UNIVERSITY OF GONDAR
COLLEGE OF MEDICINE AND HEALTH SCIENCE
SCHOOL OF MEDICINE DEPARTMENT OF OPTOMETRY

PREVALENCE OF STRABISMUS AND ASSOCIATED FACTORS AMONG KINDERGARTEN SCHOOL CHILDREN IN GONDAR CITY, NORTHWEST ETHIOPIA

BY: BIRUKTAWIT FIKRE

ADVISORS: Mr. AYANAW TSEGA (BSc, MSc)

Mrs. TSEHAY KASSA (BSc, MSc)

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BY BIRUKTAWIT FIKRE TEL. 0970408973

EMAIL:fikre.biruktawit@yahoo.com

Approved by the Examining Board

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Head, Department of Optometry

Advisors

Name	sign	date
1. Mr. Ayanaw Tsega	----------	----------
2. Mrs. Tsehay Kassa	----------	-- -------

Examiners

Name	sign	date
1. ----------	----------	----------
2. ----------	----------	----------

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List of acronyms

EPI INFO Epidemiological Information

ET Esotropia

ETB Ethiopian Birr

Kg Kilogram

KG kindergarten

MSC Masters of Science

NICU Neonatal Intensive Care Unit

RE Refractive Error

ROP Retinopathy of Prematurity

SPSS Statistical Package for Social Sciences

UOG TETC University of Gondar Tertiary Eye Care and Training Center

US United States

VA Visual Acuity

XT Exotropia

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Abstract

Introduction: Strabismus is a misalignment of the eyes, such that the visual axes of each eye are not simultaneously directed at the object of regard. It may be the result of multiple factors. It is usually attributable to refractive, sensory, organic, anatomic, motor or innervational causes. It occurs more frequently in children with neurodevelopmental conditions and born prematurely or of low birth weight. Though strabismus is a common presenting ocular problem, there are limited data in the study area about the prevalence and associated factors.

Objective: The aim of this study was to determine the prevalence and associated factors of strabismus among kindergarten school children in Gondar city.

Methods: School based cross-sectional study design was used from April 24 - May 8, 2017 with 848 sample size. Multistage systematic random sampling was used to reach at the required sample size. The data was collected by pretested and structured questionnaire and through eye examination with different ophthalmic instruments. Data was entered into epidemiological information version 3.5.1 and analyzed using statistical package for social sciences version 20. Descriptive statistics was carried out. Binary logistic regression was fitted and variables which had P value of < 0.05 in multivariable analysis were considered as statistically significant.

Result: A total of 784 study subjects were included in this study, giving a response rate of 92.5%. The median age was 6 years(IQR 1), and 432(55.1%) were female. The prevalence of strabismus was 3.1% (95% CI: 1.8-4.2). The multivariable analysis result showed that prematurity [AOR=2.8 (95% CI: 1.0-8.2)], parents with strabismus [AOR=5.8 (95% CI: 1.5-22.6)] and children with refractive error [AOR=16 (95% CI: 5.4-48.1)] were significantly associated factors with strabismus.

Conclusion and recommendation: The prevalence of strabismus was 3.1%. Prematurity, parents with strabismus and children with refractive error were independently significantly associated variables with strabismus. As vision loss and amblyopia are the major complications of strabismus, early screening is important.

Key words: Cross-sectional, kindergarten school, Northwest Ethiopia, Strabismus

Introduction

1.1. Statement of the problem

Strabismus is a misalignment of the eyes, such that the visual axes of each eye are not simultaneously directed at the object of regard (1).

Strabismus is classified as esotropia, exotropia, hypertropia, hypotropia and incyclotorsion or excyclotorsion. An esotropia is a latent or manifest convergent misalignment of the visual axes. Esodeviations are the most common type of strabismus, accounting for more than 50% of ocular deviations in the pediatric population. An exotropia is a divergent strabismus that can be latent (controlled by fusion) or manifest. In vertical misalignment of the visual axes one eye is either constantly or intermittently upward (hypertropia), downward (hypotropia). Strabismus could be cyclic (incyclotorsion or excyclotorsion) (2).

Strabismus may be accompanied by abnormal motility of one or both eyes, double vision, decreased vision, visual confusion, suppression, ocular discomfort, headaches, or abnormal head posture. Strabismus may be the result of multiple factors. It is usually attributable to refractive, sensory, organic, anatomic, motor or innervational causes(3) and it occurs more frequently in children with neurodevelopmental conditions and born prematurely or of low birth weight(4).

Population studies, from Western European and North American revealed the prevalence of strabismus is between 2% and 5% with esodeviations outnumbering exodeviations (5). However, data from some Asian studies report prevalence between 0.8% and 5.65%(6,7) and exodeviations being more common than esodeviations (8,9). In Africa a study done in Nigeria showed that the prevalence to be 0.43% (10). A study done in Ethiopia, Butajira town reveals the prevalence be 1.53% (11).

Strabismus can result in amblyopia (lazy eye), impaired stereopsis (binocular depth perception) and diverse psychosocial impacts. The most common form of amblyopia develops in the consistently deviating eye of a child with strabismus. Constant, non alternating heterotopias (typically esodeviations) are most likely to cause significant

amblyopia. Early identification and treatment of strabismic children may prevent amblyopia (12).

Strabismus has also psychosocial impacts in both children and adults. Negative attitudes toward strabismus emerge at a young age, as early as 6 years, as shown in one study done in Houston, Texas. Better understanding about when and why children first recognize strabismus may help guide the appropriate timing of medical and surgical intervention and may help parents better cope with strabismus in their young child (13-16).

In the majority of cases, strabismus is a treatable condition that requires identification and treatment at early age, particularly before the age of two years. Treatment at early age will result in best visual acuity in each eye, increased chance of stereopsis and acceptable cosmetic result. (17).

For the above reasons, continued epidemiological research into the prevalence and risk factors for strabismus (particularly factors that could identify children at risk) and the impact of strabismus on the visual function of young children is of public health importance.

In Ethiopia, strabismus is one of the common childhood eye problems, which is frequently seen at the out patient departments. However, there is limited data in the study area about the prevalence and potential risk factors. Therefore, this study aims to determine the prevalence and associated factors of strabismus among kindergarten school children in Gondar city.

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1.2. Literature review

1.2.1. Magnitude of Strabismus

There are many literatures done on magnitude and associated factors of strabismus. A lot of researches were conducted at schools, within community children and hospital based.

In a population-based cross-sectional study of United States, strabismus was found about 2.8% and from this esotropia accounts 54%, followed by exotropia(29%) and microstrabismus (15%) (18).

In Multi-Ethnic Pediatric Eye Disease Study, strabismus was present in 3.3% of white children and 2.1% of African American children. All cases of strabismus was horizontal and one case was vertical. Esotropia and exotropia were nearly equally prevalent (1.5% and 1.8%, respectively) (19).

In another study conducted in Tohono O'odham, Arizona preschoolers, kindergarten and first grade children, strabismus was found in 1.0% of the 315 children in the kindergarten/first grade, (0.3%) with esotropia and (0.6%) with exotropia (20).

In a cross-sectional, population-based study conducted in Eastern China, strabismus was found in 5.65% of preschool children including 43 with concomitant esotropia, 259 with concomitant exotropia, 8 with microtropia, 10 with pure vertical strabismus (3 dissociated vertical deviation and 7 oblique muscle dysfunction) and 1 with Type I Duane syndrome (21).

