INTRODUCTION

According to Evans [1], binocular vision is the process of coordinating and integrating the images received by the two eyes separately into a single percept. The binocular visual apparatus which consists of sensory and motor systems provides single, clear and comfortable imagery that enables us to decide widely about the nature of our rich world [2]. Despite the advantages of binocular vision – such as wider field of view, spare eye if one is marred and stereopsis–, an interruption in the coordination process could result in a condition termed as binocular vision anomalies (BVA) [1],[2]. BVA are characterized by visual problems such as blurred vision, diplopia, asthenopia, headaches, reading difficulties, loss of concentration and avoidance of task [1],[2],[3].

Some generations back, visual demand focused mostly on good distant vision because means of living rested on the ability to hunt, gather, farm and fish [4]. Contemporarily, the advent of technology has caused a shift from the ancient way of living to a more computerized world which places more burden and emphasis on the binocular vision system of man [4]. Because today's work involves reading, desk work and computer viewing, one has to possess a dynamic binocular vision system in order to work comfortably and for a longer time without fatigue. This recent upsurge in near vision activities has eventually led to the increased attention on the impact of BVA on both comfort and productivity [5] as research has shown that a high proportion of symptomatic computer users experience binocular vision problems and ocular discomfort escalates with the extent of computer use [5],[6]. Numerous studies have also indicated that these dysfunctions are commonly

encountered in clinical practice [7],[8],[9],[10],[11],[12],[13] with a recent estimation that about 20% of people who visit the optometry clinic will present with BVA [14].

In view of this, the assessment of the binocular vision status of a patient should be an integral part of the services rendered by an eye care facility. If not done routinely, this crucial examination should be carried out if a patient complains of binocular vision anomaly related symptoms or the clinician detects signs that intimate this condition [1]. When BVA in children in their sensitive period are ignored, the smooth development of their binocular vision system could be affected and hampered, resulting in conditions such as amblyopia [15]. Students and workers whose work involves identifying small details in close proximity may perform abysmally if they suffer from BVA [16]. Moreover, sportsmen or distant workers like drivers are not exempted because some binocular vision anomalies may cause ocular problems such as diplopia at distance which may result in accidents [17]. Binocular vision plays an essential role in our daily lives and activities and thus, eye care facilities should be able to detect, examine, diagnose and manage binocular vision anomalies or refer where necessary in order to ensure that their clients possess optimum single binocular vision.

In response to the aforementioned, this study sought to determine the state of management of BVA by eye care facilities in two major cities in Ghana: Accra and Kumasi with focus on whether or not the clinics manage BVA, types of BVA managed, methods employed, places of referral, clinician's perception of adequate training and instruments used for proper management.

2 MATERIALS AND METHODS

2.1 STUDY AREA AND DESIGN

A descriptive cross-sectional survey was conducted from January to February, 2014. Because of the difficulty in obtaining a full list of the clinics and their locations, the snow balling technique was used to sample 86 eye care centers from two major cities in Ghana: Accra and Kumasi, to participate in the study. Accra, being the capital city, has a population of 1,695,136 and an annual growth rate of 3.36% [18]. On the other hand, the Kumasi metropolis has a relatively smaller population of 1,170,270 but a higher growth rate of 5.4% [19]. These cities were purposively selected because they are populated with majority of the eye care centers and receive referrals from other places in the country.

2.2 ETHICAL CONSIDERATION

Eye care centers that were registered and had license to operate were included in the study. Besides that, all procedures required by the Ethics Review Committee of Kwame Nkrumah University of Science and Technology were carried out in this study.

2.3 DATA COLLECTION

Well-structured questionnaires comprising both open and closed-ended questions were administered to the eye care providers mainly the optometrist: in a few cases where the center lacked an optometrist, the ophthalmologist or ophthalmic nurse-in-charge was allowed to respond to the questionnaire. Verbal interviews and in most cases observational check-ups were conducted to confirm the answers given by the respondents. On the questionnaire, the duration of practice of the eye care clinics could be answered by checking one of these options: "less than 5 years", "5 to 10 years" and "more than 10years." The types of binocular vision dysfunctions were grouped into accommodative dysfunctions, vergence dysfunctions, strabismus and amblyopia. Treatment methods such as the use of added lens, prism, vision therapy, surgery and drugs were listed for eye care providers to check which ones applied to them. In order to assess the various instruments possessed by the clinics for effective diagnosis and management of BVA, a list of 30 instruments was compiled based on standard clinical practice guidelines stated by American Optometric Association's "Care of the Patient with Accommodative and Vergence dysfunctions" and "Care of the Patient with Strabismus and Amblyopia." They included instruments for visual acuity assessment, refraction, ocular health assessment and binocular vision assessment. Clinicians who responded to the questionnaires were made to report whether they had adequate, semi-adequate or lacked training in BVA management.

