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RESEARCH ARTICLE

ACCOMMODATIVE DISORDERS AMONG CHILDREN AGED 6-12 YEARS IN BENIN CITY, NIGERIA

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Abstract

Background: Accommodative disorders are common functional vision problems in school-aged children and are frequently overlooked during routine eye examinations. These disorders can adversely affect visual comfort, reading efficiency, and academic performance.
Aim: To determine the prevalence, distribution, and associated factors of accommodative disorders among children aged 6–12 years in Benin City, Edo State, Nigeria. A school-based cross-sectional study was conducted among primary school children aged 6–12 years in Benin city using a multistage sampling technique.
Method: Comprehensive eye examinations were performed, including distance and near visual acuity, refraction, accommodative amplitude, accommodative facility, near point of accommodation, and binocular vision assessment. Accommodative disorders were diagnosed using standard clinical criteria. Data were analyzed using descriptive statistics and chi-square tests, with statistical significance set at $p< 0.05$.
Result: Of the 420 children initially recruited, 372 met the inclusion criteria and were analyzed (attrition rate: 11.4%). The mean age was 9.97±1.78 years, with a near-equal gender distribution (51.9% females, 48.1% males). The overall prevalence of accommodative disorders was 23.7%. Accommodative insufficiency was the most prevalent disorder (14.0%), followed by accommodative in facility (5.6%) and accommodative excess (4.0%). No significant associations were observed with age group or local government area.
Conclusion: Accommodative disorders are common among children aged 6–12 years in Benin city, with accommodative insufficiency being the predominant subtype. Prolonged near work is a major modifiable risk factor. Incorporating accommodative and binocular vision assessments into routine school eye health programs is essential for early detection and improved educational outcomes.
Keywords: accommodative disorders, binocular vision anomalies, Nigeria, school-aged children, vision.

INTRODUCTION

Accommodation is a fundamental component of visual function that enables the eye to maintain clear focus on objects at varying distances through dynamic changes in the crystalline lens. In childhood, accommodative efficiency is particularly critical because academic activities are dominated by sustained near-vision tasks such as reading, writing, and digital learning. Any disruption in accommodative performance can lead to visual discomfort, reduced concentration, and learning difficulties, often without obvious distance visual impairment[1,2]. Accommodative disorders represent a group of non-strabismic binocular vision anomalies characterized by difficulty sustaining, stimulating, or relaxing accommodation. These disorders are commonly classified into accommodative insufficiency, accommodative excess, and accommodative infacility[3]. Clinically, affected children may present with symptoms such as headaches, eye strain, blurred near vision, poor reading endurance, and avoidance of near tasks[4]. Because these symptoms are nonspecific, accommodative disorders are frequently under-

recognized in routine eye examinations, especially when distance visual acuity is normal[5].

Globally, studies have reported variable prevalence rates of accommodative disorders among school-aged children, ranging from below 5% to over 25%, depending on diagnostic criteria, age group, and population characteristics[6]. Higher prevalence has been noted in settings where near work demands are intense and access to comprehensive pediatric eye care is limited[7]. The increasing use of digital devices among children has further heightened concern regarding accommodative stress and its long-term implications on visual development[8]. In low- and middle-income countries, childhood visual health initiatives have traditionally prioritized conditions such as refractive errors, ocular infections, and preventable blindness. While these efforts are essential, they often overlook functional vision problems, including accommodative and vergence disorders, that substantially affect educational performance and quality of life[9]. Consequently, many children with accommodative dysfunction remain undiagnosed and untreated, despite having potentially reversible conditions[10].

In Nigeria, existing school eye health programs and epidemiological studies have largely focused on refractive errors and ocular morbidity. There is a paucity of data addressing accommodative function and other binocular vision anomalies among children, particularly in the South–South geopolitical zone. Benin City, an urban center with diverse socioeconomic characteristics, provides a relevant setting to explore the burden of accommodative disorders within a typical Nigerian school population[11,12]. The absence of local data on accommodative disorders poses challenges for evidence-based planning of pediatric eye care services. Without reliable prevalence estimates and understanding of associated risk factors, policy makers and clinicians may underestimate the need for comprehensive binocular vision assessment in school-aged children. Identifying modifiable factors such as uncorrected refractive errors and excessive near work is especially important for designing targeted interventions[13,14]. Against this background, the present study aimed to determine the prevalence, pattern, and associated factors of accommodative disorders among children aged 6–12 years in Benin City, Edo State, Nigeria. This study seeks to inform school eye health programs, guide clinical practice, and contribute to the broader discourse on functional vision problems in African pediatric populations.

