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Full Length Research Paper

Refractive error among a sample of Female Primary School Children in Taif City, KSA

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Refractive error is the most common cause of vision impairment among children, and schools with long period of engagement in vision screening were effective in detecting undiagnosed cases. The aim of this study was to assess the prevalence of refractive error among female primary school children. A cross-sectional study was carried out from February to March 2013 using structured questionnaire and visual examination. Visual acuity of 324 students was assessed using the Snellen's chart. Those with VA 6/12 or less with or without correction in one or both eyes were examined by pinhole test, and an improvement of the VA with pinhole was considered refractive error. The prevalence of RE was 16.4%, and a significant relationship was found between having RE in one side and having a family history of wearing glasses, higher class grades, poor school performance, watching television at a distance less than 3 meters, using internet/ TV daily for more than 3 hours, and indulgence in computer or video games in the other side. The study showed that even in economically advantaged societies, refractive errors can go undetected in children. That is why integration of vision screening for refractive errors into KSA school health programmes is necessary.

Key words: Female, KSA, prevalence, refractive-errors, school-children.

INTRODUCTION

Globally, uncorrected refractive error (URE) is the most common cause of vision impairment (it represents 43% of all causes) (WHO, 2010), and it is the second most common cause of blindness after trachoma (Resnikoff *et al.,*2004 ;Holden *et al.,* 2008).Visual impairment from URE can have immediate and long-term consequences in children and adults, such as lost educational and employment opportunities and lost economic gain for individuals, families and societies (Resnikoff *et al.,* 2004).

Worldwide, 153 million people over 5 years of age are visually impaired as a result of the URE (WHO, 2006).For the age group 5–15 years, 12.8 million are visually impaired from uncorrected or inadequately corrected refractive errors (RE), with a prevalence of 0.96% (Resnikoff *et al.,* 2004). Diagnosis and treatment of refractive errors is one of the easiest ways to reduce impaired vision or even blindness (Baltussen *et al.,* 2009*).*That's why; childhood blindness was one of the priorities in the global initiative for the elimination of avoidable blindness (WHO, 1997).The Refractive Error Study in Children (RESC) has been formed under this initiative to assess the prevalence of refractive errors in children (Negrel and Ellwein, 2000). For school children, poor vision can affect school performance and has a negative influence on children future life (Bataineh and Khatatbeh, 2008). Data on RE prevalence among school-age children are needed for effective planning of eye health care (WHO, 2007). School vision testing programmes are simple to conduct, need minimal resources and greatly benefit children with significant refractive errors (Murthy, 2000). Studies have shown that visual screening of the school children is an important and very cost-effective strategy to know the magnitude of refractive errors and their correction at the appropriate time (Baltussen *et al.,* 2009*;* Al Wadaani *et al.,* 2013). Other studies recommended screening of

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school children once during the primary school years (6-11years) (Murthy, 2000). And proved that schools with long period of engagement in vision screening have been effective in detecting undiagnosed cases of refractive errors (Yawn *et al.,* 1996).

In the kingdom of Saudi Arabia (KSA), studies on the magnitude of RE among primary school children are scarce (Abolfotouh *et al.,* 1993). Of the studies done to assess this health problem are two studies carried out in Abha (Abolfotouh *et al.,*1993), and Jeddah city (Bardisi and Bin Sadiq, 2002)on pre-school children, and showed a prevalence of23% and 10.7%; respectively. Result from a study done in Al Hassa region on primary school children revealed a prevalence of RE of13.7% (Al Wadaani *et al.,*2013).Another study carried out on intermediate school entrants (12-13 years) at King Abdulaziz Medical City in Riyadh found a prevalence of9.8% (Al Rowaily and Alanizi, 2010).

It was proved that that even in economically advantaged societies with better socio-economic standard, refractive errors can go undetected in children (Vitale et al., 2006).Data about the size of the problem of refractive error among school children in Taif city are not available, that is why this study was carried out to assess the prevalence of RE among primary school children. The study was part of the practical assignment for the ophthalmology module for the 3rd year under-graduate female medical students of Taif University.