A study done in Singaporean Chinese children aged from 6 to 72 months reported that the prevalence of strabismus was 0.80%, with exotropia to esotropia ratio being 7:1. The most frequent strabismus type was intermittent exotropia (58%), followed by constant exotropia (25%) and constant esotropia (12%) (22).

A case control study carried out among primary school children in Ilorin, Nigeria reported a prevalence of strabismus be 0.43%. The prevalence for esotropia and exotropia was the same(0.14%). Congenital esotropia and accommodative esotropia constituted 50.0% and 18.8% of cases respectively while, exotropia constituted 31.3% (10).

In Ethiopia there is one study done among preschool children in Butajira town and found the prevalence of strabismus being 1.53%. Esotropia was the commonest type of strabismus (69%) followed by exotropia (24%) (11).

1.2.2. Associated factors of strabismus

There are several factors that may make an individual more likely to develop strabismus. The major associated factors revealed through different literatures are: socio-demographic characteristics, perinatal characteristics , refractive errors, family ocular history and maternal factors.

Socio-demographic factors

As shown from different cross-sectional studies, ethnicity has a significant effect in strabismus. A study conducted among school children in Bradford city, United kingdom showed that children of white British ethnicity have twice the odds of having esotropia(23). In 2003 and 2004 ,a population-based cross-sectional study done in Sydney, Australia among 6-year-old children reported that children of nonwhite ethnicity were 3 times less likely to have esotropia than white(24).

Age and sex is also a major determinant of strabismus. On the cross-sectional population-based study conducted in Baltimore, the prevalence of strabismus were almost similar for boys and girls (2.65% and 2.57% respectively). Both exotropia and esotropia were about 3 times more frequent in children after 12 months of age compared to the first year of life (25).

In a population-based cross-sectional study on Strabismus, Amblyopia and Refractive Error in Singaporean Preschoolers (STARS) showed that, strabismus was associated with families with lower parental education (22).

Perinatal characteristics

Between 1996 and 2003 retrospective chart review on perinatal risk factors of strabismus was done in Denmark. It was found that low birth weight, prematurity, large head circumference and presence of congenital abnormalities were associated with increased risk of strabismus. Delivery by Caesarean section was associated with exotropia (26).Significant associations were also found with prematurity (gestational age, 36 weeks or less), low birth weight (< 2500 g), and parent-reported admission to a neonatal intensive care unit in a cross-sectional study done in Australia (24).

Refractive error

Different studies in Baltimore, China, Singapore(STARS), Brazil and Nigeria showed that strabismus had significant association with refractive error.

A population-based cross-sectional study was conducted in China to see the association between childhood strabismus and refractive error among 5831 children aged 3 to 6 years. It has been reported that a concomitant esotropia was associated independently with spherical equivalent anisometropia of 0.50 to ≥1.00 diopter and hyperopia of ≥2.00 diopter. Concomitant exotropia was associated with astigmatism, myopia, and hyperopia (27).The odds of having esotropia were highest in children with a hyperopic mean spherical equivalent in Baltimore study(25). In STARS study strabismus was associated with astigmatism ≥1.00 diopter(22).

A cross-sectional population-based study done in southeastern region of Brazil revealed that strabismus was associated with hyperopia, astigmatism, myopia amblyopia and with moderate anisometropia (28).

A case control study done in Ilorin, Southwestern Nigeria reported that significant hypermetropia(≥ 3.50DS) was associated with strabismus (10).

Family history

In a population-based cross-sectional study on Strabismus, Amblyopia and Refractive Error in Preschoolers in Singapore showed that sibling with strabismus had significant association with strabismus (22).

1.2.3. Conceptual frame work

The variables statistically significant with strabismus are developed from literatures and books and grouped and displayed as follows.

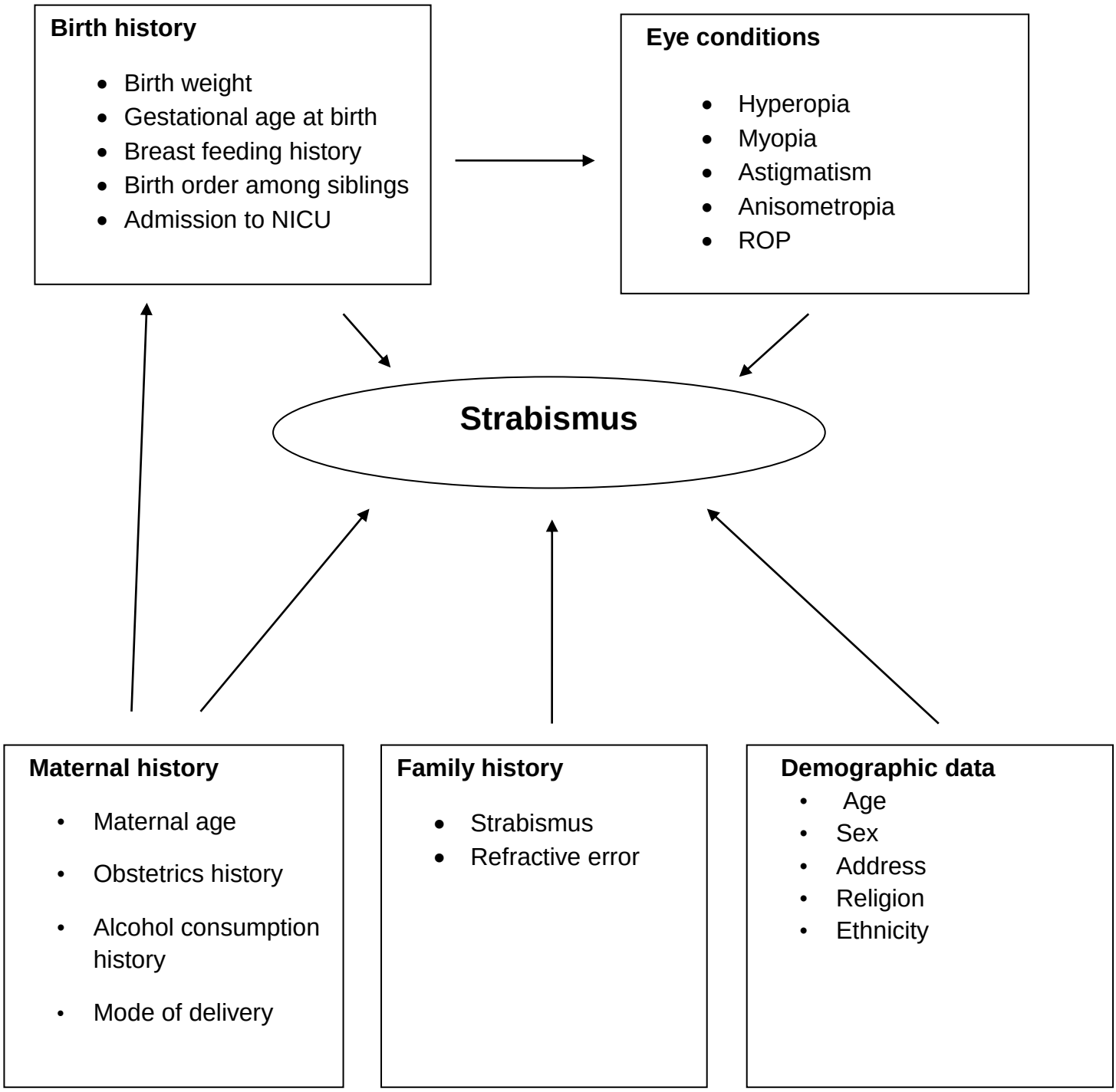


Fig.1 Conceptual frame work of variables on strabismus prevalence

1.3. Justification of the study

The most common form of amblyopia develops in the constantly deviating eye of a child with strabismus. Constant, non alternating strabismus (typically esodeviations) are most likely to cause significant amblyopia(2). Strabismus has public health significance since it leads to consequences of vision loss, reduced or absent depth perception, multiple life-long surgeries, stigma and social interaction problems of children.