METHODOLOGY

Study area

The study was done in Benin City, Edo State, Nigeria. Benin City is located on Latitude 06°19E to 6°21E and Longitude 5°34E to 5°44E with an average elevation of 77.8 m above sea level. Benin City is a pre-colonial city, the capital of the defunct Mid Western Region, Bendel State and the present day Edo State. The indigenous people of Benin City are the Edo people and they speak Bini Language. Socio-economic activities include commerce, agriculture (farming/ fishing), industry, with the oil industrial sub-sector providing the major income for the economy. The Binis are known for bronze sculpture, its casting skills and their arts and craft. The 2006 census, which is the most recent, recorded the population of the three main local government areas (Oredo, Egor and Ikpoba - Okha - Okha) which make up Benin City as 1,085,676 (NPC, 2006). For the purpose of this research, this population is projected from 2006 to be 1,841,084 in 2022 (World Population Review, 2022). The City consists mainly of three local government areas Oredo, Egor and Ikpoba - Okha Local Government Areas. It also consists partly of Ovia Northeast and Uhunmwonde Local Government Areas.

The City is located in the humid tropical rain forest belt of Nigeria with a mean annual rainfall ranging from 2050 mm to 2161 mm. Temperature values in the area are usually on the high side throughout the year with a minimum annual temperature of 21.90°C and a mean annual maximum temperature of 25.10°C. The vegetation of the area is rain forest, however the original vegetation has been undergoing modifications due to urban expansions, mining and industrial activities. However, the scope of the study is targeted at primary schools in the 3 major LGA in Benin city namely Oredo, Egor and Ikpoba - Okha.

Study design

This is a analytical cross sectional study and will involve primary schools in Benin City in order to determine children aged 6-12 years with accommodative disorders. The study will adopt the use of primary data source gotten from visual assessment conducted on the study population. Questionnaires will also be administered to participants to obtain socio-demographic information and other relevant information.

Study population

The study focused on public primary school children in the 3 major LGA in Benin City which are Oredo, Ikpoba - Okha and Egor. Accordingly, 10 public primary schools in Benin City were randomly selected. Hence, some children within the age bracket 6 – 12yrs who attended primary schools at Airforce Primary School GRA, Ebo Primary School, Umegbe Primary School, Owegie Primary School, Adolor Modern Primary School, Ehenneden Primary School, Emwinobomwan Primary School, Evbuotubu, Army Children School Ikpoba Hills, Obe Primary School and Ohen Primary School were questioned and screened.

Sample and sampling technique

The sample size was derived from the Taro Yamane's method. Thus, the formula:

$$n = \frac{N}{1 + Ne^2}$$

The variables in this formula are:

n=the sample size; N=the population of the study; e=the margin error in the calculation.

To take care of attrition, 10% of the sample size calculated was added. Therefore, the calculated sample size for the study is 420. The sampling technique employed for the study is the multistage sampling technique. The Stages are as follows:

1. First stage: Purposive sampling- This technique was used in the selection of LGA. The 3 major LGA (Oredo, Ikpoba - Okha and Egor) in Benin City were purposively selected for the study due to their large population.

2. Second stage: Stratified sampling- The 3 LGA have been naturally divided into 3 strata. Oredo, Egor and Ikpoba-Okha having 69, 59 and 63 public school respectively in the 3 strata.

3. Third stage: Proportional sampling- The number of schools required from each strata (Oredo, Egor and Ikpoba-Okha) was selected using proportional sampling technique as shown below.

No of schools required per LGA=No of schools in LGA/Total Number of schools X No of Schools required for the study.

4. Fourth stage: Simple random sampling- This technique was used in the selection of schools required for the study in each LGA (strata). The public primary schools in Oredo, Egor and Ikpoba–Okha are 189, hence, a total of 10 schools were randomly selected for the study.

5. Fifth stage: Proportional sampling- This technique was used to select the required participants per school based on the calculated sample size and the population size of the study. Considering that the various schools have different population, the number of children to be selected from each school was obtained using proportional sampling technique as shown below.

Participants required per primary school=Total number of children in the School/Population size x Calculated sample size.

6. Sixth Stage: Stratified sampling- The participants were placed into subgroups called strata based on gender. This stratified sampling method was used to naturally stratified the participants into males and females.

