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## Vision screening for correctable visual acuity deficits in school-age children and adolescents (Review)

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## TABLE OF CONTENTS

HEADER . . . . .	1
ABSTRACT . . . . .	1
PLAIN LANGUAGE SUMMARY . . . . .	2
BACKGROUND . . . . .	2
OBJECTIVES . . . . .	5
METHODS . . . . .	5
RESULTS . . . . .	7
DISCUSSION . . . . .	7
AUTHORS' CONCLUSIONS . . . . .	9
ACKNOWLEDGEMENTS . . . . .	10
REFERENCES . . . . .	10
CHARACTERISTICS OF STUDIES . . . . .	12
DATA AND ANALYSES . . . . .	14
ADDITIONAL TABLES . . . . .	14
APPENDICES . . . . .	14
WHAT'S NEW . . . . .	16
HISTORY . . . . .	17
CONTRIBUTIONS OF AUTHORS . . . . .	17
DECLARATIONS OF INTEREST . . . . .	18
SOURCES OF SUPPORT . . . . .	18
INDEX TERMS . . . . .	18

[Intervention Review]

# Vision screening for correctable visual acuity deficits in school-age children and adolescents

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## ABSTRACT

### Background

Although the benefits of vision screening seem intuitive the value of such programmes in junior and senior schools has been questioned. In addition to this, there exists a lack of clarity regarding the optimum age for screening and frequency at which to carry out screening.

### Objectives

The objective of this review was to evaluate the effectiveness of vision screening programmes carried out in schools in reducing the prevalence of undetected, correctable visual acuity deficits due to refractive error in school-age children.

### Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL), which contains the Cochrane Eyes and Vision Trials Register, in *The Cochrane Library* (2006, Issue 1), MEDLINE (1966 to March 2006) and EMBASE (1980 to March 2006). No language or date restrictions were placed on these searches.

### Selection criteria

We planned to include randomised controlled trials, including randomised cluster controlled trials.

### Data collection and analysis

Two review authors independently assessed study abstracts identified by the electronic searches. No trials were identified that met the inclusion criteria.

### Main results

As no trials were identified, no formal analysis was performed. A narrative synthesis of other retrieved studies was undertaken in order to explain current practice.

## Authors' conclusions

At present there are no robust trials available that allow the benefits of school vision screening to be measured. The disadvantage of attending school with a visual acuity deficit also needs to be quantified. The impact of a screening programme will depend on the geographical and socio-economic setting in which it is conducted. There is, therefore, clearly a need for well-planned randomised controlled trials to be undertaken in various settings so that the potential benefits and harms of vision screening can be measured.

## PLAIN LANGUAGE SUMMARY

### Screening school aged children and adolescents for reduced vision caused by the need for glasses

Worldwide, the leading cause of reduced vision in children is an unidentified need for them to wear glasses. The reduced vision that results from abnormal focusing (refractive error) can cause the children to screw up their eyes and complain of headaches. Reduced vision may affect academic performance, choice of occupation and socio-economic status in adult life. Genetic and environmental factors are known to affect the development of refractive error; it is also more common in certain racial groups. Short sightedness has become the commonest eye condition. The need to correct refractive error is determined by its effect on vision. Normal vision can usually be restored by wearing corrective glasses or contact lenses. However, there is some evidence that correction may cause an error to persist where it might otherwise have resolved or reduced naturally. Vision screening is used widely but is concentrated in developed countries; in developing countries it may serve the purpose of providing access to health care. The value of screening after school entry has been queried. Programmes vary with regard to testing personnel, set threshold for failure, frequency and setting. The disability caused by a vision deficit has not been quantified and the optimum age and number of occasions for screening have not been established. The aim of this review was to find studies that evaluated the effectiveness of school vision screening programmes in first identifying children with reduced vision. No eligible randomised studies were found. There is a clear need for reliable evidence to measure the effectiveness of vision screening. A narrative synthesis of other retrieved studies was undertaken in order to explain current practice.

## BACKGROUND

### Introduction

Uncorrected refractive error has recently been identified as the leading cause of visual impairment in children worldwide (He 2004; Maul 2000; Naidoo 2003; Pokharel 2000; Zhao 2000). Population-based, cross-sectional studies in children aged 5 to 15 years show that 8% of rural Chinese, 9% of urban Chinese, 2% of rural Nepalese, 7% of urban Chilean and 0.9% of urban South African children would benefit from spectacles (Pokharel 2000). Even in countries with well-resourced health systems uncorrected refractive error can be a major cause of visual impairment in children. In deprived inner-city schools in Baltimore, 8.3% of students who needed spectacles did not have them (Preslan 1996). Given the high prevalence of visual impairment due to uncorrected refractive errors in children and the simplicity of treatment, the detection and correction of refractive errors has been made one of the priorities of the World Health Organisation (WHO) Vision 2020 initiative (Resnikoff 2001) and is the focus of this review.

It is likely that an uncorrected visual acuity deficit has a negative impact on academic performance; correction of refractive error has been said to reduce learning difficulties (Rosner 1986). Poor academic performance can reduce choice of occupation and, therefore, socio-economic status in adult life. This can have a detrimental effect on both the individual and their community. Reduced vision can also impair the ability and inclination of a child to participate in class and to join in with peer sports and social activities thereby impeding personal development (Taylor 2000).

### Aetiology

Refractive error can be defined as the inability of an eye to bring parallel rays of light to focus on the retina. There are three types of refractive error. Myopia (short-sightedness) compromises distance vision. Hypermetropia (long-sightedness) compromises near vision and, if severe enough, distance vision as well. Astigmatism, caused by a non-spherical cornea, impairs both distance and near vision.

In normal visual development, changes in refractive error occur over the first few years of life. The majority of full-term babies

are hypermetropic at birth (Banks 1980) but this decreases with growth so that in adult life the preponderance of refractions are around zero or emmetropia (Sorsby 1964). Most of this change occurs in early childhood (Ehrlich 1997), the process is known as emmetropisation (Jensen 1995). The development of a refractive error means that emmetropisation has not occurred. Both genetic and environmental factors have been recognised as potentially causative although the precise nature of their roles and the level of interaction between them are not known.

Genetic factors: there is much evidence to suggest that myopia can be inherited (Yap 1994), maybe through genetic determination of the axial length of the eye (Canoll 1982). There is often a positive family history in children detected with refractive error and higher prevalence in certain racial groups, for example of myopia in Asian children (Ashton 1985; Au Eong 1993; Wedner 2002; Yap 1994). Environmental factors: the development of myopia is most frequently associated with an over exposure to near tasks, such as reading (Angle 1980; Sperduto 1983; Zylbermann 1993). In general, refractive errors may be related to socio-economic status and level of education (Ashton 1985; Au Eong 1993; Wedner 2002; Zylbermann 1993).