In Ethiopia, there is one community based study regarding strabismus which focused only on magnitude. This study was done in Butajira not within this study area(11). Therefore, due to difference in study area, population and limited data on associated factors, this study was designed to assess prevalence and associated factors of strabismus among kindergarten school children in Gondar city which will contribute baseline information for other researchers and policy makers it enables them to plan and implement early and regular screening programs so as to prevent amblyopia.

2. Objectives

2.1. General objective

- The purpose of this study was to determine the prevalence and associated factors of strabismus among kindergarten school children in Gondar city,2017.

2.2. Specific objectives

- To determine the prevalence of strabismus among kindergarten school children in Gondar city.
- To identify the associated factors of strabismus among kindergarten school children in Gondar city.

3. Methods and materials

3.1. Study design

School based cross-sectional study design was used.

3.2. Study area and study period

This study was conducted in Gondar city, Northwest of Ethiopia from April 24 to May 8, 2017. A data obtained from Gondar city administration statistical office indicates that Gondar city is located north of lake Tana on the lesser Angereb river and southwest of the Simien mountains. It is located 738 kilometres from Addis Abeba. According to 2007 census Gondar city has a total population of 351,675(31). There are 10 sub cities and 21 kebeles and within these, there are 25 kindergarten schools with 4628 students, 64 primary schools and 14 secondary schools. There is one government hospital-University of Gondar tertiary eye care and training center which provides different specialty eye care services and training of eye care professionals such as Optometrists and Ophthalmologists.

3.3. Source and study population

3.3.1. Source population

All kindergarten school children in Gondar city.

3.3.2. Study population

All kindergarten school children in Gondar city in the selected schools.

3.4. Inclusion and exclusion criteria

3.4.1. Inclusion criteria:

The study included randomly selected children in kindergarten schools in Gondar city.

3.4.2. Exclusion criteria:

Children with active ocular infection.

3.5. Sample size determination

A. Sample size for objective One

The minimum sample size was determined by using single population proportion formula using EPI INFO 7 software, with the following assumptions:

Population size -4628

95% confidence interval

P – Proportion of strabismus was1.53% from similar study in Butajira preschool children Ethiopia = 0.0153

d – Maximum allowable error 1% = 0.01

The sample size was **514**.

B. Sample size for objective two

By using OPEN EPI computer software and considering 95% CI, 80% power, ratio of control to case 1:1, 43.75% of controls exposed and (OR= 8), (from a study in Nigeria), the computer generated sample was **52**.

Sample size of objective one was selected since it is larger than objective two. By anticipating 10% non response rate and a design effect of 1.5, the final required sample size was **848**.

3.6. Sampling technique and procedures

Multistage sampling technique using two stages of the sampling process was used. To ensure representativeness, sample was taken from 30% of the schools. First, 8 schools out of 25 schools were selected using simple random sampling method. In eight selected schools there were 1764 preschoolers. Then systematic random sampling method with sampling fraction of 2 was used to get one student. Diagram of sampling procedures is illustrated as follows.

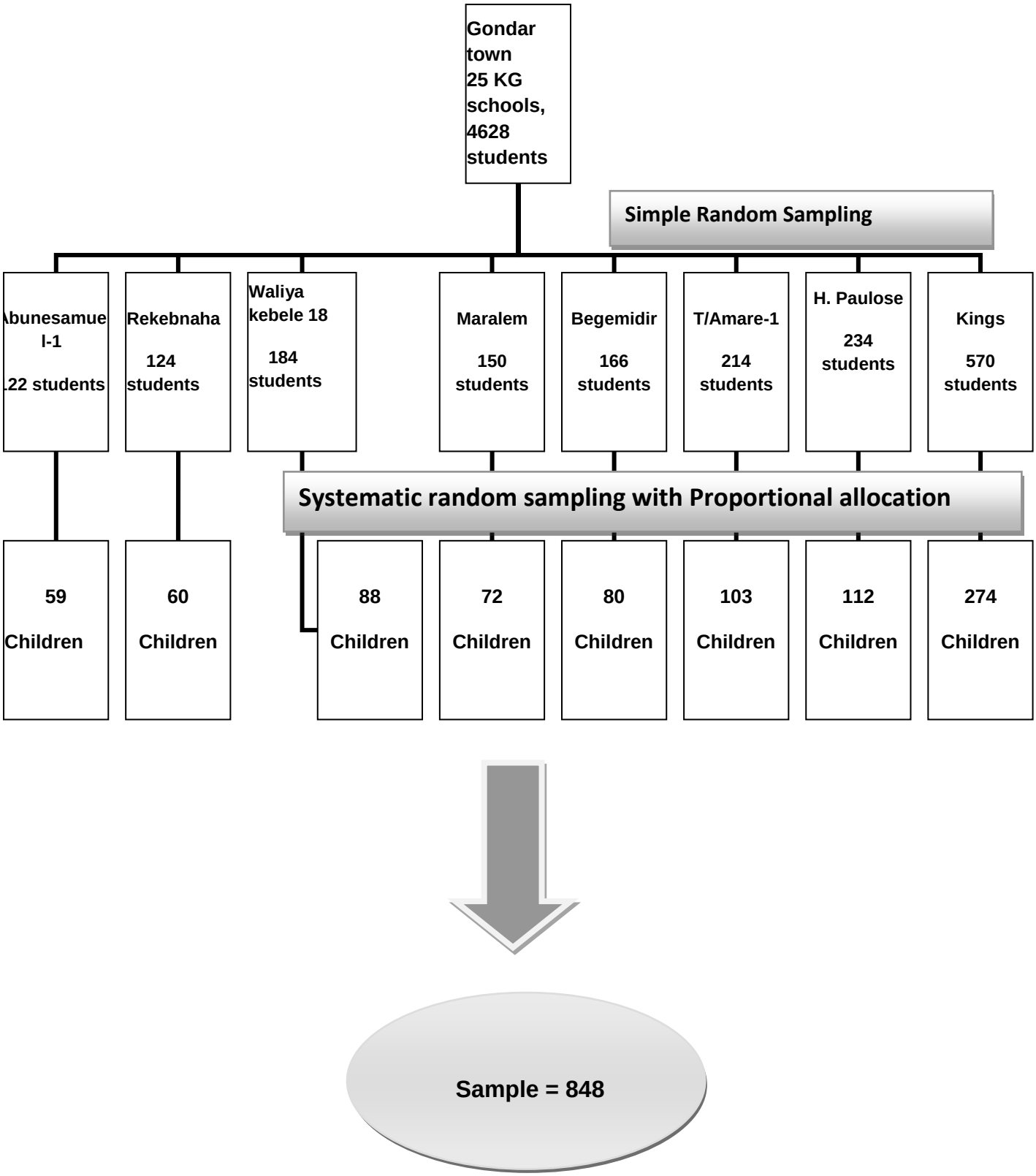


Fig.2 Schematic representation of sampling procedure for prevalence and associated factors of strabismus among KG students in Gondar city, Northwest Ethiopia 2017