7. Seventh stage: Proportional sampling- This technique was also used to proportionally select the number of males and females required for the study.

8. Eighth stage: Systematic random sampling- Systematic random sampling technique was used forthe selection of participants for the study. However, children who had ocular issues that may affect near vision or accommodative system were excluded from the study.

Study Instruments

The study instruments were the questionnaires and visual screen equipment.

a. Questionnaires – The questionnaire had 2 sections.

Section 1: Demography.

Section 2: Ocular and near work history

Reliability and validity of measurements

There are many primary school children in Benin City and data was collected from selected children for this research. The validated instrument for data collection was subjected to a pilot study using 20 students selected from three LGAs, from 3 schools different from those already selected for the study. A Cronbach's Alpha of 0.811 was obtained, which is desirable since it is greater than 0.70; implying that the instrument is reliable for the stated objectives of the study.

Data collection

The data collection exercise was conducted in 7 weeks. Each school had 3 days for sample selection and data collection. However, prior to the start of the vision screening, a consent form and questionnaire were administered to parents/Guardians of selected participants. The interview was conducted by a research assistant properly trained in the administration of questionnaires. A series of vision tests that included visual acuity (VA) measurements, ocular motility evaluation, ocular health evaluation, accommodative and binocular vision test were performed by 2 optometrists (the principal investigator inclusive) and an optician. All testing were conducted in a test station set up in classrooms provided by the school authorities and test conditions including illumination and test distance were maintained as best as possible. The activities of the weeks and some of the visual tests conducted are explained below.

Week 1- The exercise kicked off from Ikpoba - Okha LGA with Ohen Primary School, Ologbo and Obe Primary School, Obe. A day was used for selection of participants and children selected for the study were give consent forms and questionnaires to give to their parents since the school had informed parents of the exercise. Same procedure was applied to the other 8 schools. Thereafter, data was collected from the participants.

Week 2- Data collection for Obe Primary School, Obe was concluded and Army Children School Ikpoba - Okha Hills was the third school visited.

Week 3- The team moved to Egor LGA. Students of Adolor Modern Primary School Adolor and Ehenneden Primary School, Ugbowo were the fourth and Fifth school visited. The selection of participants and data collection were conducted 3 days in each school.

Week 4- The data collection for Ehenneden Primary School, Ugbowo continued in the fourth week and Emwinobomwan Primary School, Evbuotubu was also visited.

Week 5- Finally, the research team visited Oredo LGA, starting with Airforce Primary School and also Ebo Primary School, Irhirhi Ebo.

Week 6- The data collected for Ebo Primary School, Irhirhi Ebo was concluded and Umegbe Primary School, Umegbe was next.

Week 7- Finally, Owegie Primary School at Uzebu Quaters was the last school visited.

The visual screening of the participants included the following test:

Visual acuity assessment: A convenient classroom was used within the primary school with appropriate testing distance of 20 ft. The subject sat down comfortably on the chair with the left eye closed, the right eye was directed to the chart and the participant was instructed to read the alphabets. The same procedure was carried for the left eye. And findings were appropriately recorded. In cases where VA was less than the expected 6/6 such participants were excluded from the procedure. After this VA was also measured at 40 cm using the near VA chart.

External and internal examination: (using the penlight and ophthalmoscope) - The penlight was used

to examine the anterior segment structure and the ocular adnexia, to rule out any form of abnormally which might affect the result in one way or the other. This was to ensure that the findings were gotten from anatomically normal participants during the course of this study.

Hirschberg corneal reflex test: The Hirschberg corneal reflex was carried out to rule out any form of Strabismus that might be present no matter how small especially in cases where cover test does not yield satisfactory results. The room light was dimmed and the test was done monocular and then binocularly. If there was a difference in the reflex position, it indicated the presence of strabismus and such participants were dropped from the study.

Near Point of Convergence (NPC): With the subject sitting comfortably, NPC was measured using a tip of a color pencil. The participants were told what to expect during the test and his/her expected response. First, the pencil was placed at a distance of 40cm and the participants were asked how many pencil tip he/she saw, in cases where the participants responded saying they can see two targets, the distance was increased until the subject reported seeing just one pencil tip. If the participants are still seeing two targets, the procedure was discontinued for such participants. In the absence of any abnormality the pencil tip was brought closer to the participants face and is repeatedly instructed to indicate when the target become two. At the point where the target becomes double, it was recorded as the break after which the target was taken away from the patient until he/she reported seeing one target again. Note: in cases where the child does report a break, it was objectively determined by taking note of the point where one of the eyes deviated outside, the eye and the direction is noted.