## Epidemiology

Existing information on the prevalence of refractive error is difficult to compare as published studies often use different methodologies, different definitions of refractive error and different techniques for measuring refractive error. They also use convenience samples, such as school children, that are not necessarily representative of the population (Negrel 2000). The Refractive Error Study in Children (RESC) that was supported by WHO was designed to estimate the prevalence of visual impairment and its causes in children aged 5 to 15 years of age and of different ethnic origins. These population-based surveys were undertaken in different settings using a standardised study design (common definitions, measuring techniques, statistical analyses and reporting methods) (Negrel 2000). Results of surveys based on the RESC protocol are summarised in Table 1 (Dandona 2002; He 2004; Maul 2000; Murthy 2002; Naidoo 2003; Pokharel 2000; Zhao 2000).

Myopia has become the most common eye condition, worldwide. Its prevalence has reached epidemic proportions in East Asia. In Guangzhou China 73% of 15 year old children had myopia of -0.5 diopters or worse in at least one eye (He 2004). In Taiwan a prevalence of 84% was found for myopia of any severity in 16 to 18 year old school students (Lin 1999).

The prevalence of visual acuity deficits among 10 year old children in the 1970 birth cohort in the UK was estimated at 22%. However, only 7.6% had a visual acuity of less than 6/9 (Snellen) in at least one eye, and only 4.5% in both eyes (Stewart-Brown 1985). Vision screening of 1,809 children aged 8 years and attending junior schools in the UK discovered 157 children (8.7%) with treatable significant abnormalities; only 15 children (0.8%)

had correctable visual acuity deficit (all refractive errors) that had not been previously diagnosed and treated (Cummings 1996).

## Presentation and diagnosis

In childhood, reduced visual acuity as a result of refractive error may co-exist with other ocular pathologies. In these cases screening is not usually required for detection and treatment indications are related to the management of co-existing disease. This review is concerned with reduced visual acuity caused by refractive error alone.

Significant refractive error may result in blurred near vision, blurred distance vision, or both, accompanied by ocular fatigue and asthenopic symptoms such as headaches, lacrimation (watery eyes) and screwing up the eyes. Although visual impairment and refractive error are correlated, the level at which refractive error becomes significant enough to impact on visual performance varies considerably depending on the individual and measurement-specific variables (WHO 2002). As a result, the decision to correct refractive error is largely based on the presence of co-existing signs or symptoms and not on the presence or degree of refractive error. This review will, therefore, concentrate on screening for visual acuity deficits rather than for refractive error per se.

Diagnosis of reduced visual acuity is made using age-appropriate acuity tests. These most commonly use letter, picture, illiterate E or Landolt C optotypes. Diagnosis of normal or abnormal vision varies depending on the accuracy of the test, the age of the individual being tested and the expertise of the tester; unfortunately the impact of these variables may not be known, making it difficult to reliably interpret results. Traditionally, any value less than 6/6 (20/20) was considered abnormal but it is now recognised that there is a wide distribution of values within the normal range (Simmers 1997).

Diagnosis of refractive error is made by objective or subjective refraction. Autorefraction with cycloplegia has been shown to give similar results to retinoscopy with cycloplegia in children aged 5 to 15 years in China, Nepal, India and Chile (Dandona 2002; Maul 2000; Pokharel 2000; Zhao 2000). However, retinoscopy is recognised as the standard objective refraction method. In young children cycloplegia is necessary to achieve accurate measurements as the children have very active accommodation and are often unable to maintain distance fixation during testing (WHO 2000).

## Screening programmes

The two principal approaches to screening for correctable visual acuity deficits due to refractive error are either to test for the refractive error or to test for the visual acuity deficit. For reasons stated above, the main focus of this review is on outcomes from studies testing visual acuity. It is anticipated that, as it is an essential part of the diagnosis, these studies may well also include refraction data.

Visual acuity screening is a widely used approach to identifying children with reduced vision. Programmes can be provided as part of the government healthcare system or are privately run and commerce driven. Regular screening activities for correctable visual acuity deficits are concentrated in developed countries. In Ohio USA, for example, children are screened at kindergarten and then bi-annually throughout their school careers (Ohio 2004); in Sweden visual acuity is measured in pre-school age children and again at 7 and 10 years of age (Kvarnstrom 2001). In the UK routine vision screening after school entry has gradually declined but is still available (Jewell 1994). Although screening programmes have been introduced (Limburg 1999) in developing countries the great majority of children never receive an eye examination and access to health services is often limited, especially in rural areas (Wedner 2000; Wedner 2003). In Ethiopia, as in most African countries, there is no national school eye screening service (Worku 2002). There is an argument that one of the roles of mass vision screening in this context is to improve equity of access to care.

Visual acuity screening programmes vary with regard to who carries out the testing, for example teachers, nurses etc; the defined threshold for failure; and the setting. Some schemes are school based while others take place in the community, for example in clinics or at the office of the professional offering the service. The frequency of screening also varies. Screening for visual impairment should be done using an age-appropriate vision test for each eye separately or for both eyes together. For children, a visual acuity failure threshold of 6/12 (Snellen) has been recommended but 6/9 and 6/18 have also been widely used (Ingram 1989; Negrel 2000; Preslan 1996; WHO 2000). Different screening techniques are likely to differ in sensitivity and specificity.

It should be noted that visual acuity screening programmes for undetected correctable visual acuity deficits will inevitably identify some children with reduced vision due to causes other than refractive error, for example cataract or amblyopia. Whilst these conditions are not the focus of this review any data found regarding the proportions of such conditions detected by screening will be described.

## Treatment options

Treatment for reduced visual acuity due to refractive error consists of either optical correction of the error or changing the physical shape of the eye with laser treatment or surgery.

### Optical correction

(1) Spectacles are the simplest and most effective means of correcting refractive error and are, therefore, the most widely used treatment. The availability, affordability and acceptability of spectacles may affect whether any glasses prescribed are actually worn.

(2) Contact lenses are used as an alternative to spectacles mainly in developed countries but increasingly also in urban centres of developing countries.

### Refractive surgery

This is becoming more popular in high-income populations but is not commonly used in adolescents or children.

It is expected that optical correction of the refractive error will result in a more or less immediate improvement in the visual acuity, to a normal level. However, there is some evidence that optical correction can result in persistence of an error that might otherwise have naturally resolved or reduced. Emmetropisation appears to be partly reliant on normal visual experience and can be manipulated by optical correction (Dobson 1986; Hung 1995; Ingram 1991; Medina 1987; Troilo 1991). This raises the possibility that full refractive correction may not always be appropriate.

## Rationale for a systematic review

The value of visual acuity screening after the age for school entry has been queried. Hall 2003 pointed out that the disability caused by living with an uncorrected visual acuity deficit has not been quantified, and the optimum age and number of occasions for screening have not been established.