MATERIAL AND METHODS

Study Design: A cross-sectional study on a sample of female primary school-children aged 6-12 years was carried out in the context of time frame from February to March 2013.

Study Setting and Sampling: Multistage cluster sampling methodology was carried out. From all female primary schools in Taif city, two schools were selected by simple random sampling methodology. All the children attending the two schools during school visits were included in the study. Those who were absent, didn't bring the written consent or refused sharing in the study were excluded. The total number of students registered in the two schools was 328 students. The response rate was 98.7%, and the total sample of the studied school children was 324 students.

Ethical Considerations: Official approvals were obtained from the ethics committee of scientific research of Taif University. Approvals were obtained also from the director of basic education authority of Taif city and from the school headmasters. The schools administrative offices sent official letters and questionnaires with consent forms to the students' parents informing them about the aim and date of our study. Parents were asked to fill the questionnaire about the eye health of their children. And they were asked to sign the consent form for their children before sharing in the study.

Study Tools: Female medical students were divided into two groups where each group visited one school for two separate days. An ophthalmologist and two supervisor staff members accompanied the students in each visit. Visual acuity (VA) of the students was assessed using the Snellen's visual acuity chart at 6 meters distance in a well-illuminated room. The top letter on the chart was designated as 6/60, and the lowest line of letters was designated as 6/6 (Pavithra *et al.,* 2013). Children who were wearing glasses also had their VA assessed while wearing their glasses. Those with VA 6/12 or less with or without correction in one or both eyes were examined by pinhole test to evaluate the improvement of VA. An improvement of the VA with pinhole was considered refractive error (El-Bayoumy *et al.,* 2007; Ovenseri-Ogbomo and Omuemu, 2010; Kassa and Alene, 2003).

A short structured questionnaire was developed and sent to students' parents. It included: the child personal data: (age, school grade and class performance), and the family history of glasses wear (parents and siblings of the studied students). The questionnaire included questions on internet use, watching television (TV), playing computer games (number of hours spent by the child watching television per day, approximate distance between the child and the TV, number of hours spent by the child using computer or playing games per day and number of years ago the child started playing computer games). And questions on studying circumstances (number of studying hours per day and if the child is studying in dim light). The parents were asked if the child is wearing eye glasses, and the number of years of wearing it. The questionnaire also included a question about previous examination of the child eye due to any eye problem**.**

Statistical Analysis: The collected data were analyzed using SPSS version 16. The prevalence of RE among the studied sample was estimated, and Pearson chi-squared test was applied to test the relationship between variables. Differences were considered significant at $p< 0.05$.Multivariate regression analysis was performed to detect independent predictors of RE.