3.7. Variables of the study

3.7.1. Dependent variable:

- The presence of strabismus (yes/no)

3.7.2. Independent variables:

A. Socio-demographic characteristics

- Age
- Sex
- Ethnicity
- Religion
- Household head educational status

B. Birth history conditions

- Birth weight
- Gestational age at birth
- Breast feeding history
- Birth order among siblings
- Admission to NICU

C. Maternal socio-demographic and obstetric history

- Maternal age at birth
- Mode of delivery
- Maternal obstetric history
- Maternal alcohol consumption history

D. Ocular conditions

- Myopia
- Hyperopia
- Astigmatism
- Anisometropia
- Retinopathy of prematurity
- Nerve palsy

E. Family history of ocular health

- Family history of Refractive error
- Family history of strabismus

3.8. Operational definitions

Strabismus was defined as heterotropia of ≥10Δ magnitude at distance or near fixation either vertically or horizontally.

Prematurity: A birth history that takes place before 36 weeks of gestation(27).

Low birth weight: A birth weight of less than 2.5 kilogram(27).

Retinopathy of prematurity: Vascular or cicatricial change in the fundus.

Refractive error was defined as a child who had myopia of ≥ –0.50DS, hyperopia of ≥ +2.00DS, astigmatisms of ≥ –0.75DC, anisometropia was defined as difference of ≥ 2.00DS between eyes(11).

3.9. Data collection

3.9.1. Data collection tools

Pretested questionnaire and occluder, pen torch, Snellen letter charts, direct ophthalmoscope, retinoscope and full trial set were used during data collection.

3.9.2. Data collection procedure

Clinical assessment of strabismus

The eye examination was performed by 7 senior optometrists. Visual acuity was measured at 3 meter distance using Snellen chart.

Ocular alignment was assessed by using the Hirschberg corneal light reflex test, and cover test was performed at both distance and near fixation target using pen torch. To determine the presence or absence of a heterotropia, each eye was occluded for a minimum of 3 seconds at both distance and near fixation. The movement of the uncovered eye was observed and presence and type of heterotropia was recorded. Binocular and monocular ocular movements were examined at nine diagnostic positions of gaze. Estimation of the magnitude of strabismus was done by hirschberg corneal light reflex test. Refractive error was measured at 3 meter in all children using dry retinoscopy.

Parental Questionnaire

A questionnaire totalling 20 items was sent to be completed by the corresponding parents or legal guardians of each child. The questionnaire contained information about socio-demographic data, parental education, the child's birth history, breast feeding history, maternal age at birth, maternal obstetric history, maternal alcohol consumption history during pregnancy and family history of strabismus and refractive error.

3.9.3. Data quality control

Data was collected with a pretested semi-structured questionnaire and through eye examination. Training was given to data collectors. The collected data was checked out for the completeness, accuracy and clarity by the Investigator on daily basis. Data clean up and cross-checking was done before analysis.

3.10. Data management and analysis

The data was entered into EPI INFO version 3.5.1, and was exported to SPSS version 20 for processing and analysis. Data coding, cleaning and checking was done before analysis. Multi-collinearity among independent variables was checked using variance inflation factor and tolerance. Frequencies, proportions and summary statistics were calculated for selected variables. Binary and multivariable logistic regression was used to identify factors associated with strabismus. The variables that are found with $P<0.2$ in bivariable was entered to multivariable analysis. Both Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) with 95% confidence interval (CI) were used to show the strength of association. Those variables in multivariable analysis with p-value < 0.05 were considered as statistically significant.

4. Ethical consideration

Before conducting the study, ethical clearance was obtained from the institutional ethical review board of University of Gondar, College of Medicine and Health Sciences. Official letters was obtained from Gondar district education bureau. Informed consent was obtained from the parents. All parents of children were informed about the purpose of the study, and examination and interview was done only with those who agreed to give a written consent to participate.

Moreover, the confidentiality of information obtained was guaranteed by using code numbers rather than personal identifiers and by keeping the questionnaire locked. Children found with strabismus was referred to Gondar university specialized hospital for further diagnosis and treatment.

5. Results

5.1. Socio-demographic characteristics of the study participants

Seven hundred eighty four study subjects were included with response rate of 92.5%. The median age of the participants was 6 years (IQR 5,6). More than half of the study participants (55.1%) were female. Majority (92.7%) of the study participants were Orthodox Christians in religion and Amhara (94.1%) in ethnicity. About one third of fathers (35.5%) attained higher education. (Table 1).

Table 1. Socio-demographic characteristics of the study participants in Gondar city Northwest Ethiopia, 2017(n=784).

Variables	Frequency	Percent
Sex		
Male	352	44.9
Female	432	55.1
Age in year		
3-5	334	42.6
6-8	450	57.4
Father's educational status		
Uneducated	72	9.2
Read and write only	156	19.9
Primary education	80	10.2
Secondary education	198	25.2
College and above	278	35.5

5.2. Prevalence of strabismus

Strabismus was diagnosed in 24 children (3.1%) (95% CI: 1.8%-4.2%) who comprised of 11 (46%) males and 13 (54%) females. Of those children who had strabismus 14 children (58.3%) had esotropia and 8 (33%) had exotropia, and 2(8.3%) had vertical tropia. Five children with esotropia were hyperopic between 1.00Ds and 4.00Ds. Two children with Down syndrome had alternate esotropia. Among them one had myopia of 3.00Ds and the other one was hyperopic of 3.50Ds. One child with esotropia had an overaction of left inferior oblique muscle. Intermittent exotropia was more prevalent (62.5%) than constant exotropia. There was one child with sensory exotropia who had bilateral congenital cataract extraction.

Table 2. The proportion of strabismus among study participants in terms of age and sex, in Gondar city, Northwest Ethiopia, 2017(n=784).