The purpose of screening children of school age is to reduce the proportion of children in the population who have a visual acuity deficit that could be corrected by spectacles. The impact of a screening programme may depend on the economic development of the country in which it is taking place. In more developed economies, where spectacle provision is widely available, the impact may be small. In poorer countries the potential impact may be greater if successful delivery and appropriate intervention can be achieved and maintained.

Evidence for the effectiveness of screening in reducing the proportion of school-age children and adolescents with a correctable visual acuity deficit needs to be reviewed. The effectiveness of different screening strategies in different settings needs to be examined and the impact of living with undetected correctable visual acuity deficits quantified in order to aid decision making, in both developing and developed countries.

The aim of this review is to identify studies that have evaluated the effectiveness of visual acuity screening programmes in different settings. It is also our intention to examine different screening strategies to identify which are most effective and to explore the long-term effects of screening, for example on academic performance and lifestyle.

The potential for a screening programme to cause harm was to be reported, in particular the impact of spectacle correction on the development of refractive error.

## OBJECTIVES

The primary objective of this review was to compare the effect of visual acuity screening to no screening in reducing the prevalence of undetected, correctable visual acuity deficits caused by refractive error in children and adolescents.

Subgroup analyses were planned, if and when appropriate, to determine the effect of the type of personnel conducting the testing, that is teacher, nurse, or eye trained personnel; and the threshold applied for failure.

Secondary objectives were to report available evidence regarding the disability associated with living with an uncorrected visual acuity deficit and to document reports of the harms and costs associated with screening and resulting treatment.

## METHODS

### Criteria for considering studies for this review

#### Types of studies

We will include randomised controlled or cluster randomised controlled trials.

#### Types of participants

We will include participants who have been screened in a school screening programme. Referred participants will have had a fundus and media examination, post screening, to identify any other ocular pathology.

#### Types of interventions

We will include studies in which screening was carried out by visual acuity (VA) assessment using any age-appropriate vision test, any threshold for failure and administered by any testing personnel, measuring:

- (1) monocular VA or binocular VA, or both;
- (2) distance VA only;
- (3) near and distance VA.

Those who fail screening will have been referred for refraction (by any method) and fundus and media examination to confirm cases where visual acuity deficit is due to refractive error alone.

The following comparisons are planned:

- screening versus no screening;
- failure threshold of worse than 6/9 (Snellen) (or equivalent) versus failure threshold of 6/9 (Snellen) or better (or equivalent);
- type of testing personnel, that is nurses, teachers, and eye trained personnel.

Studies screening at school entry will be excluded.

We will exclude studies that have screened only for refractive error, that is those which have not analysed the impact of refractive error on vision. However, it is anticipated that eligible studies may include both types of data.

### Types of outcome measures

#### Primary outcomes

The primary outcome for this review is the prevalence of uncorrected but correctable visual acuity deficits due to refractive error in screened versus unscreened comparable populations, measured at twelve months from screening. Protocols for assessing compliance with glasses will be included where they are reported. Vision at the outcome assessment must be tested with any prescribed spectacles in place.

#### Secondary outcomes

Secondary outcomes for this review are:

- (1) prevalence of correctable visual acuity deficits in children in screened versus unscreened comparable populations at between six and twelve months from screening;
- (2) proportion of participants with visual acuity deficit due to causes other than refractive error, for example cataract, amblyopia.

#### Adverse effects

Any evidence of the following adverse effects will be described:

- (1) impact of correction of refractive error on the development of refractive error by comparing the prevalence and degree of refractive error in screened versus unscreened populations. This can only be examined in studies reporting refractive data in addition to visual acuity data.
- (2) anxiety (from interviews, self-completion questionnaires, focus groups etc).

#### Quality of life measures

Any formal, validated assessment of quality of life undertaken will be described. Specifically, the effects of screening (and resulting effects on vision) on aspects of life such as general confidence, academic achievement, employment, social interaction etc. will be reported. Various vision specific quality of life measures are in use for adult populations, for example the Visual Function Questionnaire (VFQ) and the National Eye Institute Visual Function Questionnaire (NEI VFQ-25). There is a recently developed (Felius 2004) children's visual function questionnaire (CVFQ) for children up to seven years of age but few other validated, vision specific measures for young children. We will report any validated assessment

of quality of life whether it is undertaken in childhood or in adulthood.

### **Economic outcomes**

Two reports of the costs associated with screening were found and have been reported.

### **Follow up**

A minimum period of six months is required between intervention and outcome measure.

## **Search methods for identification of studies**

### **Electronic searches**

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) which contains the Cochrane Eyes and Vision Trials Register, in *The Cochrane Library* (Issue 1, 2006), MEDLINE (1966 to March 2006) and EMBASE (1982 to March 2006). There were no language or date restrictions in the electronic searches. The searches in the Appendices were also used in a separate Cochrane review of screening for amblyopia (Powell 2005) and, therefore, contain some additional terms not strictly relevant to this review.

See: [Appendices](#) for details of search strategies for each database.

### **Searching other resources**

To date it has not been possible to conduct any manual searches or to contact any researchers who are active in this field. However, the following handsearching is planned for updates of this review. We plan to manually search the *British Orthoptic Journal* from 2003 to the present for studies that meet the inclusion criteria (years prior to 2003 have already been searched). The following conference proceedings will also be searched where possible:

- European Strabismus Association (ESA);
- International Strabismus Association (ISA);
- American Association of Paediatric Ophthalmology and Strabismus (AAPOS);
- Royal College of Ophthalmologists (RCO).

## **Data collection and analysis**

### **Assessment of search results**

One review author checked the search results and selected all reports of studies that made reference to refractive error, myopia and

vision screening. Any reports that were clearly not relevant were excluded at first viewing. Two authors then screened the remaining titles and abstracts of the reports to establish if they met the inclusion criteria for this review. Three reports had no abstract so full papers were obtained. No trials were identified that met the inclusion criteria for this review, so none were assessed for quality and no data were collected or analysed.

### **Methods to be used in updates to the review**

Any trials that become available in the future will be included in the review using the following methods.

### **Assessment of quality**

Trial quality will be assessed using the guidelines in Section 6 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2005b) and the Cochrane Eyes and Vision Group Review Development Guidelines.

We will assess three main sources of bias:

- (1) selection bias - controlled by randomisation and allocation concealment;
- (2) detection bias - whether or not examiners responsible for measuring outcomes were masked to the group allocation of participants;
- (3) attrition bias - we will consider whether follow-up rates and compliance were similar for groups and how participants lost to follow up were accounted for. If studies report that an intention-to-treat analysis (ITT) has been performed we will assess whether both a) participants where no outcome was collected, and b) those who only received some or none of their allotted treatment have been included. We will only interpret a true ITT analysis to have been undertaken if both these criteria have been fulfilled.