2.4 DATA ANALYSIS

The collected data was stored in a secured place out of reach of any person except the researchers. The Stata software version 11.0 was employed in analyzing the data. Descriptive analyses were represented in mean, standard deviations and frequency distribution tables whiles p values for association between two categorical data were computed using Pearson's χ^2

test. Two-sample t-test was used to determine significant differences between the mean number of instruments possessed by clinics in the two locations as well as the mean number of instruments possessed by private or public clinics. ANOVA analysis was made to determine significant statistical association between number of instruments and duration of practice of the clinics. A p value less than 0.05 was considered statistically significant.

3 RESULTS

3.1 DEMOGRAPHICAL CHARACTERISTICS

Out of the 86 clinics that participated in the study, 51 (59.3%) were located in the Accra metropolis while the remaining 35 (40.7%) were found in the Kumasi metropolis. The clinics included 71(82.6%) private and 15(17.4%) public eye care centers (Table 1). Majority (54.7%) of the clinics had been in existence for less than five years (Table 1).

3.2 MANAGEMENT OF BINOCULAR VISION ANOMALIES

Binocular Vision Anomalies were managed by 63 (73.3%) clinics based on their responses (Table 1). Thirteen clinics (56.5%) out of the remaining 23 explained that they could not manage BVA because they lacked the necessary equipment. Lack of qualified personnel and other reasons (such as affiliation to bigger clinics and lack of BVA patients) accounted for 7(30.4%) and 3(13.1%) clinics respectively.

According to the results, the percentages of clinics that managed BVA were comparable in Accra and Kumasi (p value= 0.858). In the Accra metropolis, clinics that had been in operation for longer periods were likely to manage BVA (p value= 0.003), whereas no such significant association was found in the Kumasi metropolis (p value = 0.231) and in the overall study (p value = 0.243). Moreover, type of ownership of a clinic was not associated with management of BVA in the overall study (p value =0.055), in the Kumasi metropolis (p value = 0.385) and in the Accra metropolis (p value = 0.058).

Table 1: Distribution of clinics by ownership, duration of practice and management of BVA (number (%))

City	Number	Ownership		Duration of practice			Management of BVA	
		Private	Public	Less than 5 years	5 to 10 years	More than 10 years	Yes	No
Accra	51 (59.3)	44(86.3)	7(13.7)	28(54.9)	10(19.6)	13(25.5)	37(72.5)	14(27.5)
Kumasi	35(40.7)	27(77.1)	8(22.9)	19(54.3)	6(17.1)	10(28.6)	26(74.3)	9(25.7)
Total	86(100)	71(82.6)	15(17.4)	47(54.7)	16(18.6)	23(26.7)	63(73.3)	23(26.7)

3.3 TYPES OF BINOCULAR VISION ANOMALIES MANAGED BY THE CLINICS

Sixty clinics (69.8%) managed accommodative dysfunctions while 49 (57%) managed vergence dysfunctions. Amblyopia and strabismus were managed by 36 (41.9%) and 22 (25.6%) clinics respectively. Similar trend was identified in both Accra and Kumasi metropolises but with different proportions (Table 2).

Table 2: Distribution of the Types of BVA managed by the clinics

City	Type of BVA (number (%))			
	Accommodative dysfunction	Vergence dysfunction	Amblyopia	Strabismus
Accra	36(70.6)	29(56.9)	24(47.1)	14(27.5)
Kumasi	24(68.6)	20(57.1)	12(34.3)	8(22.9)
Total	60(69.8)	49(57.0)	36(41.9)	22(25.6)

3.4 METHODS EMPLOYED IN THE MANAGEMENT OF BINOCULAR VISION ANOMALIES

In this study, added lenses were used by 60 clinics (69.8%) to manage BVA. This was followed by the use of vision therapy, prisms, surgery and drugs by 50 (58.1%), 22 (25.6%), 14 (16.3%) and 10 (11.6%) clinics respectively (Table 3). This trend was slightly different from results in both cities. While in the Kumasi metropolis, drugs (5.7%) were employed as a method of management more than surgery (2.9%); in the Accra metropolis, surgery (25.5%) was used more than prisms (21.6%) and drugs (15.7%) in that order to manage BVA (Table 3).

