Refractive error

Uncorrected refractive error

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We need to act now to eliminate preventable blindness by the year 2020

In 1997, the World Health Organization set itself an ambitious goal to eliminate avoidable blindness in the world by 2020, with one of the five main priorities being refractive errors.[1 2] A recent review of the impact of Vision 2020 on preventable blindness, other than uncorrected refractive errors, indicates that current estimates of global blindness are less than projected, and thus the trend is in the right direction to meet the Vision 2020 goal for the other conditions.[3] The article by Fotouhi *et al* in this month's issue of *BJO* (p 534) indicates that we are not doing so well on meeting the goal to eliminate vision impairment caused by uncorrected refractive error in Tehran. At this point, perhaps readers are thinking that the problem of uncorrected refractive error is unique to countries with relatively poorer healthcare systems. Let us consider the paper by Fotouhi *et al* in the global context of vision impairment caused by refractive errors.

A PubMed search in January 2006 using the search strategy ''uncorrected refractive error AND epidemiology'' and ''undercorrected refractive error AND epidemiology'' revealed 19 population based studies of uncorrected refractive errors,[4–22] all of them published since the release of Vision 2020 in 1997. Information abstracted from each article included the age and size of the study cohort, the definition of uncorrected refractive error, the percentage of the study population with uncorrected refractive error, and the myopia prevalence rate, if available (table 1). These data were merged with country specific estimates of per capita gross domestic product for the year 2003 (http://eie.doe.gov/pub/international/iealf/tableb2c.xls) and entered into SPSS for analysis. Simple linear regression was used to quantify the relation between uncorrected refractive error and myopia prevalence and per capita gross national product in 2003. The uncorrected refractive error rate ranged from 0.7% to 22.3% and rose with age, with uncorrected refractive error being the primary cause of moderate vision impairment in most studies. Relative prosperity, as indicated by the per capita gross national product, was not associated with the prevalence of uncorrected refractive error; all countries are doing equally poorly at addressing the burden of uncorrected refractive error (fig 1). As expected, myopia prevalence was found to be strongly correlated with the rate of uncorrected refractive error ($R^2 = 0.57$, fig 2).

In addition to providing a global picture of uncorrected refractive error, this review of the published literature revealed some of the challenges facing researchers and policy makers who want to assess the current status of uncorrected refractive error in the world. Firstly, there is no agreed upon terminology, with both ''uncorrected refractive error'' and ''undercorrected refractive error'' in common use. Secondly, researchers have used various cut-off points and levels of improvement after spectacle correction to define uncorrected refractive error. The visual acuity cut-off point of 6/12 is often chosen because that is the vision required to legally obtain a driver's licence in many countries, and therefore can have a major impact on daily functioning. The visual acuity cut-off point of 6/18 is usually chosen because it is the World Health Organization criterion for moderate visual impairment.

If myopia is responsible for much of the uncorrected refractive error in the world, then we must consider the epidemiology of myopia to approach the challenge of eliminating vision impairment because of uncorrected refractive error. Heritability of refractive error has been estimated to be as high as 85%.[23] Despite the high estimated heritability, environment, particularly near work, has been shown to play an important part in the development of myopia.[24 25] Evidence of the relative impact of environment versus genetics is demonstrated through rapid changes in incidence in recent decades. Recent reviews of the epidemiology of myopia reveal that the prevalence and incidence of myopia have been increasing, especially in Asian populations where myopia has reached epidemic proportions. With more than 20% of the world's population residing in China alone, any increase in myopia, and subsequent uncorrected refractive errors, in China will affect the global estimates and ability to meet the Vision 2020 goal to eliminate preventable blindness.

Provision of appropriate spectacles is one of the simplest, most cost effective strategies to improve vision, yet uncorrected refractive error is the primary cause of moderate vision impairment throughout the world. In many countries, a shortage of eye care specialists in rural areas may contribute to the problem.[2] What novel strategies have been proposed to address the problem of uncorrected refractive errors? It has been estimated that up to 20% of moderate vision impairment could be eliminated through the availability of affordable, ''off the shelf'' spectacles for moderate refractive errors.[26] This is a simple strategy, yet has not been adopted in any countries to my knowledge. Perhaps a randomised clinical trial would provide sufficient proof for countries to comfortably adopt this strategy to reduce uncorrected refractive error. Adoption could be accomplished in the context of driver's licence renewals to implement screenings and make

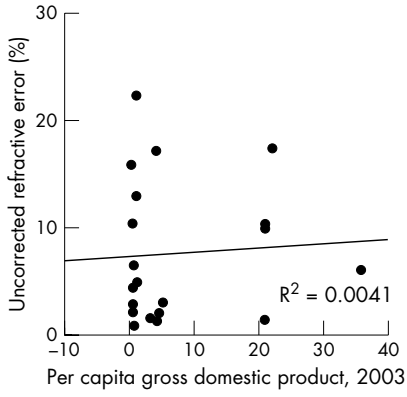

Figure 1 Relation of uncorrected refractive error to per capita gross domestic product, 2003.