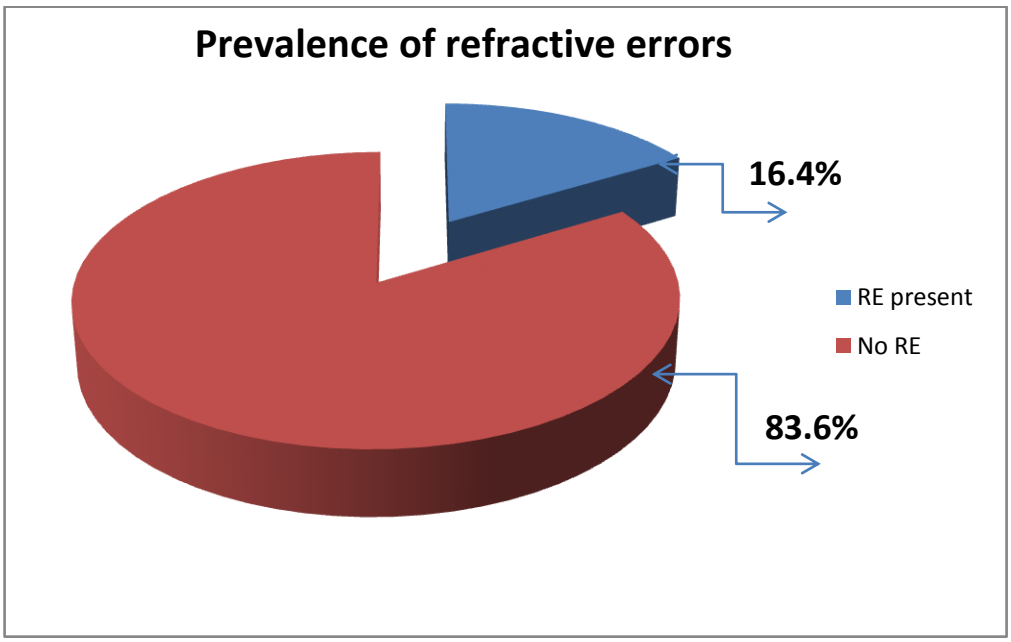
RESULTS

This study was carried out on primary school children with an age ranging from 6-12 years. Table 1 show that 46.9% of students were in an age less than 10 years, while 53.1% were in an age more than 10 years. The highest percent of children were from the 5th grade, and the lowest was from the 1st grade. 1.2% of the studied children were wearing glasses, and 42.6% of them had a family history glasses wear. Figure (1) shows that the prevalence of refractive errors among the studied sample was 16.4%. RE prevalence was significantly higher among students having positive family history of wearing glasses, compared to those with negative family history

Table 1. Distribution of the Studied Sample According to Age and Other Variables.

Parameter	Number	%
Age groups:		
- < 10 years	152	46.9
- ≥10 years	172	53.1
School grades:		
- 1st	46	14.2
- 2nd	54	16.7
- 3rd	52	16.0
- 4th	53	16.4
- 5th	67	20.7
- 6th	52	16.0
Children wearing eye glasses:	4	1.2
- Wearing	320	98.8
- Not wearing		
Number of years of wearing glasses (No. 4):		
- Less than 1 year	1	25
- 1-3 years	3	75
Family history of wearing glasses:		
- Positive	138	42.6
- Negative	186	57.4

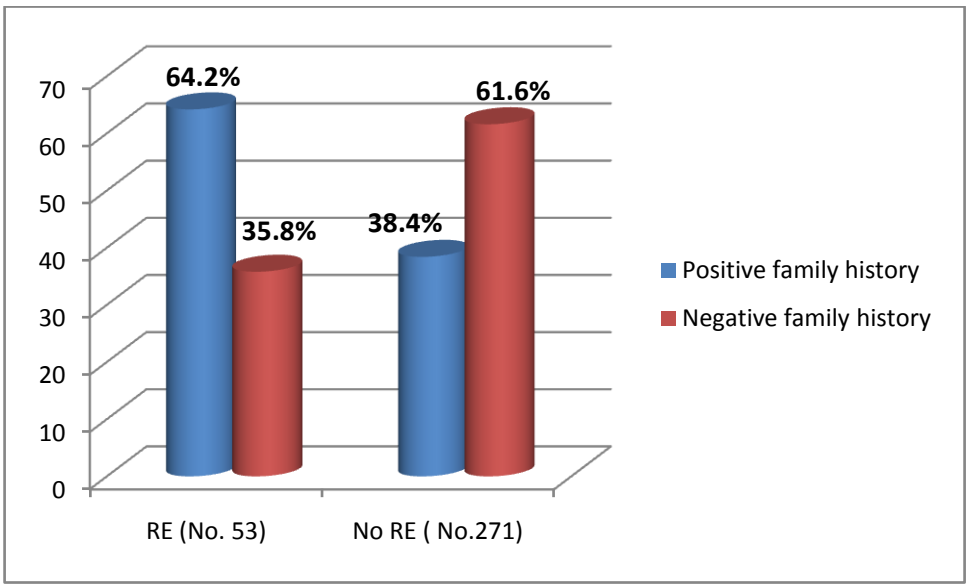
Figure 1. Prevalence of Refractive Errors among the Studied Sample



(p=0.001) Figure (2). The prevalence RE was significantly higher among students in higher grades 5th and 6th grades, compared to others in lower grades 1st, 2nd, 3rd and 4th grades (p=0.045) Figure (3). Figure (4) shows that according to the class performance of studied students, the prevalence of excellent and very good performance was higher among students without RE compared to those having RE (p=0.006).