Table 3: Distribution of the methods employed by the clinics in the management of BVA

City	Methods employed in BVA management (number (%))				
	Added lens	Vision therapy	Prisms	Surgery	Drugs
Accra	37(72.5)	31(60.8)	11(21.6)	13(25.5)	8(15.7)
Kumasi	23(65.7)	19(54.3)	11(31.4)	1(2.9)	2(5.7)
Total	60(69.8)	50(58.1)	22(25.6)	14(16.3)	10(11.6)

3.5 REFERRAL OF UNMANAGED CASES OF BINOCULAR VISION ANOMALIES

Out of the 86 clinics, 79 (91.9%) reported that they referred BVA cases they could not manage. All the 51 clinics in the Accra metropolis claimed that unmanaged cases of BVA were referred. Overall, the ophthalmologist received most (55.7%) of these referrals from the eye care centers in this study. However, while in the Kumasi metropolis, most (46.4%) of the referrals were directed to the optometrist; in the Accra metropolis, the ophthalmologist was the target for the majority (68.6%) of referrals of BVA cases (Table 4).

Table 4: Distribution of Professionals referred to by the eye care centers in the study

City	Professional referred to by eye care centers				
	Optometrist only	Ophthalmologist only	Optometrist or ophthalmologist	Neurologist	Orthoptist or ophthalmologist
Accra	3(5.9)	35(68.6)	12(23.5)	1(2.0)	0(0)
Kumasi	13(46.4)	9(32.1)	5(17.9)	0(0)	1(3.6)
Total	16(20.25)	44(55.70)	17(21.51)	1(1.27)	1(1.27)

3.6 CLINICIAN’S PERCEPTION OF ADEQUATE TRAINING IN MANAGEMENT OF BINOCULAR VISION ANOMALIES AND THE NEED FOR MORE SERVICES

Approximately two-thirds (68.6%) of the clinicians who responded to the questionnaire reported that they had adequate training in BVA management. While eight (9.3%) clinicians claimed that they did not have adequate training, 19 (22.1%) of them reported that they had semi-adequate training in BVA management (Table 5). In the overall study population (p value = 0.001) and in the Accra metropolis (p value = 0.000), it was found that report of adequacy of training in BVA management was positively associated with management of BVA. However, in the Kumasi metropolis, such association was not realized (p value = 0.2). Eighty three (96.5%) clinics acceded to the need for more BVA services including a unanimous consent from all the 51 clinics in the Accra metropolis.

Table 5: Distribution of the clinics based on Clinician’s perception of adequacy of training in BVA management and the need for BVA services

City	Clinician’s perception of adequacy of training in BVA management			The need for BVA services		
	Adequate training	Semi-adequate training	Lack of adequate training	Agree	Neither agree nor disagree	Disagree
Accra	36(70.6)	8(15.7)	7(13.7)	32(91.4)	3(8.6)	0(0)
Kumasi	23(65.7)	11(31.4)	1(2.9)	51(100)	0(0)	0(0)
Total	59(68.6)	19(22.1)	8(9.3)	83(96.5)	3(3.5)	0(0)

3.7 INSTRUMENTS AVAILABLE FOR EFFECTIVE DIAGNOSIS AND MANAGEMENT OF BINOCULAR VISION ANOMALIES

A total of 30 instruments which included those for visual acuity testing, refraction, ocular health assessment and binocular vision assessment were enlisted for the study. The number of clinics that had a particular type of instrument was documented (Table 6). In the overall study population, the mean number (standard deviation (SD)) of instruments possessed by the clinics was 15.88(4.5). Eye care centers in the Accra metropolis (16.92 (5.22)) had a significantly higher mean number of instruments than those in the Kumasi metropolis (14.37 (2.59); p value = 0.0045). Two clinics –one in Kumasi and the other in Accra– had 6 instruments which was the least number of instruments possessed by a clinic in the study whereas the maximum was 27.

It was noticed in the overall study (p value = 0.002) and in the Accra metropolis (p value = 0.001) but not in the Kumasi metropolis (p value= 0.275) that older clinics were likely to possess more instruments than younger ones. Also, private clinics in the Kumasi metropolis were more likely to possess more number of instruments than public ones (p value = 0.003). This association was seen in the overall study (p value = 0.032) but not in the Accra metropolis (p value = 0.283).