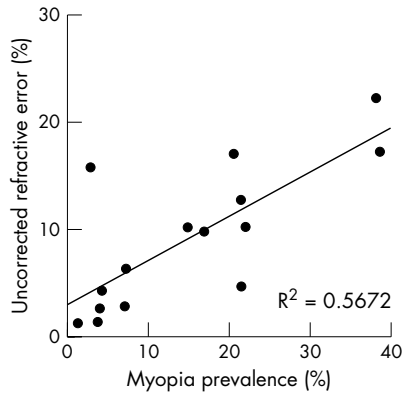

Figure 2 Relation of uncorrected refractive error to myopia prevalence.

Table 1 Population based studies of uncorrected and undercorrected refractive error

Study name, location	Age of subjects	Sample size	Definition of uncorrected refractive error	% uncorrected refractive error
Tehran Eye Study	5–95	6497	<6/12 in better eye, improve with spectacles	4.8%
Refractive Error Study in Children, Sydney	6	1738	<6/12 in better eye, improve with spectacles	1.3%
Bangladesh	30+	11 624	<6/12 in better eye, improve with spectacles	10.2%
Refractive Error Study in Children, Guangzhou, China	5–15	5053	⩽6/12 in better eye, improve to 6/10	22.3%
Refractive Error Study in Children, South Africa	5–15	4890	⩽6/12 in better eye, improve to 6/10	1.4%
Refractive Error Study in Children, New Delhi	5–15	6447	⩽6/12 in better eye, improve to 6/10	6.4%
Refractive Error Study in Children, rural Andhra Pradesh, India	7–15	4074	⩽6/12 in better eye, improve to 6/10	2.7%
Projecto VER, Mexican Americans in Arizona, USA	40+	4774	<6/12 in better eye, improve 2 lines	6.0%
Refractive Error Study in Children, Gombak District, Malaysia	7–154	4634	⩽6/12 in better eye, improve to 6/10	17.1%
Refractive Error Study in Children, Shunyi District, China	5–15	5884	⩽6/12 in better eye, improve to 6/10	12.8%
Refractive Error Study in Children, La Florida, Chile	5–15	5303	⩽6/12 in better eye, improve to 6/10	15.8%
Refractive Error Study in Children, Mechi Zone, Nepal	5–15	5067	⩽6/12 in better eye, improve to 6/10	2.9%
Visual Impairment Project, Victoria, Australia	40+	4735	<6/6–2 letters in better eye, improve 1+ lines	9.8%
Blue Mountains Eye Study, Australia	49–97	3654	⩽6/9 in better eye, improve 2+ lines	10.2%
Tanjang Pagar Survey, Singapore	40–79	1232	2+ line improvement in either eye	17.3%
National Eye Survey, Malaysia	All ages	18 027	<6/18 in better eye, improvement	1.2%
Andhra Pradesh Eye Disease Study, India	All ages	2522	<6/12 in better eye, improvement	4.3%
Sumatra, Indonesia	21+	989	<6/18, improve 2+ lines	0.7%
Lebanon	All ages	10 148	<6/18, improvement	1.9%
South Karachi, Pakistan	5–15	5110	<6/18, improvement	2%

spectacles available when needed. Annual vision screening of the elderly as a component of annual physical examinations has also been suggested.[27] Other culturally specific, age specific, feasible ideas need to be developed and evaluated within each country.

Another area of potential research to accompany the implementation of strategies to reduce uncorrected refractive error is to quantify the impact of this reduction on quality of life and other outcomes, such as road accidents. Research to date has focused primarily on the impact of uncorrectable vision impairment on quality of life and road accidents. These data could provide evidence of the need for ongoing support of programmes to eliminate uncorrected vision impairment.

In summary, uncorrected refractive error is a global challenge that will keep us from meeting the Vision 2020 goal unless changes are made between now and then. Politicians, policy makers, primary care providers, and eye specialists need to work together to develop simple, creative strategies to combat vision impairment caused by uncorrected refractive error. The published data can serve as a baseline to compare the success of future interventions. The time to act boldly is now.

Br J Ophthalmol 2006;**90**:521–530.
doi: 10.1136/bjo.2006.090233

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Accepted for publication 1 February 2006

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