Amplitude of Accommodation (AA): The Push up to blur technique was used in measuring the AA. With the left eye occluded and in a bright room illumination, the near VA chart is presented to the subject and the subject was directed to read a line above the best corrected VA of the poorer and as they read, the card was brought closer to the eye until the subject reports first sustained blur or difficulty reading the chart, that distance was noted and converted to its dioptric equivalent. Same procedure was repeated to the left eye, and then both eyes with findings being recorded appropriately. Note in cases where the subject could not read fluently he/she was made to call the alphabets.

Monocular Estimated Method (MEM): MEM objectively tests a patient´s accommodative response at the near working distance at 40cm. This method is valuable in the diagnosis of binocular anomalies or accommodative dysfunction. The patient held the test at 40cm and binocularly looked at the screen. . The test was performed under normal room illumination. The retinoscope beam was oriented vertically and the streak was guided across the patient´s left and right eye as well as valuate the reflex for WITH or AGAINST motion or for neutrality. The test was done in both eyes a few times and the estimated dioptric value required to neutralise the observed motion was noted. The estimate was confirmed by inserting a lens into the patient´s line of sight (but do not longer than one second) while evaluating the reflex. If the right lens was chosen, neutrality was spotted. Repeat the same steps for the other eye as well. The normal values are between +0.25 D and +0.50 D.

Near Point of Accommodation (NPA): For this test, we used relatively small letters (0.4M or 0.5M) to help better control accommodation. Slowly move these letters closer to the eye until it become blurry. Measure the distance the letters became blurry. This was the near point of accommodation. Using a card that has a word printed on it, close one eye and focus on the letter. Measure the distance of the card form the eye using a ruler or a meter stick. Now slowly bring the card as close to your open eye as possible, and stop when the subject no longer see a clear, detailed word. This value is your near-point accommodation. Repeat this procedure three times and then test the other eye.

Accommodative facility test: Accommodative facility tested the patient's ability to make sudden and accurate accommodative changes under binocular conditions by reading short and simple words under special conditions. Firstly, mount +2.00/-2.00 pairs of lenses into a flipper device (two lenses on each side). All data of children with eye disorders collected from each facility were sorted by the researcher to identify the ones with accommodative disorders according to clinical signs and diagnostic criteria shown in Table 3.

Statistical analysis

Data obtained from this study was analyzed using descriptive statistics (tables and bar charts). Chi-square analysis in the Statistical Package for Social Sciences (SPSS, version 25.0) was used to test for significance in associations, $p<0.05$ was set as statistical significance. These enabled the researcher to establish the statistical significance of the relationship between age, gender, near work and distribution of accommodative disorder in the study population.

Ethical approval

Ethical approval was obtained from the Health Research Ethical Committee of the Ministry of Defence, Abuja before commencement of the study (NHREC/28/01/20208). Informed consent was obtained from the School management/parents/guardians of the participants with the willingness of wards to participate. The study was conducted according to the tenets of the World Medical Association-Helsinki Declaration (1968), as revised (2013).

RESULTS

A total of 420 children were selected for this study with 48 failing to meet the inclusion criteria, making the sample size to be 372 children for this study. Hence the attrition rate was 11.4%.

Demographics

According to Table 1, gender distribution of the respondents were 193 (51.9%) females and 179 (48.1%) males.

Table 1: Gender and age categories of the participants.

Sociodemographic Characteristics		Frequency (%)
Gender	Female	193 (51.9)
	Male	179 (48.1)
	Total	372 (100)
Age categories	6-8 years	77 (20.7)
	9-10 years	129 (34.7)
	11-12 years	166 (44.6)
	Total	372 (100)

Table 2: Local Government Areas (LGAs) and schools distribution of the participants.