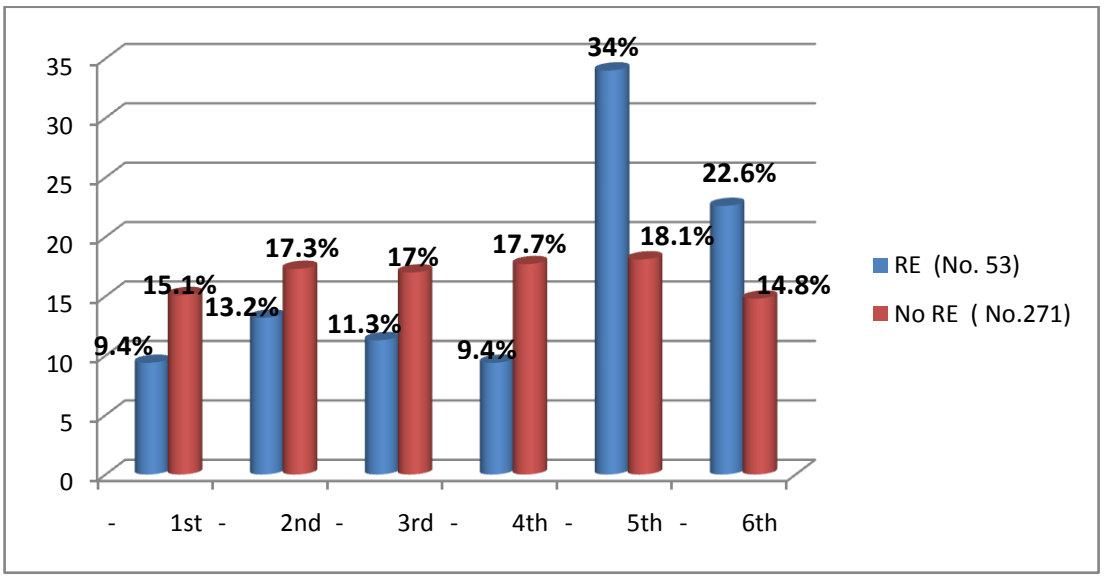
The prevalence of RE was significantly higher among students who watch TV at a distance less than three meters (P<0.002), who daily use internet and TV for three hours or more (P<0.01), who play computer games for

Figure 2. Relationship between Family History of Wearing Glasses and Refractive Errors



Chi square (χ2): 12.04 p-value: 0.001

Figure 3. Relationship between Class Grade and Refractive Errors



Chi square (χ2): 11.33 p-value: 0.045

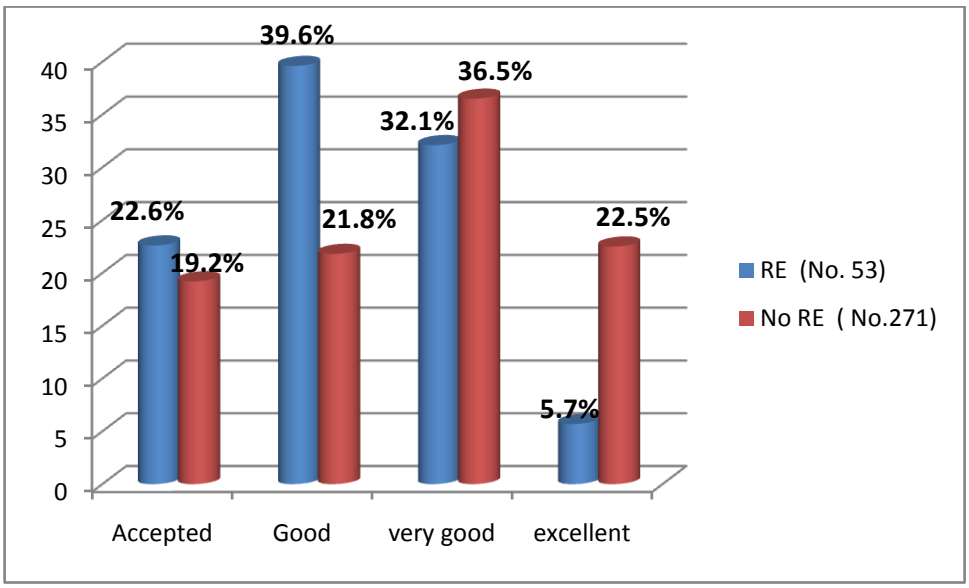
three years or more (P<0.002), and who study daily for three hours or more (P<0.02) (Table 2).