Each parameter will be graded as (A) yes - requirements met; (C) no- requirements not met; or (B) unable to determine. We will seek clarification from authors of studies graded B. We will exclude studies graded B or C in sensitivity analyses to examine whether they have an impact on the size and direction of effect.

### **Data collection**

Two authors will independently extract data using the Cochrane Eyes and Vision group data collection form. Both authors will enter data into Review Manager (RevMan) 4.2 using the double data-entry system to check for discrepancies.

### **Data synthesis**

Studies included in the review will be checked for homogeneity by:

- (1) examining the characteristics of the included studies;
- (2) looking for poor overlap of the confidence intervals on the forest plot;



(3) the result of the chi-squared test.

If appropriate, a meta-analysis will be carried out using the RevMan software. If heterogeneity has been detected we will not combine results but present a descriptive summary of results. Sub-group analyses are planned for trials with failure thresholds of 6/9 (Snellen) or better; worse than 6/9 (Snellen) (or equivalent); and of trials carried out by different types of personnel, that is teachers, school nurses and eye trained professionals. Cluster trials will be dealt with according to the guidelines in the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2005).

It is anticipated that there will be two sets of data: screening versus no screening (intervention versus no treatment) and one screening protocol compared to another. These will be summarised separately. Within each group, the proportion of participants with correctable visual acuity deficits should be reported as an outcome measure, that is dichotomous data. We plan to use the risk ratio as the measure of effect. For continuous data we will present the weighted mean difference. If different instruments have been used to measure outcomes but are similar enough to be combined the standardised mean difference will be calculated.

### Sensitivity analysis

We plan the following sensitivity analyses:

- (1) excluding trials graded C on any aspect of methodological quality;
- (2) excluding trials graded B or C on any aspect of methodological quality;
- (3) excluding industry funded studies;
- (4) excluding unpublished studies.

## RESULTS

### Description of studies

See: [Characteristics of excluded studies](#).

The original electronic searches identified a total of 901 reports of studies. Full text copies were obtained for three papers where no abstract was provided; all three papers were excluded as they were not trials (Cross 1985; Gole 2001; Yamada 2004).

An additional 528 reports were identified in the first update of this review (March 2006); none of these were eligible for inclusion and, therefore, to date no trials evaluating the effectiveness of screening for visual acuity deficits in school-age children have been found.

### Risk of bias in included studies

No trials met the inclusion criteria so none have been assessed for quality.

### Effects of interventions

Since no randomised controlled trials were identified no data were extracted or analysed.

## DISCUSSION

The primary aim of vision screening in junior and senior schools is to identify children who acquire visual acuity deficit due to the development of refractive error, especially myopia (Cross 1985). While other causes of reduced vision may also be detected these are relatively rare (Dandona 2002; He 2004; Maul 2000; Murthy 2002; Naidoo 2003; Pokharel 2000; Zhao 2000). This form of screening is not expected to impact on the prevalence of refractive error itself but should reduce the prevalence of cases where it remains uncorrected. To achieve this, vision screening programmes must not only reliably detect the target condition but also ensure that treatment, in whatever form, is available, affordable and can be realistically implemented. The remit of this review was to identify randomised controlled trials (including randomised cluster controlled trials) that evaluated the effectiveness of screening as an intervention, however, no such studies were found.

The retrieved literature consists mainly of observational, cross-sectional and cohort studies. A small selection of these, which cannot be regarded as having been systematically identified (as randomised controlled trials would have been) included some studies identified in reference lists and are described in an attempt to explain current practice.

The desired impact of a vision screening programme varies depending on the environment in which it is conducted. For example, in low-income countries, and in deprived areas of some high-income countries the main aim of a screening programme might be to identify children in school who could benefit from spectacles; these children would not otherwise have had access to care. In populations with a higher incidence of refractive error, such as Chinese populations in South East Asia, it is likely that a greater proportion of children will have significant uncorrected refractive errors thereby potentially increasing the justification for screening (He 2004; Zhao 2000). It would, therefore, seem appropriate to consider the rationale for screening in different geographic and socio-economic circumstances.

### School vision screening programmes in the West

#### (1) The UK

Although access to a vision test by a school nurse is readily available for individual pupils when concerns have been raised, mass

screening of visual acuity in schools in the UK has gradually declined. Two studies examining the impact of the withdrawal of this service suggested that most new deficits detected by screening are minor. Most children with ocular abnormalities have already been examined by the time they are screened (Cummings 1996; Jewell 1994). Less than 1% (9/1,069) of 13 to 15 year old students in Oxfordshire were prescribed and wore spectacles as a consequence of having failed screening (Jewell 1994). Similarly, of 1,809 students aged 8 to 10 years in the Cambridge Health District less than 1% (15/1809) had newly identified problems requiring treatment (Cummings 1996). Major reviews have since questioned the value of school screening programmes in the UK (Hall 2003; Snowden 1997).

In two large cohorts of children and adolescents it was shown that approximately one third of children did not wear their prescribed spectacles; these were possibly prescriptions for minor visual acuity deficits (Cummings 1996; Jewell 1994).

## (2) The USA

The American Association for Pediatric Ophthalmology and Strabismus (AAPOS) encourages screening programmes for visual impairment in children with subsequent referral to eye care professionals trained to care for eye problems in children. It advocates the education of volunteer lay persons and auxiliary medical personnel to perform vision screening (AAPOS 1991). In the USA, therefore, vision screening for school children and adolescents is widespread. Specific recommendations and requirements vary from state to state, however.

There appear to be very few attempts to formally evaluate the impact of these programmes. A study of an underprivileged inner-city school population found that of the 11% of 680 (76/680) children who failed screening 8.2% (6/76) failed due to uncorrected refractive error. Of the 22 children who already had glasses 15 were consistently wearing spectacles; even though only six of these children had any demonstrable benefit to visual acuity from their prescription. At follow up one year later, only 30% (12/40) of participants were wearing their spectacles; more than half the original study group were lost to follow up (Preslan 1996; Preslan 1998).

## School vision screening programmes in Asia

### (1) India

In India vision screening in schools is becoming more common, especially in urban areas. A five year follow up of screening reported that 3.8% (205,082) of 5.39 million students had been identified/refracted by the programme and that 0.8% (43,922) of children had been provided with glasses by the scheme. According

to teachers 96.5% (42,390/43,922) of these students were wearing their spectacles in class (Limburg 1999).

Data were only available for 61 of the 200 study districts and results may, therefore, be biased in favour of better organised districts. Some data were also excluded because screening had been carried out by ophthalmic assistants and the focus of this study was the performance of teachers as primary vision screeners.