Demography		Frequency		Total (%)
		Male	Female	
LGA	Oredo	48	58	106 (28.5)
	Ikpoba – Okha	66	65	131 (35.2)
	Egor	65	70	135 (36.3)
	Total	179	193	372 (100)
School	Airforce Primary School,	16	18	34 (9.1)
	Ebo Primary School, IrhirhiEbo	10	13	23 (6.2)
	Umegbe Primary School, Umegbe	12	14	26 (7.0)
	Owegie Primary School, UzebuQuaters	10	12	22 (5.9)
	Emwinobomwan Primary School, Evbuotubu	12	23	43 (11.5)
	Adolor Modern Primary School Adolor	23	25	48 (12.9)
	Ehenneden Primary School, Ugbowo	21	23	44 (11.8)
	Army Children School Ikpoba Hills	22	21	43 (11.5)
	Obe Primary School, Obe	22	22	44 (11.8)
	Ohen Primary School, Ologbo	21	19	44 (11.8)
	Total	179	193	372 (100)

The age categories of the participants showed that those aged 6-8 years were 77 (20.7%), those aged 9-10 years were 129 (34.7%) and those of 11-12 years were 166 (44.6%). Table 2 showed the distribution of participants based on Local Government Areas (LGAs) and their respective schools. Results showed that 28.5% were form Oredo LGA, 35.2% from Ikpoba - Okha while the remaining 36.3% were from Egor LGA. Table 3 shows the statistics of the age and estimated near work time on daily basis of the respondents. Results showed that the ages of the participants were between 6 and 12 years with an overall mean age of 9.88±1.70 years. Also, hours spent on near work were between 1-4 hours with an average of 2.34±0.88 hours (Table 4). Results showed that majority of the respondents 197 (53.0%) spend 2 hours on near work on daily basis, 73 (19.6%) spend 3 hours, 52 (14.0%) spend 4 hours and 50 (13.4%) spend 1 hour on the average near work activities. The accommodative status of the participants; 88 (23.7%) had accommodative disorders while 284 (76.3%) had no accommodative disorders. Table 5 shows the participants' demographic distribution with respect to accommodative status. According to age categories of the participants, 15 (19.5%) among the 6-8 years category have accommodative disorder while 62 (80.5%) do not; among 9-10 years, 29 (22.5%) have accommodative disorder while 100 (77.5%) do not; and among 11-12 years, 44 (26.5%) have accommodative disorders while 122 (73.5%) do not. A chi-square analysis showed no significant association between accommodative status and the age groups (p>0.05).

Table 3: Descriptive statistics of age and estimated near work time of the participants.

Descriptives	N	Minimum	Maximum	Mean	Std. Deviation
Age	372	6	12	9.97	1.775
Estimated timing for near work (hrs)	372	1	4	2.34	0.881

Table 4: Descriptive statistics of accommodative variables of the overall participants.

Accommodative Variables	Range	Mean	Std. Deviation	Skewness	Kurtosis
Binocular Accommodative Facility (MAF) cpm	2-11	9.40	2.720	-1.284	-0.073
Monocular Accommodative Facility (MAF) cpm RE	2-11	9.35	2.695	-1.205	-0.332
Monocular Accommodative Facility (MAF) cpm LE	1-11	9.27	2.848	-1.260	-0.004
Minimum Amplitude of Accommodation (AVG AA)	12.00-13.50	12.50	0.443	0.557	-0.639
Near Point of Accommodation (NPA) RE	4.5-11.1	6.73	0.876	1.695	6.515
Near Point of Accommodation (NPA) LE	4.5-11.1	6.74	0.888	1.722	6.448
Monocular Estimate Method (MEM) RE	-50.00-1.50	0.12	3.702	-13.445	181.005
Monocular Estimate Method (MEM) LE	-25.00-1.25	0.04	2.939	-8.372	69.122
Amplitude of Accommodation (AA) RE	9.0-22.0	15.11	1.847	0.367	4.101
Amplitude of Accommodation (AA) LE	9.0-22.0	15.10	1.858	0.353	4.083

Table 5: Distribution of participants' demographics based on accommodative status.

Demographics		Outcome		Total	Chi-Square (c^2) Analysis
		Accommodative problem n=88 (23.7%)	Normal n=284 (76.3%)		
Age categories	6-8 years	15 (19.5%)	62 (80.5%)	77 (100%)	c^2=1.589; df=2
	9-10 years	29 (22.5%)	100 (77.5%)	129 (100%)	*p*=0.452
	11-12 years	44 (26.5%)	122 (73.5%)	166 (100%)	
LGA	Oredo	26 (24.5%)	80 (75.5%)	106 (100%)	c^2=1.724; df=2
	Ikpoba - Okha	35 (26.7%)	96 (73.3%)	131 (100%)	*p*=0.422
	Egor	27 (20.0%)	108 (80.0%)	135 (100%)	
Gender	Female	32 (16.6%)	161 (83.4%)	193 (100%)	c^2=11.119; df=1
	Male	56 (31.3%)	123 (68.7%)	179 (100%)	*p*=0.001
Estimated Timing for Near Work (Hrs)	1	4 (8.0%)	46 (92.0%)	50 (100%)	c^2=101.894;
	2	19 (9.6%)	178 (90.4%)	197 (100%)	df=3
	3	28 (38.4%)	45 (61.6%)	73 (100%)	*p*<0.0001
	4	37 (71.2%)	15 (28.8%)	52 (100%)	

Table 6: Distribution of accommodative disorders in the LGAs.