Age	Strabismus		No Strabismus	
	Male	Female	Male	Female
3-5	1	9	138	186
6-8	9	5	204	232

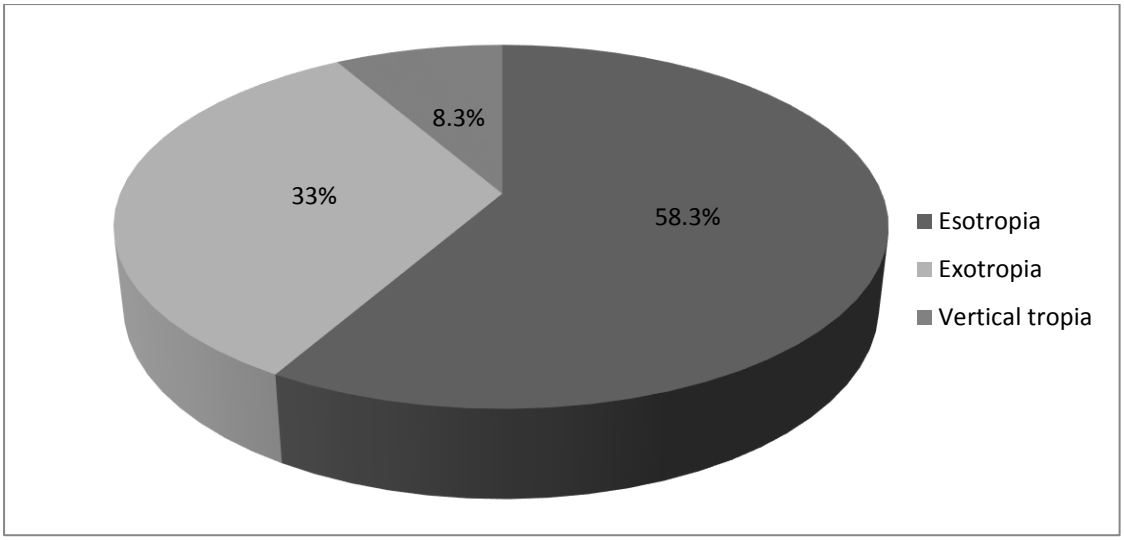


Fig 3. The classification of strabismus among study participants, Gondar city, Northwest Ethiopia, 2017.

Refractive error was found in 10(41.6%) of strabismic children. The most common type of refractive error was hyperopia(20.8%), followed by myopia(12.5%), and astigmatism(8.3%). (figure 4).

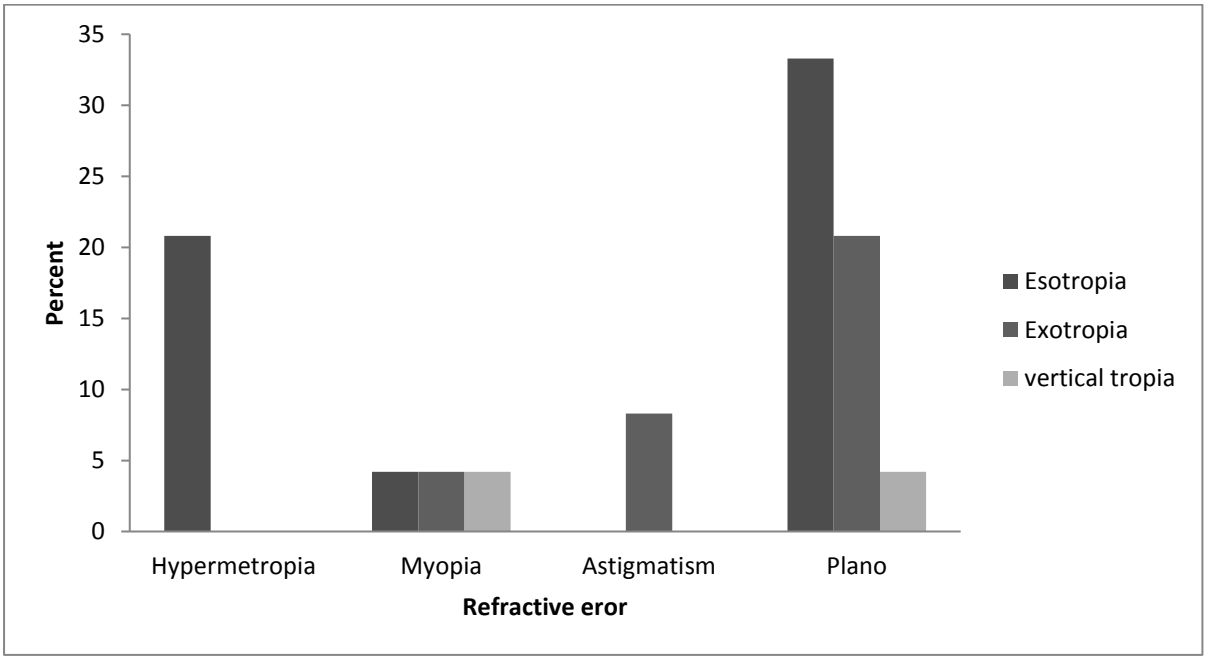
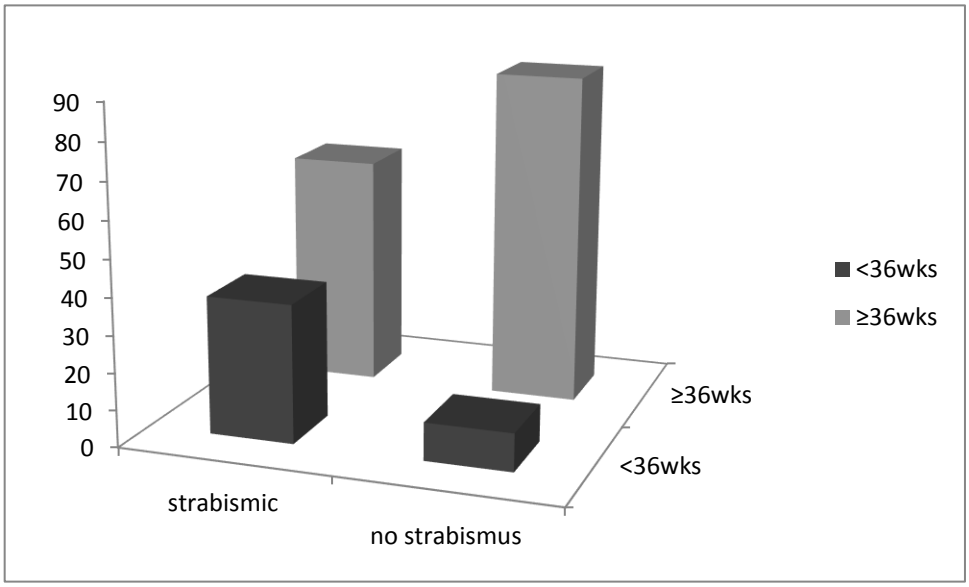


Fig.4. Distribution of refractive error among strabismus group, Gondar city, Northwest Ethiopia, 2017

Majority of study participants were born maturely (88.8%),had birth weight of ≥ 2.5 kilogram (84.7%), and had a history of breast feeding ≥ 6 months (86.2%).(figure 5).



key=Gestational age(wks= weeks)

Fig.5. Shows the gestational age characteristics of study participants, Gondar city 2017.

5.3. Factors associated with strabismus

After adjusting for sociodemographic, child and maternal birth history, family and child's ocular condition the multivariable logistic regression revealed that children who were born prematurely (p=0.04), had parents with strabismus (p=0.01), and had refractive error(p=0.001) were more likely to have strabismus.