### (2) South East Asia

In many South East Asian populations myopia has reached epidemic proportions. In senior high and vocational schools in Taiwan more than 80% of students have been reported to be short-sighted and 10 to 15% have high myopia of > 6 dioptres (Lin 1988). In Singapore, 29% of Chinese school children aged 7 to 9 years were myopic (Saw 2004). In urban Southern China, 9.6% of children aged 5 to 15 years had correctable visual acuity deficit; 95% due to uncorrected refractive errors (He 2004). The high prevalence of refractive errors together with high levels of schooling in this region may support the demand for a successful school vision screening programme.

## School vision screening programmes in Africa

Little information is available on the prevalence of uncorrected refractive errors in sub-Saharan Africa. The prevalence of correctable visual acuity deficit has been shown to be low in school-age children, below 1%, though the prevalence of refractive errors may be higher in selected groups, such as senior school students (Naidoo 2003; Wedner 2000). Where the prevalence of refractive error is low the proportion of false positives will tend to be higher because the positive predictive value of screening is influenced by the prevalence of the condition. In addition, availability, affordability and acceptability of spectacles may be problematic, especially in rural areas. Human and financial resources available for screening are usually very limited. There is an urgent need, therefore, for good evidence to inform the introduction of any new programmes. A study currently being conducted by Wedner in Tanzanian secondary schools is exploring the costs and benefits of various screening techniques and interventions for correctable visual acuity deficits.

## Who should test vision in school?

Studies in India and Tanzania have examined the role of teachers as vision screeners. Comparisons are difficult as different techniques were used for the identification of visual acuity deficit. In India, 40 to 90% of students who failed the teachers' screening were prescribed spectacles (Limburg 1999). In Tanzania, primary school teachers correctly identified 80% of students with bilateral impaired eyesight of worse than 6/12 (Wedner 2000). No literature

was identified that has validated the role of ophthalmic assistants, school nurses, orthoptists or doctors carrying out vision screening in schools.

### Quality of life measures

Even though several studies looked into the association between myopia, intelligence and school achievement (Ashton 1985; Helveston 1985; Peckham 1979) no papers were identified that explored the impact of correcting poor eyesight with spectacles on academic performance and, therefore, job opportunities and income in later life.

### Cost of screening

Very few reports of estimated costs were found. Cummings 1996 estimated the total cost of screening for a school year group of 2800 children in the UK to be between £3461 and £6922, taking into account both clerical and nursing costs. The estimated cost for testing and recording each new significant abnormality was between £165 and £330. In India, Limburg 1999 explored the savings that could be made by implementing primary screening by school teachers rather than by periodic visits from teams of ophthalmic personnel. It was calculated that the cost per child screened was 60% higher when using the visiting ophthalmic teams.

### Adverse effects

There are very few clinical studies that examine the effect of optical correction on the development of refractive error but sufficient is known from animal studies and a notable clinical trial (Ingram 1991) to raise concern regarding the possibility of harm from inappropriate treatment. Ingram 1991 found that a group of children who wore spectacles for hypermetropia were significantly less likely to normalise (emmetropise) than a comparable group of children who did not wear spectacles. Animal studies have suggested that over-correcting myopia will lead to its exacerbation but the clinical implications of these findings remain poorly understood.

### Summary

Despite vision screening being performed widely in schools in high-income and in many middle-income countries its effectiveness has not been established. School vision screening is generally perceived to be beneficial but no randomised controlled trials have been conducted which can confirm or refute this view; and which could provide some quantification of benefit to be set against cost. Good evidence is needed to justify the introduction of new programmes in low-income countries, for example sub-Saharan Africa, where opportunity cost is a major consideration.

The effectiveness of a school vision screening programme does not depend solely on accuracy of the screening process. The availability of affordable and acceptable spectacles and of human and financial resources to provide the necessary treatment is crucial. The potential for screening to be harmful should not be forgotten. The ramifications of conducting programmes where the parameters for intervention are not well defined include not only the undue cost and inconvenience associated with false referrals but also the possibility of unnecessary treatment. Screening will not reduce the incidence of refractive error and there is a possibility that excessively or inappropriately correcting refractive error may inhibit the younger child's ability to naturally correct the defect (emmetropisation) (Ingram 1991). These factors need to be considered when planning any future research or programmes.

## AUTHORS' CONCLUSIONS

### Implications for practice

At present, it would appear that there is no good quality evidence that can be used to justify the introduction of new school vision screening programmes. Absence of evidence of effectiveness does not mean that screening is of no value, simply that any value has not been properly identified and quantified. The possibility of doing harm has also not been considered.

Where primary eye care services are very scarce, screening in schools offers the opportunity of identifying children with a problem that would otherwise be missed. Such problems can be surprisingly severe before they come to the attention of carers.

The pressure for screening is greater where refractive error is more common and is quite intense in countries such as Singapore where there appears to be an epidemic of myopia among the Chinese inhabitants. It should be remembered that screening has no impact on incidence in this context.

In some high-income countries, such as the UK, the prevalence of uncorrected refractive errors in school children is considered to be too low to justify a screening programme in many regions. In low and middle-income countries with a sufficiently high prevalence of visual acuity deficits, good evidence on the effectiveness of screening has to be made available before human and financial resources are utilised for school vision screening programmes.

### Implications for research

There is a clear need for reliable evidence to measure the effectiveness of vision screening. Research is needed to demonstrate whether school vision screening leads to a substantial decrease in the prevalence of uncorrected yet correctable visual acuity deficits due to refractive error. Evaluation of the impact of different screening methods (personnel, test types etc.) in different settings is also

required. More evidence is needed on whether spectacle correction improves school performance in students with significant refractive errors. In countries with low school attendance, information is needed on whether screening programmes in schools are sufficient or whether additional efforts have to be made to identify children with correctable visual acuity deficit in the community. Where there is the intention to introduce a new screening programme the opportunity to carry out a randomised, controlled trial should not be missed so that the potential benefits of this intervention can be measured.

## ACKNOWLEDGEMENTS

We would like to acknowledge and thank Karen Blackhall who prepared and executed the electronic searches. Thank you also to Catey Bunce, Roberta Scherer, Ivan Wood and Allen Foster for peer reviewing and to Maria Cristina Bohorquez for her translation work. In addition, many thanks to Anupa Shah and Richard Wormald at the Cochrane Eyes and Vision Group editorial base for their advice and support throughout the review process.

## REFERENCES

### References to studies excluded from this review

#### Cross 1985 *{published data only}*

Cross AW. Health screening in schools. *Journal of Pediatrics* 1985;**107**(4):487–94.

#### Gole 2001 *{published data only}*

Gole G. Refractive errors in childhood and adolescence. *Medicine Today* 2001;**2**(10):87–9.

#### Yamada 2004 *{published data only}*

Yamada Y. Myopia in primary school children. *Japanese Journal of Clinical Ophthalmology* 2004;**58**(2):125–9.