Further analysis using multiple logistic regression (Table 3) indicated that the presence of RE was significantly related to class performance, family history of wearing glasses, TV watching distance, hours of using internet and TV daily, years of playing computer games and daily studying hours.

DISCUSSION

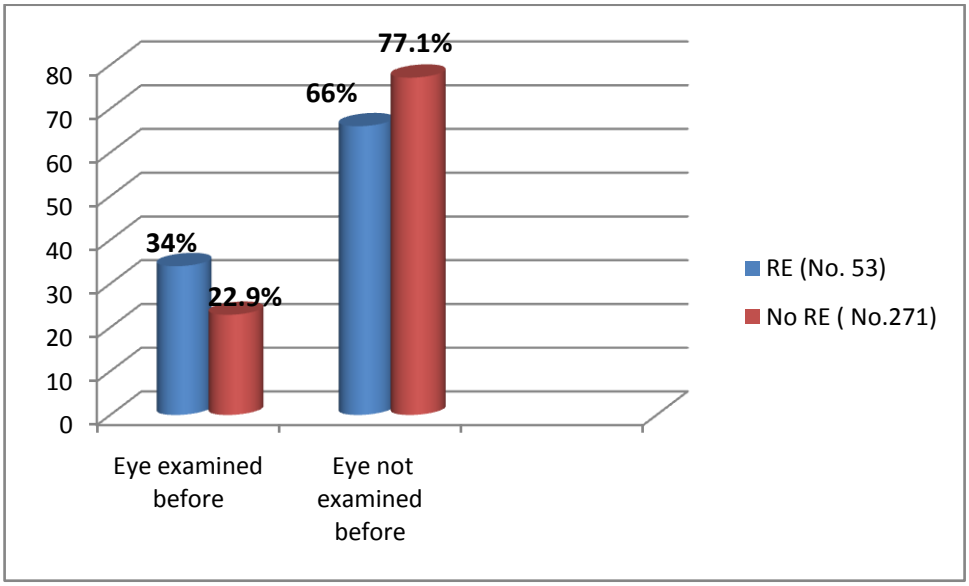
Vision problems are common among school children and can affect children concentration on studies and other activities (Prema, 2011). That is why the pattern of refractive error among school children should be understood to plan effective programs to deal with this problem (Shresthaa *et al.,* 2011). In this study, the preva-

Figure 4. Relationship between Class Performance and Refractive Errors



Chi square (χ2): 12.6 p-value: 0.006

Figure 5. Relationship between Previous Examination of the Eye and Refractive Errors



Chi square (χ2): 2.92 p-value: 0.116

lence of refractive errors among the studied sample was 16.4%. This prevalence is higher than that reported from a Saudi study done on primary school children in Al Hassa, where the overall prevalence was 13.7% (Al Wadaani *et al.,* 2013). It is also higher than another study done in in Riyadah on adolescents which showed a prevalence of 9.8% (Al Rowaily and Alanizi, 2010).This higher prevalence could be explained in the light of higher female susceptibility to RE due to female tendency to have steeper cornea, shorter eye sight and steeper crystalline lens compared to males (Mohidin *et al.,* 2005).In addition in a conservative as Saudi Arabia, girls tend to stay indoors more than boys; and this can lead to longer periods of watching television and near work activities. Moreover, this higher prevalence could be attributed to conducting the previous two studies in both male and female students, while this study was carried out on females only.