Children who were born prematurely (gestational age of <36 weeks) were nearly 3 times to develop strabismus than those who were born maturely(gestational age of ≥36 weeks) (AOR=2.8, 95% CI: 1.0-8.2). Children who had parents with strabismus were nearly 6 times more likely be strabismic (AOR=5.8, 95% CI: 1.5-22.6) than those with parents who had no strabismus. Refractive error was significantly associated with strabismus. Children who had significant refractive error were 16

times more likely to be strabismic (AOR=16, 95% CI: 5.4-48.1) than those who were emmetropic.(Table 3)

Table 3. Factors associated with strabismus among kindergarten school children in Gondar city Northwest Ethiopia, 2017 (n=784)

Variables	Strabismus		COR, (95% CI)	AOR, (95%CI)
	Yes (n=24)	No (n=760)		
Age				
3-5	10	324	1.0(0.42-3.6)	
6-8	14	436	1.00	
Sex				
Male	10	342	0.9(0.3-2.5)	
Female	14	418	1.00	
Birth weight in kilogram				
<2.5 Kg	5	115	1.4(0.5-4.0)	
≥2.5 Kg	19	645	1.00	
Gestational age				
<36 weeks	10	79	6.1(2.6-14.3)	2.8(1.0-8.2)**
≥36 weeks	14	681	1.00	1.00
Breast feeding				
<6 months	7	101	2.6(1.0-6.6)	
≥6 months	17	659	1.00	
Admission to NICU				
Yes	6	38	6.3(1.2-11.6)	
No	18	722	1.00	
Birth order				
First-born child	13	316	1.00	
Others	11	444	0.6(0.2-1.3)	
Maternal age				
16-30	17	648	1.00	
31-41	7	112	2.3(0.9-5.8)	

Mode of delivery				
Vaginal	19	667	1.00	
Cesarean section	5	93	1.8(0.6-5.1)	
Took alcohol during pregnancy				
Yes	5	142	1.1(0.4-3.1)	
No	19	618	1.00	
Maternal illness during pregnancy				
Yes	6	42	5.6(0.3-6.8)	
No	18	718	1.00	
Parents with strabismus				
Yes	5	15	13.0(4.3-39.6)	5.8(1.5-22.6)*
No	19	745	1.00	1.00
Parents with refractive error				
Yes	6	93	2.3(0.9-6.1)	
No	18	667	1.00	
Refractive error				
Yes	10	26	20.1(8.1-49.6)	16(5.4-48.1)**
No	14	734	1.00	1.00

** P value <0.05 ** P value <0.001*

6. Discussion

Strabismus is a common ophthalmic problem in young children. An understanding of the prevalence of strabismus and the factors associated adds a new knowledge about the risk factors of strabismus, leading to better understanding and management of the condition.

The overall prevalence of strabismus in this study was 3.1% (95% CI: 1.8%-4.2%) which is in line with many studies reported across the world (18,19,27,29,) but higher than reports of previous studies in Butajira town, Ethiopia (1.53%)(11), Nigeria (0.43%)(10), Singapore (0.80%)(22), Iran (1.68%)(30) and Japan (1.28%)(6). This discrepancy might be due to difference in study population. In this study kindergarten school children were included, age between 3 years up to 8 years. While the Butajira study included children under age five which misses most of school age children. Children after entering school they spent much of their time at near and may become myopic which is a risk for exotropia. In Nigeria and Japan they have included elementary school children by which time the refractive status of most children stabilizes and the risk of strabismus may decrease. In Iran they included only children aged seven years old. In addition to the age difference seen in these studies, there is also ethnic difference between this study and the reported studies, which greatly influences strabismus prevalence as reported in many studies(19,23,27).

The definition of strabismus influences reported prevalence rates. The definition used in some studies(10,29) differs from this study with strabismus defined as a deviation (eso or exo) present for both near and distance fixation, ie, a constant deviation. This study however defined strabismus as present for near or distance fixation, therefore including both constant and intermittent deviations in the calculation which may increase the prevalence.

The prevalence found in this study is lower than a study conducted in Eastern China(5.65%)(21). It may be due to the variation in race between this study participants and Asian descent. Most Asian nations are more myopic as a result of complex genetic trait responsible for myopia and in turn could be a risk for exotropia as exodeviations outnumber in this population (21,22).

In this study refractive error which is repeatedly reported in other studies (10,22,23,25,28) also found to be predictor of strabismus in these children. Children who had refractive error were found to be 16 times more likely to have strabismus as compared to those who had no refractive error. This may be due to high possibility of developing strabismus in the presence of significant refractive error. The uncorrected hyperopia forces the patient to accommodate to sharpen the retinal image, thus inducing increased convergence. If the patient's fusional divergence mechanism is insufficient to compensate for the increased convergence tonus, esotropia results(2).

Children who had parents with strabismus were nearly 6 times more likely to be strabismic in reference to those with parents who had no strabismus which is in agreement with Singaporean study(22). This is due to the inheritance nature of strabismus. A family history of strabismus is often present, but well defined genetic patterns are unusual(2).

Prematurity was associated with strabismus in this study. Children who were born prematurely were nearly 3 times more likely to be strabismic than those who were born maturely. Studies from Denmark(26) and Australia(27) supported this result. This could be due to risk of myopia in premature infants which could be associated with amblyopia or strabismus and prematurely developed sensory and motor system.

7. Limitation of the study

Limitations of study design always need to be considered in the interpretation of the prevalence findings. The method used was cross sectional and all the limitations of cross sectional study design will also be present here.

This study is school based study so may not represent children in the community.

8. Conclusion

Prevalence of strabismus was 3.1%. These finding is significant as strabismus is the major cause of amblyopia and visual loss and may help clinicians to better understand the patterns of strabismus. Prematurity, parents with strabismus and children with refractive error were independently significantly associated variables with strabismus. This study determined statistically the importance of family history in the development of strabismus, and the very close associations between refractive error and strabismus.

9. Recommendation

For Gondar city administration health office

It is better if create awareness regarding strabismus through different mass media like television, radio and other means.

For Non-Governmental organizations

It is better to give attention to strabismus detection in kindergarten school based programs

For parents

It is better to bring their children to the eye care center for ocular examination.

For researchers

It is better to explore more on strabismus prevalence specially on community base as there may be social stigma on strabismic children and so as they may stay home.

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11. Annex

Annex 1. Information sheet

Title of the research project – Prevalence and associated factors of strabismus among kindergarten school children in Gondar city.

Name of principal investigator – Biruktawit Fikre.

Name of organization- University of Gondar, College of Medicine and Health Sciences, School of medicine and Department of Optometry
Name of sponsor - University of Gondar

Introduction

This information sheet and consent form was prepared with the aim of studying the prevalence and associated factors of strabismus among kindergarten school children in Gondar city, 2017. The research group included the principal investigator, six trained data collectors, one supervisor, and two advisors from University of Gondar.

Purpose of the research project

The main purpose this study was to determine the prevalence and associated factors of strabismus among kindergarten school children in Gondar city.

Procedures

Institution based cross-sectional study was conducted to study strabismus prevalence and associated factors among kindergarten school children from March15-June25, 2017. The sample size was 848 and selected by multistage sampling method. A pretested semi-structured questionnaire, Snellen letter charts, cover test at distance and near fixation, hirschberg light reflex test, ocular motility and non cycloplegic refraction was used to collect data..

Benefits, Risks and/of Discomfort

By participating in this research project you may feel some discomfort in wasting your time (a maximum of 15 minutes).However, your participation is definitely important to assess burdens of strabismus and associated factors which helps us to design appropriate strategy to provide regular screening plan, management and prevention methods.

There is no risk in participating in this research project. You will be benefited to get free examination at University of Gondar Tertiary Eye care and training center.

Incentives/Payments for Participating

You will not be provided any incentives or payment to take part in this project.