### Additional references

#### AAPOS 1991

AAPOS Committee of The American Association for Pediatric Ophthalmology and Strabismus. Eye care for the children of America. *Journal of Pediatric Ophthalmology and Strabismus* 1991;**28**(2):64–7.

#### Angle 1980

Angle J, Wissmann DA. The epidemiology of myopia. *American Journal of Epidemiology* 1980;**111**:220–8.

#### Ashton 1985

Ashton GC. Nearwork, school achievement and myopia. *Journal of Biosocial Science* 1985;**17**:223–33.

#### Au Eong 1993

Au Eong KG, Tay TH, Lim MK. Education and myopia in 110,236 young Singaporean males. *Singapore Medical Journal* 1993;**34**:489–92.

#### Banks 1980

Banks MS. Infant refraction and accommodation. *International Ophthalmology Clinics* 1980;**20**:205–32.

#### Canoll 1982

Canoll JP. On emmetropisation. *Journal of Theoretical Biology* 1982;**95**:135–44.

#### Cummings 1996

Cummings GE. Vision screening in junior schools. *Public Health* 1996;**110**:369–72.

#### Dandona 2002

Dandona R, Dandona L, Srinivas M, Sahare P, Narsaiah S, Munoz SR, et al. Refractive error in children in a rural

population in India. *Investigative Ophthalmology & Visual Science* 2002;**43**:615–22.

#### Deeks 2005

Deeks JJ, Higgins JPT, Altman DG, editors. Analysing and presenting data. Cochrane Handbook for Systematic Reviews of Interventions 4.2.5 [updated May 2005; Section 8. In: The Cochrane Library, Issue 3, 2005. Chichester, UK: John Wiley & Sons, Ltd.

#### Dobson 1986

Dobson V, Serbris SL, Carlson MR. Do glasses prevent emmetropisation in strabismic infants?. *Investigative Ophthalmology & Visual Science* 1986;**27**:2.

#### Ehrlich 1997

Ehrlich DL, Braddick OJ, Atkinson J, Anker S, Weeks F, Hartley T, et al. Infant emmetropisation: longitudinal changes in refraction components from nine to twenty months of age. *Optometry and Vision Science* 1997;**74**:822–43.

#### Felius 2004

Felius J, Stager DR Sr, Berry PM, Fawcett SL, Stager DR Jr, Salomao SR, et al. Development of an instrument to assess vision-related quality of life in young children. *American Journal of Ophthalmology* 2004;**138**(3):362–72.

#### Hall 2003

Hall DMB, Elliman D. *Health for All Children*. 4th Edition. Oxford: Oxford University Press, 2003.

#### He 2004

He M, Zeng J, Liu Y, Xu J, Pokharel G, Ellwein LB. Refractive error and visual impairment in urban children in Southern China. *Investigative Ophthalmology & Visual Science* 2004;**45**:793–9.

#### Helveston 1985

Helveston EM, Weber JC, Miller K, Robertson K, Hohberger G, Estes R, et al. Visual function and academic performance. *American Journal of Ophthalmology* 1985;**99**(3):346–55.

#### Higgins 2005a

Higgins JPT, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions 4.2.5 [updated

- May 2005]. In: The Cochrane Library, Issue 3, 2005. Chichester, UK: John Wiley & Sons, Ltd.
- Higgins 2005b**  
Higgins JPT, Green S, editors. Assessment of study quality. Cochrane Handbook for Systematic Reviews of Interventions 4.2.5 [updated May 2005; Section 6. In: The Cochrane Library, Issue 3, 2005. Chichester, UK: John Wiley & Sons, Ltd.
- Hung 1995**  
Hung L, Crawford M, Smith E. Spectacle lenses alter eye growth and refractive status of young monkeys. *Nature Medicine* 1995;**1**:761–5.
- Ingram 1989**  
Ingram RM. Review of children referred from the school vision screening programme in Kettering during 1976–8. *BMJ* 1989;**298**(6678):935–6.
- Ingram 1991**  
Ingram RM, Arnold PE, Dally S, Lucas L. Emmetropisation, squint and reduced visual acuity after treatment. *British Journal of Ophthalmology* 1991;**75**(7):414–6.
- Jensen 1995**  
Jensen H. Myopia in teenagers. *Acta Ophthalmologica Scandinavica* 1995;**73**:389–93.
- Jewell 1994**  
Jewell G, Reeves B, Saffin K, Crofts B. The effectiveness of vision screening by school nurses in secondary school. *Archives of Disease in Childhood* 1994;**70**:14–8.
- Kvarnstrom 2001**  
Kvarnstrom G, Jakobson P, Lennerstrand G. Visual screening of Swedish children: an ophthalmological evaluation. *Acta Ophthalmologica Scandinavica* 2001;**79**:240–4.
- Limburg 1999**  
Limburg H, Kansara HT, D'Souza S. Results of school eye screening of 5.4 million children in India—a five-year follow-up study. *Acta Ophthalmologica Scandinavica* 1999;**77**(3):310–4.
- Lin 1988**  
Lin LL, Hung L, Shih Y, Hung P, Ko L. Correlation of optical components with ocular refraction among teenagers in Taipei. *Acta Ophthalmologica* 1988;**185**:69–73.
- Lin 1999**  
Lin LL, Shih YF, Tsai CB, Chen CJ, Lee LA, Hung PT, et al. Epidemiologic study of ocular refraction among schoolchildren in Taiwan in 1995. *Optometry and Vision Science* 1999;**76**:275–81.
- Maul 2000**  
Maul E, Barroso S, Munoz SR, Sperduto RD, Ellwein LB. Refractive Error Study in Children: results from La Florida, Chile. *American Journal of Ophthalmology* 2000;**129**:445–54.
- Medina 1987**  
Medina A. A model for emmetropisation: the effects of correcting lenses. *Acta Ophthalmologica* 1987;**65**:565–71.
- Murthy 2002**  
Murthy GVS, Gupta SK, Ellwein LB, Munoz SR, Pokharel GP, Sanga L, et al. Refractive error in children in an urban population in New Delhi. *Investigative Ophthalmology & Visual Science* 2002;**43**:623–31.
- Naidoo 2003**  
Naidoo KS, Raghunandan A, Mashige KP, Govender P, Holden BA, Pokharel GP, et al. Refractive error and visual impairment in African children in South Africa. *Investigative Ophthalmology & Visual Science* 2003;**44**:3764–70.
- Negrel 2000**  
Negrel AD, Maul E, Pokharel GP, Zhao J, Ellwein LB. Refractive Error Study in Children: sampling and measurement methods for a multi-country survey. *American Journal of Ophthalmology* 2000;**129**:421–6.
- Ohio 2004**  
Ohio Department of Health Hearing/ Vision Screening for Children. [www.odh.state.oh.us/odhprograms/hvscr/hvscr1.htm](http://www.odh.state.oh.us/odhprograms/hvscr/hvscr1.htm) (accessed 3 August 2004).
- Peckham 1979**  
Peckham CS, Gardiner PA, Tibbenham A. Vision screening of adolescents and their use of glasses. *British Medical Journal* 1979;**1**:1111–3.
- Pokharel 2000**  
Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive Error Study in Children: results from Mechi Zone, Nepal. *American Journal of Ophthalmology* 2000;**129**:436–44.
- Powell 2005**  
Powell C, Porooshani H, Boroquez MC, Hatt S. Screening for amblyopia in childhood. *Cochrane Database of Systematic Reviews* 2005, Issue 3. [DOI: 10.1002/14651858.CD005020.pub2]
- Preslan 1996**  
Preslan MW, Novak A. Baltimore vision screening project. *Ophthalmology* 1996;**103**:105–9.
- Preslan 1998**  
Preslan MW, Novak A. A Baltimore Vision Screening Project. Phase 2. *Ophthalmology* 1998;**105**(1):150–3.
- Resnikoff 2001**  
Resnikoff S, Pararajasegaram R. Blindness prevention programmes: past, present, and future. *Bulletin of the World Health Organization* 2001;**79**(3):222–6.
- Rosner 1986**  
Rosner J, Rosner J. Some observations of the relationship between the visual perceptual skills development of young hyperopes and age of first lens correction. *Clinical Experimental Ophthalmology* 1986;**69**:166–8.
- Saw 2004**  
Saw SM, Carkeet A, Chia KS, Stone RA, Tan DT. Component dependent risk factors for ocular parameters in Singapore Chinese children. *Ophthalmology* 2004;**109**(11):2065–71.