LGA	Accommodative outcomes				Total	Chi-Square (c^2) Analysis
	AE (%)	AI (%)	AIF (%)	Normal		
Oredo	3 (2.8)	18 (17)	5 (4.7)	80 (75.5)	106 (100)	c^2 value = 3.447
Ikpoba - Okha	7 (5.3)	19 (14.5)	9 (6.9)	96 (73.3)	131 (100)	df=6
Egor	5 (3.7)	15 (11.1)	7 (5.2)	108 (80)	135 (100)	*p*=0.751
Total	15 (4.0)	52 (14)	21 (5.6)	284 (76.4)	372 (100)	

Based on LGA participants at Oredo, 26 (24.5%) had accommodative disorders while 80 (75.5%) do not; at Ikpoba - Okha, 35 (26.7%) participants had accommodative disorders while 96 (73.3%) were normal; and at Egor, 27 (20.0%) participants had accommodative disorders while 108 (80.0%) were normal. A chi-square analysis showed no significant association between accommodative status and the LGA distribution of participants ($p>0.05$). According to gender, 32 (16.6%) females had accommodative disorders while 161 (83.4%) were normal, and 56 (31.3%) males had accommodative disorders while 123 (68.7%) do not. A chi-square analysis showed significant association between accommodative status and the gender ($p<0.05$). This implies that male participants have significantly higher accommodative disorders compared to their female counterparts.

Observing the estimated timing for near work, participants with 1 hour daily of near work showed 4 (8.0%) with accommodative disorders while 46 (92.0%) were normal, participants with daily 2 hours of 19 (9.6%) participants with accommodative disorders while 178 (90.4%) do not, those with 3 hours had 28 (38.4%) participants with accommodative disorders while 45 (61.6%) were normal and those who spend 4 hours had 37 (71.2%) with accommodative disorders while 15 (28.8%) were normal. A chi-square analysis showed significant association between accommodative status and the estimated timing of near work ($p<0.05$). This implies that participants with more than 2 hours of near work have significantly higher accommodative disorders compared to their counterparts with 2 hours or less daily estimated near work. Overall, 284 (76.4%) of the respondents present with no accommodative disorder while 88 (23.6%) have accommodative disorders. The distributions of the accommodative disorders are as follows: 15 (4.0%) presented with accommodative excesses (AE), 52 (14.0%) presented accommodative insufficiency (AI) accounting for the highest accommodative disorder, while 21 (5.6%) presented with accommodative infacility (AIF).

A Chi Square test for independence was used to determine the relationship between LGAs and accommodative outcomes and there was found to be no association between LGAs and the presence of an accommodative disorder (c^2=3.447, df=6, p=0.751). From this, it can be deduced that in the study population, location of the schools do not predispose a child to having an accommodative disorder (Table 6). Study showed that the presence of accommodative outcomes based on gender of the respondents, results showed that females, 161 (83.4%), exhibited normal accommodative outcomes than males, 123 (68.7%).

The highest variation among the exhibited accommodative disorder was observed with accommodative infacility, with 17 (9.5%) males and 4 (2.1) females. Accommodative insufficiency was 31 (17.3%) in males and 21 (10.9%) in females, while accommodative excess was 8 (4.5%) in males and 7 (3.6%) in females.

Table 7: Accommodative disorder of the participants based on age categories.

Age categories	Accommodative outcomes				Total (%)	Chi-Square (c^2) Analysis
	AE (%)	AI (%)	AIF (%)	Normal (%)		
6-8 years	1 (1.3)	9 (11.7)	5 (6.5)	62 (80.5)	77 (100.0)	c^2 value = 3.944
9-10 years	7 (5.4)	16 (12.4)	6 (4.7)	100 (77.5)	129 (100.0)	df=6
11-12 years	7 (4.2)	27 (16.3)	10 (6.0)	122 (73.5)	166 (100.0)	*p*=0.684
Total	15 (4.0)	52 (14.0)	21 (5.6)	284 (76.3)	372 (100.0)	

Table 8: Estimated timing for near work (hrs) of participants and accommodative outcomes.