Confidentiality

We will not write your name and the information collected from you will be kept confidential and stored in a file, by assigning a code number to it. Hence, no report of the study ever identifies you.

Right to Refusal or Withdraw

You have the full right to refuse from participating in this research and to withdraw at any time you wish.

Person to contact

This research project was reviewed and approved by the ethical committee of the University of Gondar. If you have any question you can contact any of the following individuals and you may ask at any time you want.

Name: Biruktawit Fikre Name: Ayanaw Tsega Name. Tsehay Kassa
Tele: 0970408973 Tele: 0918211994 Tele: 0918806291

Annex 2. Informed consent form in English

Parent/guardian consent form for interview and eye examination

Dear parent/ guardian

Your child is participating in survey undertaken to detect strabismus and its associated factors. Strabismus has a direct effect on visual status of the child which has complication on the vision that leads to visual reduction. This makes it important to identify burdens and factors associated to strabismus so that your child has a better chance to learn and develop. The result of your child's eye examinations will be collected for research and program planning purposes by University of Gondar, college of Medicine and Health Science Department of Optometry.

With your permission, we would like to:

1. Conduct interview with child
2. Conduct eye examination
3. Collect demographic and strabismus related information from you and your child. If we find that your child has strabismus, we will offer your child free check up through University of Gondar Tertiary Eye Hospital.

You do not have to agree to do these things if you don't want to do**.** You can withdraw your consent at any time. All information that we collect will be confidential and no identifiable information will be released.

I acknowledge that I have understood this consent and the reasons for the study have been explained to me by my own language. I give my consent to my child participating in the study.

Parent/guardian ---------- sign and date ----------

Researcher/witness ---------- sign and date ----------

Annex 3 – Amharic version of informed consent

የፈቃድ መጠየቂያ ቅፅ

መለያ ቁጥር ----------

ወላጅ/ሞግዚት የፈቃድ መጠየቂያ ቅፅ ለመጠይቅና ዓይን ምረመራ

የተከበሩ ወላጅ/ሞግዚት

ልጅዎ የዓይን መንሸዋረር በሽታ መጠንና ተያያዥ ምክንያቶችን ለማወቅ በሚደረገው ጥናት ላይ ይሳተፋል/ትሳተፋለች፡፡ የዓይን መንሸዋረር በሽታ በልጆች ላይ በብዛት የሚከሰትና የዕይታ መቀነስ እና የዐይን መስነፍ የሚያመጣ በመሆኑ ጥናቱን አስፈላጊ ያደርገዋል፡፡ ይህ ዳሰሳ ጥናት ዋና ዓላማው የዓይን መንሸዋረር በሽታ መጠንና ተያያዥ ምክንያቶችን ለይቶ በማወቅ ለጎንደር ዩኒቨርስቲ ህክምናና ጤና ሳይንስ ኮሌጅ የዓይን ህክምና ክፍል በማቅረብ አስፈላጊውን ድጋፍ ለመሰጥት ነው፡፡ ከጥናቱ የሚገኝ የእርሶ ና የልጅዎ መረጃ ምስጢሩ የተጠበቀና ከጥናቱ ውጪ ለምንም ጉዳይ የማንጠቀምበት መሆኑን ለመግለፅ እንወዳለን፡፡

በእርሶ ፍቃድ እኛ የምንፈልገው፡-

1. ከእርሶ ጋር ና ከልጅዎ ጋር ቃለመጠይቅ ማድረግ
2. ለልጅዎ የዓይን ምርመራ ማድረግ
3. ልጅዎ የዓይን መንሸዋረር በሽታ ያለው ከሆነ በጎንደር ዩነቨርስቲ ህክምናና ጤና ሳይንስ ኮሌጅ የዓይን ህክምና ክፍል ነፃ ምርመራ ያገኛል፡፡

በጥናቱ ላይ መሳተፍም አለመሳተፍም ይችላሉ፡፡ መሃል ላይ የማይመች ነገር ካለ ማቋረጥም ይችላሉ፡፡ ነገር ግን የእርሶ መሳተፍ ለጥናቱ ወሳኝ በመሆኑና መረጃዎ ምስጢሩ የተጠበቀ ስለሆነ እንዲሳተፉ እንመክሮታለን፡፡

የዚህ ጥናት ዓለማ፣ ጥቅሙ ና ጉዳቱ በግልፅ በሚስማማኝ ና በሚገባኝ መንገድ ስለተነገርኝ ልጄ ና እኔ በጥናቱ ለመሳትፍ ተስማምቻለሁ፡፡

ወላጅ/ሞግዚት ስም ---------- ፊርማ ---------- ቀን ----------

የጥናቱ ባለቤት ---------- ፊርማ ---------- ቀን ----------

Annex 4. English version of questionnaire

Pre tested semi-structured questioners with data extraction form for prevalence and associated factors of strabismus among KG school children in Gondar city, Northwest Ethiopia.

Introduction

Good morning/afternoon, my name is ---------- I am a student in University of Gondar. I am a member of a research group working in GUH. I am studying the prevalence of strabismus and associated factors in KG school children in Gondar city by asking questions and doing physical examination. Your truth full answers for all of our questions are important to know prevalence of strabismus and associated factors. Your answers will be confidential and secret. If you decide that, you do not want to participate in the study now or at any time in the future, you do not want to participate. But we appreciate you if you try to participate and we will go 15 minutes for us to complete the questionnaire and physical examination. Thank you. Next, I will read a consent, which assures your interest to participate.

Do I have your permission to continue?

Name ---------- signature ---------- date ----------

If yes thank you and continue ----------

If no, thank you and go to next study subject ----------

Data collector

Name ---------- signature---------- date----------

Checked by supervisor

Name ---------- signature---------- date----------

S. N	Questions	Responses Category/answers	Remark
	1. Demographic		
	ID		
1	Child's age in years		
2	Child's sex	1. Male 2. female	
3	Educational status of household head	1. Unable write and read 2. Able to write and read 3. Primary school 4. Secondary school 5. College/university	
4	Ethnicity	1. Amhara 2. Tigray 3. Oromo 4. Others	
5	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Others	
	2. Child's birth history		
6	When was the gestational age of the child?	1. < 36 weeks 2. ≥ 36 weeks	
7	What was his/her birth weight?	1. < 2.5 kg 2. ≥ 2.5 kg	
8	For how many months he/she breast feed?	1. < 6 months 2. ≥ 6 months	
9	Birth order among siblings		
10	Did the child admitted to NICU?	1. Yes 2. No	
11	If yes to question 10, why?	----------	

3. Family history			
12	Are there siblings with strabismus?	1. Yes 2. No	
13	Are parents strabismic?	1. Yes 2. No	
14	Do parents wear spectacle?	1. Yes 2. No	
15	If yes to question 14,why?	1. Reading 2. For sight 3. For strabismus 4. Photochromic	The answer could be more than one
4. Maternal History			
16	How old was the mother when giving birth?	----------	
17	What was the mode of delivery?	1. Vaginal 2. Caesarean section	
18	Did mother smoke during pregnancy?	1. Yes 2. No	
19	Did mother took alcohol(tela) during pregnancy?	1.. Yes 2. No	
20	Was there any complications during pregnancy or delivery?		Write down any problem during pregnancy or delivery