**Simmers 1997**

Simmers AJ, Gray LS, Spowart K. Screening for amblyopia: a comparison of paediatric letter tests. *British Journal of Ophthalmology* 1997;**81**:465–9.

**Snowden 1997**

Snowden SK, Stewart-Brown SL. Preschool vision screening. *Health Technology Assessment* 1997;**1**(8):1–83.

**Sorsby 1964**

Sorsby A. *Modern Ophthalmology*. Vol. 3, London: Butterworth, 1964.

**Sperduto 1983**

Sperduto RD, Seigel D, Roberts J, Rowland M. Prevalence of myopia in the United States. Prevalence of myopia in the United States. *Archives of Ophthalmology* 1983;**101**:405–7.

**Stewart-Brown 1985**

Stewart-Brown S, Butler N. Visual acuity in a national sample of 10 year old children. *Journal of Epidemiology and Community Health* 1985;**39**:107–12.

**Taylor 2000**

Taylor HR. Refractive errors: magnitude of the need. *Community Eye Health* 2000;**13**:1–2.

**Troilo 1991**

Troilo D, Wallman J. The regulation of eye growth and refractive state: an experimental study of emmetropisation. *Vision Research* 1991;**31**:1237–50.

**Wedner 2000**

Wedner SH, Ross DA, Balira R, Kaji L, Foster A. A prevalence survey of eye diseases in primary school children in a rural area of Tanzania. *British Journal of Ophthalmology* 2000;**84**:1291–7.

**Wedner 2002**

Wedner SH, Ross DA, Todd J, Anemona A, Balira R, Foster A. Myopia in secondary school students in Mwanza City,

Tanzania: the need for a national screening programme. *British Journal of Ophthalmology* 2002;**86**:1200–6.

**Wedner 2003**

Wedner SH, Dineen B. Refractive errors. *Tropical Doctor* 2003;**33**:207–9.

**WHO 2000**

World Health Organization. Elimination of avoidable visual disability due to refractive errors. WHO/PBL/00.79 2000.

**WHO 2002**

WHO Refractive Error Working Group. Report on strategic planning meeting of refractive error working group. 2002: 1–30.

**Worku 2002**

Worku Y, Bayu S. Screening for ocular abnormalities and subnormal vision in school children of Butajira town southern Ethiopia. *Ethiopian Journal of Health Development* 2002;**16**(2):165–71.

**Yap 1994**

Yap M, Wu M, Wang SH, Lee FL, Liu ZM. Environmental factors and refractive errors in Chinese school children. *Clinical and Experimental Optometry* 1994;**77**:8–14.

**Zhao 2000**

Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD, Ellwein LB. Refractive Error Study in Children: results from Shunyi District, China. *American Journal of Ophthalmology* 2000;**129**:427–35.

**Zylbermann 1993**

Zylbermann R, Landau D, Berson D. The influence of study habits on myopia in Jewish teenagers. *Journal of Pediatric Ophthalmology and Strabismus* 1993;**30**:319–22.

\* Indicates the major publication for the study

## CHARACTERISTICS OF STUDIES

### Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Cross 1985	Not a randomised controlled trial or cluster randomised trial
Gole 2001	Not a randomised controlled trial or cluster randomised trial
Yamada 2004	Not a randomised controlled trial.

## DATA AND ANALYSES

This review has no analyses.

## ADDITIONAL TABLES

Table 1. VA 0.5\* or worse in at least one eye in children aged 5 to 15 years

Country	n	Presenting %	Uncorrected %	Best corrected %	% due refractive err
China (Shunyi)	5884	10.9	12.8	1.8	87.8
China (Ghangzhou)	5053	10.3	22.3	0.6	95.6
Chile	5303	14.7	15.8	7.4**	62.1
Nepal	5067	2.8	2.9	1.4	55.1
South Africa	5599	1.2	1.4	0.3	66.4
Urban India	6447	7.4	9.0	2.1	80.9
Rural India***	4074	4.9	5.0	2.5	53.0
*0.5 dec (6/12 Snellen)					
**Difficulties measuring visual acuity (VA) accurately, particularly in young children					
***aged 7 to 15					



## APPENDICES

### Appendix 1. CENTRAL search strategy

- #1 SCHOOLS
- #2 CHILD DAY CARE CENTERS
- #3 CHILD
- #4 INFANT
- #5 (#1 or #2 or #3 or #4)
- #6 (child\* or adolesc\* or juvenile\* or minor\* or school\* or kindergarten\* or pre-school\* or (pre next school\*) or nurser\*:ti) or (child\* or adolesc\* or juvenile\* or minor\* or school\* or kindergarten\* or pre-school\* or (pre next school\*) or nurser\*:ab)
- #7 (#5 or #6)
- #8 VISION SCREENING
- #9 VISION DISORDERS di:pc
- #10 (vision or visual)
- #11 (test\* or screen\* or diagnos\* or assessment\*)
- #12 (#10 and #11)
- #13 VISION TESTS
- #14 MASS SCREENING
- #15 (#8 or #9 or #12 or #13 or #14)
- #16 #7 and #15
- #17 STRABISMUS
- #18 AMBLYOPIA
- #19 REFRACTIVE ERRORS
- #20 (amblyopi\* or squint\* or strabism\* or anisometri\* or myopi\* or hypermetropi\* or astigmati\* or ammetropi\* or hyperopi\*)
- #21 (lazy near eye\*)
- #22 eye\* or sight\* or vision\* or visual\*
- #23 problem\* or defect\* or impair\* or deficit or reduc\*
- #22 (#17 or #18 or #19 or #20 or #21 or #22 or #23)
- #25 (#16 and #22)