Estimated Timing for Near Work (Hrs)	Accommodative outcomes				Total (%)	Chi-Square (c^2) Analysis
	AE (%)	AI (%)	AIF (%)	Normal (%)		
1	0 (0)	3 (6)	1 (2.0)	46 (92)	50 (100)	c^2 value =
2	2 (1)	11 (5.6)	6 (3.0)	178 (90.4)	197 (100)	109.925[a]
3	6 (8.2)	19 (26.)	3 (4.1)	45 (61.6)	73 (100)	df=9
4	7 (13.5)	19 (36.5)	11 (21.2)	15 (28.8)	52 (100)	p<0.0001
Total	15 (4.0)	52 (14.0)	21 (5.6)	284 (76.3)	372 (100)	

Table 9: Distribution of accommodative disorders in the LGAs.

LGA	Outcome		Total	Chi-Square (c^2) Analysis
	Accommodative problem n=88 (23.7%)	Normal n=284 (76.3%)		
Oredo	26 (24.5)	80 (75.5)	106 (100)	c^2=1.724
Ikpoba - Okha	35 (26.7)	96 (73.3)	131 (100)	df=2
Egor	27 (20)	108 (80)	135 (100)	p=0.422

A further analysis using chi-square analysis found a significant association between gender and the presence of an accommodative disorder (accommodative infacility) (c^2=14.616, df=3, p=0.002), when compared with normal vision. This implies that accommodative disorders could be more present in males than females among the respondents.

Table 7 showed the distribution of accommodative disorder of the respondents based on their age categories. Results showed that participants aged 6-8 years had least accommodative disorders of 19.5%: AE=1 (1.3%); AI=9 (11.7%); AIF=5 (6.5%), 9-10 years had 22.5% accommodative disorders: AE=7 (5.4%); AI=16 (12.4%); AIF=6 (4.7%), while 11-12 years had 26.5% accommodative disorders: AE=7 (4.2%); AI=27 (16.3%); AIF=10 (6.0%). A further analysis to compare the association between age categories and accommodative outcomes using Chi-square test showed no significant association between accommodative disorders and age categories of the participants (c^2 value=3.944, df=6, p value=0.684).

Table 8 showed the estimated time for near work and the associated accommodative outcomes. Results revealed that accommodative disorders are more prevalent with increasing near work hours (c^2 value=109.925; df=9; p<0.0001). The near work timing breakdown of participants with accommodative disorders when compared with normal participants showed that 1 hr had 8.0% accommodative disorders: AE=0 (0.0%); AI=3 (6.0%); AIF=1 (2.0%), 2 hrs had 9.6% accommodative disorders: AE=2 (1.0%); AI=11 (5.6%); AIF=6 (3.0%), 3 hrs had 38.4% accommodative disorders: AE=6 (8.2%); AI=19 (26.0%); AIF=3 (4.1%), and 4 hrs (71.2%) had highest accommodative disorders AE=7 (13.5%); AI=19 (36.5%); AIF=11 (21.2%). This implies that the more time spent on near work activities the likelihood of the occurrence of accommodative disorders most especially 3 hours and above predisposing to accommodative insufficiency and above 4 hours resulting in accomm-odative infacility.

Table 9 showed the distribution of accommodative disorders in the 3 LGAs. In Oredo, 26 (24.5%) had accommodative disorders while 80 (75.5%) do not; at Ikpoba-Okha, 35 (26.7%) participants had accommodative disorders while 96 (73.3%) were normal; and at Egor, 27 (20.0%) participants had accommodative disorders while 108 (80.0%) were normal. A chi-square analysis showed no significant association between accommodative status and the LGA distribution of participants (p>0.05). This means that the alternate hypothesis which states that "there will be significant difference in the distribution of accommodative disorders among children age 6-12 years in the 3 LGAs in Benin City" is hereby rejected. Consequently, the null hypothesis which states that "there will be no significant difference in the distribution of accommodative disorders among children age 6-12 years in the 3 LGAs in Benin City" is hereby accepted.