1. Physical examinations				
1	Visual acuity	RE	LE	OU

2	Cover test/ Prism cover test	
3	. Hirschberg test	
4	Ocular Motility	

		RE	LE
5	Dry retinoscopy		
6	Funduscopy		

Annex 5. Amharic version of questionnaire

የጎንደር ዩኒቨርስቲ

ህክምናና ጠና ሳይንስ ኮሌጅ

የዓይን ህክምና ክፍል

መለያ ቁጥር ----------

<u>የመጠይቅ ና ምርመራ ቅፅ</u>

ጤና ይስጥልኝ ----------እባላለሁ፡፡ የጎንደር ዩኒቨርስቲ ተማሪ ና የዩኒቨርስቲው የጥናት ቡድን አባል ነኝ፡፡ በህጻናት ላይ የሚከሰተውን የዐይን መንሸዋረር በሽታ መጠንና ተያያዥ ምክንያቶችን በጎንደር ከተማ ውስጥ በሚገኙት አፀደ ህጻናት ተማሪዎች መካከል ቃለ መጠይቅ ና ምርመራ በማድረግ እያጠናን እንገኛለን፡፡ ይህ ጥናት እርሶ በሚሰጡን መረጃ ላይ የተመሰረተ ስለሆነ ፍቃድዎ ከሆነ መረጃውን በመስጥትና ልጅዋትን ለዐይን ምርመራ እንዲፈቅዱልን በትህትና እንጠይቃለን፡፡በጥናቱ ላይ መሳተፍ የማይፈልጉ ከሆነ አሁንም ሆነ በሂደት ወስጥ አለመስማማት ይችላሉ፡፡ ሆኖም ግን ጥናቱ ከትንሽ ጊዜ መፍጀት ውጪ ምንም አይነት ጉዳት የማያመጣ ስለ ሆነ እርሶም ሆኑ ልጅዎ እንዲሳተፉ እናበረታተለን፡፡ መረጃዎ ምስጢራዊነቱ የተጠበቀ፣ ለጥናቱ ብቻ የሚውል ና ለሌላ ጉዳይ የማንጠቀምበት መሆኑን ልናረጋግጥልዎ እንወዳለን፡፡ ቃለ መጠይቁና ምረመራው 15 ደቂቃ የሚፈጅ ስለ ሆነ ፍቃደኝነትዎን በፊርማ እንዲገልጡልን ና ዉል እንዲ ወስዱልን በትህትና እየጠየቅን ወደ ቃለ መጠይቁና ምረመራው እንሄዳለን፡፡

ለመሳተፍ ፈቃደኛ ከሆኑ ወደ ሚቀጥለው ገፅ ይለፉ.

ማንኛውም ሊያነሱ የሚፈልጉት ጥያቄ ካለዎት ተመራማሪውን በሚቀጥለው አድራሻ ማነጋገር ይችላሉ፡፡

ስም ፡ ብሩክታዊት ፍቅሬ

ስ. ቁ፡ 0970408973

<u>የመረጃ የሰበሰበው</u>

ስም ---------- ፊርማ ---------- ቀን ----------

<u>መረጃውን ያረጋገጠው</u>

ስም---------- ፊርማ ---------- ቀን ----------

ሀ. ማህበራዊ መረጃ			
ተ.ቁ	ጥያቄ	የመልስ አማራጭ	ምርመራ
1	የህፃኑ ፆታ	ሀ. ወንድ ለ. ሴት	
2	የህፃኑ ዕድሜ በዓመት	----------	
3	የቤተሰብ አባወራ የትምህርት ደረጃ	ሀ. ማንበብና መጻፍ የማይችል /የማትችል ለ. ማንበብና መጻፍ የሚችል/የምትችል ሐ. አንደኛ ደረጃ መ. ሁለተኛ ደረጃ ሠ. ኮሌጅ/ዩኒቨርስቲ	
4	ብሄርዎ ምንድነው?	ሀ. አማራ ለ. ትግሬ ሐ. ኦሮሞ መ. ሌላ ካለ ይጠቀስ	
5	ሃይማኖትዎ ምንድነው ?	ሀ. ኦርቶዶክስ ለ ሙስሊም ሐ. ፕሮቴስታንት መ. ካቶሊክ ሠ. ሌላ ካለ ይጠቀስ	
ለ. የህፃኑን የውልደት ሁኔታ በተመለከተ			
6	ህጻኑ በስንት ወሩ/ሯ ተወለደ/ች?	ሀ. ከዘጠኝ ወር በታች ለ. ዘጠኝ ወር ና ከዛ በላይ	
7	ህጻኑ ሲወለድ/ስትወለድ ስንት ኪሎ ነበር/ረች?	ሀ. ከ2.5 ኪሎ በታች ለ. 2.5 ኪሎ ና ከዛ በላይ	
8	የእናት ጡት ብቻ ለስንት ወር ጠባ/ች?	ሀ. ከ6 ወር በታች ለ. 6 ወር ና ከዛ በላይ	
9	ስንተኛ ልጅዎት ነው/ች?	----------	
10	የህፃናት ፅኑ ህሙማን ማቆያ ገብቶ/ታ ነበር?	ሀ. አዎ ለ. አልገባም/ችም	
11	ለጥያቄ 10 መልሱ አዎ ከሆነ ለምን?	----------	
ሐ. የቤተሰብ ሁኔታን በተመለከተ			
12	የዓይን መንሸዋረር ያለበት/ባት ወንድም/እህት አሉት/ሏት?	ሀ. አዎ ለ. የለም	

13	ወላጆች የዓይን መንሸዋረር አለባቸው?	ሀ. አዎ ለ. የለም	
14	ወላጆች መነፅር ያደርጋሉ?	ሀ. አዎ ለ. አያደርጉም	
15	ለጥያቄ 14 መልሱ አዎ ከሆነ ለምን?	ሀ. ለማንበቢያ ለ. ለእይታ ማስተካከያ ሐ. ለተንሸዋረረ ዓይን መ. ለፀሀይ መከላከያ	መልሱ ከአንድ በላይ ሊሆን ይችላል
መ. የእናት የእርግዝና ሁኔታን በተመለከተ			
16	እናት ህጻኑን ስትወልድ ስንት አመቷ ነበር?	----------	
17	የህፃኑ የዉልደትሁኔታ እንዴት ነበር?	ሀ. በምጥ ለ. በቀዶ ጥገና	
18	እናት እርጉዝ እያለች ሲጋራ ታጨስ ነበር?	ሀ. አዎ ለ. አታጨስም	
19	እናት እርጉዝ እያለች አልኮል(ጠላም ሊሆን ይችላል) ትወስድ ነበር?	ሀ. አዎ ለ. አትወስድም	
20	እናት በእርግዝና ወይም በወሊድ ወቅት ያጋጠማት ችግር ነበር?	----------	ማንኛውም ችግር ከነበረ ይጠቀስ

Annex 6: Declaration

I, the undersigned, senior clinical optometry student declare that this thesis proposal is my original work in partial fulfillment of the requirement for the degree of master of clinical optometry.

Name: Biruktawit Fikre

Signature: ----------

Place of submission: University of Gondar, college of medicine and health sciences, department of optometry

Date of Submission: ----------

Advisors

Name	Signature
1. Mr. Ayanaw Tsega	----------
2. Mrs. Tsehay Kassa	----------