The number of instruments possessed by the clinics was grouped into very low (0-6), low (7-12), medium (13-18), high (19-24) and very high (25-30) levels to provide a clearer picture of the distribution. Majority (57%) of the clinics in the study had medium level number of instruments. Again, clinics with greater number of instruments were more likely to manage BVA than those with smaller numbers. This trend was found in both Kumasi (p value =0.004) and Accra (p value =0.000) and in the overall study population (p value =0.000) (Table 7).

From Table 6, instruments that are necessary for performing visual acuity testing (e.g. snellen and illiterate E charts), refraction (e.g. retinoscope or autorefractor, trial lens set and frame) and ocular health assessment (e.g. ophthalmoscope and slit lamp) were possessed by quite a good number of the clinics. On the contrary, clinics lacked in general, instruments (marked * in Table 6) that are considered necessary for detecting, measuring and managing BVA.

Table 6: Distribution of the Number of the Various Instruments Possessed by the Clinics in the study

Instrument	Number of instruments (%)			Instrument	Number of instruments (%)		
	Accra	Kumasi	Total		Accra	Kumasi	Total
Snellen chart	51	35	86(100)	Pinhole	49	35	84(97.7)
Illiterate E	50	35	85(98.8)	Occluder*	51	35	86(100)
Logmar chart	10	5	15(17.4)	RAF rule*	14	1	15(17.4)
Near chart	51	34	85(98.8)	Maddox rod*	36	33	69(80.2)
Picture chart	34	6	40(46.5)	Maddox wing*	0	0	0(0)
Isolated chart	13	2	15(17.4)	Red/green goggles*	36	0	36(41.9)
Retinoscope/ Autorefractor	42	27	69(80.2)	Accommodative flippers*	17	0	17(19.8)
Trial lens set	48	33	81(94.2)	Prism flippers*	0	0	0(0)
Trial frame	49	33	82(95.3)	Prism bar*	10	4	14(16.3)
Pd rule	50	33	83(96.5)	Mallet*	2	0	2(2.3)
Phoropter*	15	7	22(25.6)	Penlight*	51	35	86(100)
JCC	33	10	43(50.0)	Slit lamp	32	32	64(74.4)
Focimeter	30	30	60(69.8)	Ophthalmoscope	51	35	86(100)
Astigmatic dial	5	1	6(7.0)	Stereochart with polaroid lenses *	9	0	9(10.5)
Duochrome chart	2	24	26(30.2)	Synoptophore *	0	0	0(0)

*Instruments considered as necessary for detecting, measuring and managing BVA in this study

Table 7: Cross Tabulation of the Number of Clinics that manage BVA and their level of number of instruments

Number of instruments owned by the clinics		Management of BVA						
		Accra		Kumasi		Overall		
Level	Range	Manage	Do not manage	Manage	Do not manage	Manage	Do not manage	Total
Very low	0-6	0	1	0	1	0	2	2 (2.3)
Low	7-12	3	10	0	3	3	13	16(18.6)
Medium	13-18	16	3	25	5	41	8	49(57.0)
High	19-24	13	0	1	0	14	0	14(16.3)
Very high	25-30	5	0	0	0	5	0	5(5.8)
P value		0.000		0.004		0.000		

4 DISCUSSION

Based on the responses from the clinics, this study revealed that most (73.3%) of the clinics manage some form of BVA in their facilities. It was also noticed that the percentages of clinics that managed BVA in both cities were comparable suggesting that accessibility to BVA services in the two cities might be fairly distributed taking into consideration their respective population sizes.

From Table 2, accommodative and vergence dysfunctions were reported as mostly managed by the clinics in both Accra and Kumasi metropolises and in the overall study population. Generally, research has shown that these two types of binocular vision dysfunctions are more prevalent than strabismus and amblyopia [7] [20]. This suggests that most of the patients that will attend the eye care centers with BVA may report with accommodative or vergence dysfunctions resulting in the higher frequency of their management. Furthermore, therapy for management of accommodative and vergence dysfunctions such as the use of plus lenses or vision therapy may not require advanced and expensive procedures and instrumentations [4], permitting most of the clinics to manage these conditions and not encumber themselves with the other types of BVA.