DISCUSSION

The present study provides comprehensive insight into the burden and determinants of accommodative disorders among primary school children aged 6–12 years in Benin City, Edo State, Nigeria. After accounting for an attrition rate of 11.4%, the final sample of 372 participants was adequately representtative across gender, age groups, schools, and local government areas, strengthening the internal validity and generalizability of the findings within the urban context of Benin City. The overall prevalence of accommodative disorders in this study was 23.7%, indicating that nearly one in four children had some form of accommodative dysfunction. This prevalence is relatively high and aligns with reports from similar school-based studies in developing and developed settings, where accommodative disorders have been documented as common but under diagnosed visual problems among school-aged children. The observed prevalence underscores the clinical and public health relevance of accommodative anomalies in pediatric populations, particularly in environments where academic demands increasingly rely on sustained near vision[15,16].

Accommodative insufficiency emerged as the most prevalent accommodative disorder, accounting for 14.0% of the total study population and representing the dominant subtype among affected children. This finding is consistent with the literature, which frequently identifies accommodative insufficiency as the most common accommodative anomaly in children and adolescents. The predominance of accommodative insufficiency may reflect increased near visual

demands coupled with inadequate accommodative stamina, especially in children with uncorrected refractive errors or limited visual hygiene practices. Accommodative infacility (5.6%) and accommodative excess (4.0%) were less prevalent but remain clinically significant due to their impact on reading efficiency and visual comfort[17,18]. Analysis of accommodative status across age categories showed a gradual increase in prevalence with advancing age, from 19.5% among children aged 6–8 years to 26.5% among those aged 11–12 years. Although this trend suggests a cumulative effect of prolonged academic and near work exposure with age, the association did not reach statistical significance. This lack of significance is in agreement with several studies that report accommodative disorders across all school-age groups, emphasizing that these conditions are not limited to older children but can occur early in formal education[19,20].

Gender-based analysis revealed a statistically significant association between accommodative disorders and male gender, with males exhibiting a markedly higher prevalence (31.3%) compared to females (16.6%). Furthermore, accommodative infacility was particularly more common among males. This finding contrasts with some reports that show no gender difference but aligns with others suggesting that behavioral factors, such as longer duration of near work, increased screen exposure, or reduced symptom reporting thresholds, may predispose male children to accommodative dysfunction. These results highlight the need for gender-sensitive considerations in school vision screening and preventive strategies[21,22]. A key finding of this study was the strong and statistically significant association between accommodative disorders and estimated daily near work duration. Children who engaged in near work for more than two hours per day demonstrated a sharply increased prevalence of accommodative disorders, with the highest burden observed among those with three to four hours of near work. Notably, accommodative insufficiency predominated at three hours of near work, while accommodative infacility became more prominent at four hours. This dose–response relationship provides compelling evidence that pro-longed near tasks constitute a major modifiable risk factor for accommodative dysfunction in children[23,24].

The distribution of accommodative disorders across the three local government areas showed no significant differences, indicating that geographic location within Benin City did not predispose children to accommodative anomalies. This uniformity suggests that accommodative disorders are influenced more by individual visual demands and behaviors than by school location or administrative boundaries. These findings reinforce the need for routine assessment of accommodative function in school eye health programs and support the integration of visual hygiene education aimed at regulating near work duration to mitigate accommodative stress among school-aged children[25].

Limitations of the study

The major limitations encountered during this study was that a few of the initially enlisted participants failed to meet the inclusion criteria. Additionally, some of the younger children responded poorly during screening, due to their inability to read and understand some instructions. In spite of the aforementioned challenge, efforts were made to ensure that the participants cooperated efficiently. Consequently, the research objectives were realized as the quality and validity of the study was retained.

CONCLUSIONS

This study demonstrates that accommodative disorders constitute a significant visual health problem among children aged 6–12 years in Benin City, Edo State, Nigeria, with nearly one-quarter of the study population affected. Accommodative insufficiency was the predominant disorder, followed by accommodative infacility and accommodative excess, underscoring the substantial burden of functional vision anomalies beyond refractive errors in school-aged children. The findings further reveal that accommodative disorders are strongly associated with male gender and, most importantly, prolonged near work duration. Early detection, timely intervention, and integration of comprehensive binocular vision care into school eye health programs are essential to improving visual function, academic performance, and overall quality of life in this population.

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AUTHOR'S CONTRIBUTIONS

Tamunominabo E: formal analysis, conceptualisation, data organisation, writing original draft. **Anetor GO:** literature survey. **Anetor J:** critical review, editing. **Obeagu EI:** data analysis, manuscript writing. Final manuscript was checked and approved by all authors.

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DATA AVAILABILITY

The related author can provide the empirical data supporting the study's conclusions upon request.

CONFLICT OF INTEREST

There are no conflicts of interest in regard to this project.

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