### Appendix 2. MEDLINE search strategy

- #1 (“Schools-” / all SUBHEADINGS in MIME,MJME) or (“Child health Services”/ all SUBHEADINGS in MIME,MJME) or ((explode “Child-Day-Care-Centers” / all SUBHEADINGS in MIME,MJME) or (explode “Child-” / all SUBHEADINGS in MIME,MJME))
- #2 ((child\* or adolesc\* or juvenile\* or minor\* or school\* or kindergarten\* or pre?school\* or nurser\*)in AB) or ((child\* or adolesc\* or juvenile\* or minor\* or school\* or kindergarten\* or pre?school\* or nurser\*)in TI)
- #3 #1 OR # 2
- #4 (explode “Vision-Screening” / all SUBHEADINGS in MIME,MJME) or (“Vision-Disorders” / diagnosis ,prevention-and-control in MIME,MJME)
- #5 (visual or vision) near4 (test\* or screen\* or diagnos\* or assessment\*)
- #6 (((explode “Vision-Tests” / all SUBHEADINGS in MIME,MJME) and (PY:MEDS = 1966-1988)) or ((explode “Mass-Screening” / all SUBHEADINGS in MIME,MJME) and (PY:MEDS = 1966-1988)))
- #7 #4 OR #5 OR # 6
- #8 ((eye\* or sight\* or vision\* or visual\*) near4 (problem\* or defect\* or impair\* or defici\* or reduc\*)) or (lazy near eye\*) or (amblyopi\* or squint\* or strabism\* or anisometri\* or myopi\* or hypermetropi\* or astigmati\* or ammetropi\* or hyperopi\*) or (explode “Strabismus-” / all SUBHEADINGS in MIME,MJME) or (explode “Amblyopia-” / all SUBHEADINGS in MIME,MJME) or (explode “Refractive-Errors” / all SUBHEADINGS in MIME,MJME)
- #9 #7 AND #8
- #10 #3 AND #9

To identify randomised controlled trials, we combined this search with the Cochrane Highly Sensitive Search Strategy phases one and two as contained in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2005a).

### Appendix 3. EMBASE search strategy

#1 exp School/  
#2 exp day care/  
#3 exp child health care/  
#4 Child/  
#5 (child\$ or adolesc\$ or juvenile\$ or minor\$ or school\$ or kindergarten\$ or preschool\$ or pre-school\$ or nurser\$)ab,ti  
#6 #1 or #2 or #3 or #4 or #5  
#7 exp Vision Test/  
#8 exp Visual Disorder/pc, di [Prevention, Diagnosis]  
#9 ((vision or visual) adj3 (test\$ or screen\$))mp  
#10 #7 or #8 or #9  
#11 exp STRABISMUS/  
#12 exp AMBLYOPIA/  
#13 exp Refraction Error/  
#14 ((eye\$ or sight\$ or vision or visual) adj5 (problem\$ or defect\$ or impair\$ or deficit\$ or reduc\$))mp  
#15 (lazy adj3 eye\$)mp  
#16 (amblyop\$ or squint\$ or strabism\$ or anisometropi\$ or myopi\$ or hypermetropi\$ or astigmati\$ or ammetropi\$ or hyperopi\$)mp  
#17 #11 or #12 or #13 or #14 or #15 or #16  
#18 #6 and #10 and #17  
To identify randomised controlled trials we combined the above search with the following.  
#1 Randomized Controlled Trial/  
#2 Controlled Study/  
#3 randomization/  
#4 Double Blind Procedure/  
#5 Single Blind Procedure/  
#6 Clinical Trial/  
#7 Crossover Procedure/  
#8 follow up/  
#9 exp prospective study/  
#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9  
#11 exp ANIMAL/  
#12 Nonhuman/  
#13 Human/  
#14 #11 or #12  
#15 #14 not #13  
#16 #10 not #15  
#17 (clinica\$ adj3 trial\$).mp.  
#18 ((singl\$ or doubl\$ or trebl\$ or tripl\$) and (mask\$ or blind\$ or method\$)).mp.  
#19 exp PLACEBO/  
#20 placebo\$.mp.  
#21 random\$.mp.  
#22 exp Methodology/  
#23 (latin adj3 square\$).mp.  
#24 ((control\$ or prospectiv\$ or volunteer\$) adj3 (trial\$ or method\$ or stud\$)).mp.  
#25 (cross adj3 over\$).mp.  
#26 (crossover\$ or cross-over\$).mp.  
#27 #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26  
#28 #27 not #15  
#29 #16 or #28

## WHAT'S NEW

Last assessed as up-to-date: 3 April 2006.

Date	Event	Description
30 July 2008	Amended	Converted to new review format.

## HISTORY

Protocol first published: Issue 4, 2004

Review first published: Issue 1, 2005

Date	Event	Description
9 May 2006	New search has been performed	In the first update of this review an additional 528 reports of studies were identified; none were eligible for inclusion. Additional detail regarding possible harm from early or inappropriate treatment with glasses has been added into the introductory text and the discussion

## CONTRIBUTIONS OF AUTHORS

Coordinating the review: CP

Undertaking manual searches: CP

Screening search results: CP, SW, SH

Organising retrieval of papers: CP

Screening retrieved papers against inclusion criteria: CP, SW

Appraising quality of papers: CP, SW

Abstracting data from papers: CP, SW

Writing to authors of papers for additional information: CP

Providing additional data about papers: CP

Obtaining and screening data on unpublished studies: CP

Data management for the review: CP

Entering data into RevMan: CP, SW

Analysis of data: CP, SW

Interpretation of data: CP, SW

Writing the review: CP, SW, SH

First update of review: SH

## DECLARATIONS OF INTEREST

Susanne Wedner has published previously in the field of refractive error.

## SOURCES OF SUPPORT

### Internal sources

- No sources of support supplied

### External sources

- Christian Blind Mission, Germany.
- Sightsavers International, UK.

## INDEX TERMS

### Medical Subject Headings (MeSH)

\*Vision Screening; Adolescent; Refractive Errors [complications; \*diagnosis]; Vision Disorders [\*diagnosis; etiology]

### MeSH check words

Child; Humans