In comparison to other countries, RE prevalence in our study is more or less compatible with that reported from

Table 2. Relationship between Refractive Errors and Circumstances of Studying, TV Watching and Computer Use

Parameter	RE (No. 53)		No RE (No.271)		Chi square (χ^2)	p-value
	No.	%	No.	%		
TV distance (in meters):						
- <3	37	69.8	125	46.1	9.94	0.002
-≥3	16	30.2	146	53.9		
Hours of using Internet & TV daily:						
- <3						
- ≥3	19	35.8	150	55.4	6.75	0.011
	34	64.2	121	44.6		
Years of playing computer games (in years):	15	28.3	140	51.7	9.69	0.002
- <3	38	71.7	131	48.3		
- ≥3						
Studying hours daily:						
- <3	20	37.7	149	55	5.28	0.024
- ≥3	33	62.3	122	45		
Studying in dim light:						
- Yes	10	18.9	36	13.3	1.13	0.28
- No	43	81.1	235	86.7		

Table 3. Multivariate analysis of factors associated with RE.

Variable	Regression coefficient	p-value
Class Performance		
- Good	1.639	0.008
-Very good	1.460	.019
Family History of Wearing Glasses	0.993	0.005
TV watching distance	1.073	0.004
Hours of using Internet & TV daily	0.827	0.031
Years of playing computer games	1.317	0.000
Studying hours daily	0.758	0.033

studies done on1ry school children in Egypt (17.5%), Malaysia (17.1%), Qatar (15.2%), Chile (15.8%) and India (13.09%) (Saad and El-Bayoumy, 2007; Goh *et al.,* 2005; Benerand Al-Mahdi, 2012; Maul*et al.,*2000;Singh*et al.,* 2013). However, it is lower than the prevalence reported from similar studies carried out in Tunisia (57.2%), Jordan (25.32%), Egypt (22.1%), China (21.1%), Pakistan (19.8%) and Qatar (19.7%) (Ayed *et al.,* 2002; Bataineh and Khatatbeh, 2008; El-Bayoumy *et al.,* 2007; He *et al.,* 2005; Ali *et al.,* 2007; AL-Nuaimi *et al.,* 2010). This lower prevalence could be attributed to conducting the previously mentioned studies on much larger samples of school children.

The prevalence observed in our study is much more than that found in studies done in Karachi (8.9%), Nepal (8.58 %), Ethiopia (7.6%), Bangalore (7.03%), Egypt (7.1%), Nigeria (6.9%), India (5.46%), Kenya (5.2%), Jordan (4.6%), Ghana **(**4.5%), Sudan (2.19%) and South Africa (1.4%) (Alam*et al.,* 2008; Shresthaa *et al.,* 2011;Kassa and Alene, 2003; Pavithra *et al.,* 2013;El-Moselhy*et al.,* 2011; Ayanniyi *et al.,*2010; Padhye*et al.,* 2009; Muma *et al.,* 2009; Ereifej, 2012; Ovenseri-Ogbomo and Omuemu, 2010; Rushood *et al.,*2013; Naidoo*et al.,*2003).This difference could be attributed to the better socioeconomic conditions in KSA that affects the life style as watching television, computer use and the chance to get education. Moreover, the observed variation from results of the previously mentioned studies (even in studies done in the same country) could be attributed the variation in the operational definition and cut off points of refractive errors, another cause of this variation may be related to environmental influences (AL-Nuaimi*et al.,* 2010).

The present study showed a significant relationship between prevalence of RE and family history of wearing glasses. The same result was seen in other studies which

reported strong association between RE and family history of RE (Prema, 2011; Saad and El-Bayoumy, 2007; Ali *et al.,* 2007; Mutti *et al.,* 2002; Hetal *et al.,* 2011; Khandekar *et al.,* 2005; Khader *et al.,* 2006; Guggenheim *et al.,* 2007; Yingyong, 2010).

The current study revealed higher prevalence of RE among students in the higher grades (5^{th} and 6^{th} grades). This is in line with another study where risk factor analysis revealed strong associations between RE with education and factors related to education such as tuition lessons in primary school (Saw *et al.,* 2001).And it is in line with studies which showed that educational grade was positively related to RE (Ali *et al.,* 2007; Afghani *et al.,* 2003), and the educational length was related to myopia (Jacobsen *et al.,* 2007). Other studies explained this in the light of more hours of near-work per day as a result of higher school grade (Saad and El-Bayoumy, 2007).