In this study, added lenses and vision therapy were reported by the clinics as the most-employed methods of management. Because of their effectiveness and simplicity; added lenses, vision therapy and prisms are mostly used in the treatment of accommodative and vergence dysfunctions [4] which are already known to be mostly managed by majority of the clinics in the study. It then confirms that if these types are mostly managed because they are more prevalent, then, added lenses and vision therapy should be the most-employed methods of treatment. The relatively lower use of prisms compared to added lenses and vision therapy could be explained by the difficulty in prescribing prisms in the country. The lens production companies in Ghana rarely manufacture prisms and importing them from abroad for a patient could be expensive. It is therefore recommended that policy makers and bodies regulating eye care services in the country should work on improving accessibility to prisms in order to broaden the options of management of BVA in the country. The existence of more clinics with advanced infrastructure and qualified professionals in the Accra metropolis could explain why surgery was used more in the Accra metropolis than in the Kumasi metropolis.

Furthermore, clinics in this study reported that they referred their unmanaged cases mostly to the ophthalmologist, followed by the optometrist. Admittedly, the scope of practice of the ophthalmologist in Ghana surpasses that of the optometrist and includes surgery which the optometrist is incapable of performing. However, ruling out situations like inadequate training in BVA management and lack of required instruments, optometrists being the primary eye care providers and mostly, the renders of binocular vision services, should be able to handle most of the cases of BVA with the exception of rare situations requiring extra ocular muscle surgery. Possibly, these unmanaged cases referred to the ophthalmologist included procedures that were out of scope of practice of the optometrist while those referrals directed to the optometrist could be as a result of lack of optometrist at the facility, lack of required instruments and perhaps, lack of expertise in the management of those cases.

Unsurprisingly, this study demonstrated that clinician's perception of adequacy of training in BVA management was associated with management of BVA. Across domains such as health, sports and academics, research has established an association between knowledge and performance in that subjects who are abreast with the techniques and skills of a particular field are most likely to perform successfully [21],[22],[23]. It is therefore recommended that more in-service training and occasional workshops on modern trends of BVA management should be organized for clinicians in order to possibly ensure an improvement in the number of clinics that manage BVA and the efficiency of management.

Even though clinics in the Accra metropolis had a higher significant mean number of instruments than those in the Kumasi metropolis, generally, majority of the clinics had medium (13–18) number of instruments. Also, according to Table 6, most of the clinics lacked the instruments (e.g. mallet, prism bars, Maddox wing, RAF, accommodative and prism flippers, synoptophore etc.) that are required in detecting, measuring and managing binocular vision dysfunctions. This could suggest that clinics that manage BVA may improvise with the use of the Maddox rod and loose prisms which are inherent in the trial lens case and thus, it would be very difficult for them to perform tests such as Von Graefe, measurement of vergence amplitudes and facility etc. This therefore questions the efficiency of management of BVA in the various eye care facilities. Also, it was identified that clinics with higher number of instruments were likely to manage BVA than those with lower numbers. Indisputably, it will be very arduous for clinics to operate and provide binocular vision services bereft of the prerequisite equipment. Eye care facilities are therefore encouraged to purchase the necessary instruments that would help them in managing BVA cases more efficiently.

Generally, this study relied mostly on the responses of the clinics during the collection of data as it was difficult to ascertain whether the clinics managed BVA or not. Also, due to time constraints, observational check-ups needed to confirm the presence of the instruments reported as being owned by the clinics were not carried out for some of the clinics.

5 CONCLUSIONS

In conclusion, most (73.3%) of the clinics reported that they managed some form of BVA in their facilities. Accommodative and vergence dysfunctions were reported to be largely managed by the clinics with added lenses and vision therapy being the most employed method of management. Referral of unmanaged cases was directed to the ophthalmologist and optometrist. In the overall study, majority of the clinics had medium (13–18) number of instruments and lacked instruments that are prerequisite in detecting, measuring and managing BVA suggesting a possible lack of efficient management of BVA in most of the clinics. It was found that as the number of instruments possessed by the clinics increased, the likelihood of management of BVA also increased. This study recommends that clinics in the two major cities and the entire country should endeavor to acquire the necessary instruments for management of BVA. It is also recommended that policy makers and bodies that regulate the provision of eye care services should assist in increasing accessibility to prisms and occasional workshops to help widen the options for management of BVA and bring to speed the skills and knowledge of eye care providers in the attempt to raise the standards of binocular vision services rendered to the society.

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CONFLICT OF INTEREST

The authors of this manuscript have no conflicts of interest.

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