In the present work, students without RE were found to have better class performance. This result is in agreement with another study done on school children in Ghana (Ovenseri-Ogbomo and Omuemu, 2010).It is also in agreement with a study done primary school children in Brazil where children with low vision had a 10% higher probability of dropping out of school and 18% higher probability of repeating a grade (Gomes-Neto *et al.,* 1997).

About one of the studied students (18.19%) had their eyes examined before for eye problems, which is a figure higher than that reported from Ghana, India and South Africa (0.6%, 0.56% and 2.7%; respectively) (Ovenseri-Ogbomo fifth and Omuemu, 2010; Naidoo *et al.,*2003; Dandona *et al.,* 2002). This difference could be attributed to the poor uptake of refractive services in the mentioned countries due to low socioeconomic status (Ovenseri-Ogbomo and Omuemu, 2010). In a study carried out on school children in Saudi Arabia, 99.74% of the students had televisions at home, of them 93% had more than 2 televisions (Ghamdi, 2013). In the present work, a significant difference was found between students with and without RE according to the distance of watching TV. This result agrees with that found in a Pakistani and Singapore- China study which revealed a strong relationship between short distance TV watching and the development of RE (Ali *et al.,* 2007; Saw *et al.,* 2001).

It is also in line with another study where watching television from a close distance have been associated with myopia (Ling *et al.,* 1987).

In the previously mentioned Saudi study (Ghamdi, 2013), 28.9% of school children spend three and more hours using computer daily, and 35% of them watch TV three and more hours daily.

In this study, a significant difference was found between students with and without REs according to daily hours of using computer and TV. In agreement with these results are those found in other studies which found a highly significant positive correlation between low vision and hours spent on the computer or TV (Bener *et al.,* 2010; Davey *et al.,* 2013; Bener *et al.,* 2011; Morrison and Gore, 2010).

The same result was also found in a Qatari study where a higher proportion of children wearing glasses were among students watching internet/television for more than three hours a day (Benerand Al-Mahdi, 2012). A significant statistical difference was found between students with and without REs according to years of playing computer games. This result was also found in an Indian study which showed that prolonged duration of TV watching and computers use for more than one year were significantly associated with uncorrected refractive error (Davey *et al.,* 2013), which in agreement with previous studies (Ali*et al.,* 2007; Elkington and Frank, 1991).

Studies have showed a positive association between RE and near-work activity such as reading and writing (Khader *et al.,* 2006). In our study, the significant difference found between students with and without REs according to studying hours was also revealed from other studies (Prema, 2011; Saad and El-Bayoumy, 2007;(Khader *et al.,* 2006; Yingyong, 2010).

The non-significant relationship was found between students with and without RE according to studying in dim light in the present study, is in contrast with results found in other studies (Ali*et al.,* 2007;Davey *et al.,* 2013). This could be attributed to the better socioeconomic standard of the studied sample. In addition, Saudi Arabia rank the second among the world oil producing countries with the availability and regularity of electricity.

Study Limitations

A limitation faced this study was the rules of the educational authorities in KSA, that prevent female researchers from conducting studies on male students. The researches didn't have an opportunity to assess the prevalence of RE among male students to determine the gender difference. This calls for more studies done on both sexes to be appropriately representative

CONCLUSION AND RECOMMENDATIONS

The prevalence of refractive error among the studied children was 16.4%. This prevalence calls for the importance of integration of visual screening for RE in the school health programs in KSA. In addition, health education sessions for students and their parents are needed to increase students awareness about risk factors of RE.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

Principal responsibility for study design was assumed by Dalia Desouky who developed the questionnaire and the informed consent, wrote the protocol and planed the study. She assisted in data collection, data entry, and carried out all aspects of statistical design and analysis. She took the primary responsibility in responding to the reviewers' comments. Nighat Murad participated in the study planning. She took the responsibility of the administrative aspects of the research and assisted in data collections and data entry. All authors read and approved the final manuscript

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ABBREVIATIONS

KSA Kingdom of Saudi Arabia
URE Uncorrected Refractive Error
RE Refractive Error
RESC Refractive Error Study in Children
VA Visual Acuity
TV Television
WHO World Health Organization

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