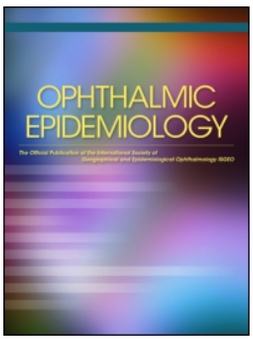

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Compliance and Predictors of Spectacle Wear in Schoolchildren and Reasons for Non-Wear: A Review of the Literature

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ABSTRACT

Purpose: Uncorrected refractive errors are the leading cause of visual impairment in children, affecting children in all settings. The majority of refractive errors can be corrected with spectacles. High compliance with spectacle wear is required for children to realize the benefit, such as higher academic achievement. This review collates evidence on compliance with spectacle wear, factors which predict spectacle wear and reasons for non-compliance among schoolchildren.

Methods: Literature searches were conducted on Medline, Embase, Global Health and the Cochrane Library. The date range was January 2000 to November 2017 and there were no language restrictions. The search retrieved a total of 1299 references, 522 duplicate records were removed leaving 777 references to assess. Twenty-five studies were included in the review.

Results: Evidence suggests that greater severity of uncorrected refractive error and lower levels of uncorrected visual acuity are associated with higher levels of spectacle wear. Addressing socio-demographic reasons for non-compliance is complex as they are context specific. Evidence that children become less compliant with spectacle wear with increasing age is not consistent. Quantitative data indicate girls are more likely to be compliant with spectacles wear than boys, but qualitative studies highlight specific challenges faced by girls.

Conclusion: There was considerable variation between studies in how spectacle compliance was defined, the time interval between dispensing the spectacles and assessment, and how compliance was assessed. There is need to standardize all aspects of the assessment of compliance. Further qualitative and quantitative studies are required in a range of settings to assess the biomedical and socio-demographic factors which affect spectacle wear compliance using standard definitions.

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Introduction

The World Health Organization (WHO) estimates that there are 19 million children with vision impairment globally, 12 million of whom have uncorrected refractive error (RE).[1] Refractive errors affect children of all ethnicities and in all settings, i.e., urban and rural and in low, middle and high-income countries. The commonest type of RE, myopia, increases with increasing age. Myopia in children and adolescence is increasing rapidly in several Asian countries where it can affect up to 70% of school children. In response to this, eye health activities in schools are increasing in all regions of the world, with several large-scale initiatives.[2–4]

The majority of children have uncomplicated REs which can be readily and cost-effectively corrected with spectacles.[5–7] There is evidence that children can be adversely affected by vision impairment and that it has an impact on their academic performance,[8] visual functioning, behavioural development[9] and quality of life.[7] Despite the benefits of wearing spectacles, there is some evidence that a high proportion of children in many settings do not wear them. An earlier review of school-based approaches to the correction of refractive errors in children included a section spectacle compliance, which included only five studies.[10]

Purpose and focus of the review

The purpose of this review is to collate the evidence on compliance with spectacle wear, factors which predict spectacle wear and reasons for non-compliance among schoolchildren. This information will be of value to those designing and implementing school eye health programmes.

Methods

The search was wide-reaching, to identify as many studies as possible which reported on the correction of refractive errors in children. Papers were reviewed

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for inclusion even if compliance was not an expressed purpose of the study.

Literature searches were conducted on Medline, Embase, Global Health and the Cochrane Library. (See appendices for search strategies used.) The date range was January 2000 to November 2017 and there were no language restrictions. The search retrieved a total of 1299 references, 522 duplicate records were removed leaving 777 references to assess.

Study selection and assessment

Two reviewers independently assessed 777 references for potential inclusion in the review. In addition, further publications were identified from checking the citations from appropriate studies. Two non-English language articles were excluded as resources were not available for translation. A total of 35 articles were included in this review, and included randomized control trials (RCTs), observational cross-sectional studies and qualitative research. Studies were excluded if they were not undertaken in schools, or only included pre-primary or post-secondary school-age children. The following information was extracted from included studies, as relevant, and entered into an Excel spreadsheet: study design; setting (country) and participants (age, gender, number and comparison groups, if relevant). Main outcomes: how compliance with spectacle wear was defined and assessed, and rates of compliance; predictors of spectacle wear with relevant statistics, and reasons non-wear. Other outcomes were follow-up rates, use of prescribing guidelines, health education and medium of delivery, and whether students could select their preferred spectacle frames.

There was considerable heterogeneity across studies in terms of purpose, design, and the outcomes measured and how they were measured which limited comparisons and generalizability of the findings.

Results

Several of the 35 included studies reported more than one of the outcomes of interest (i.e., compliance, predictors and reasons for non-wear). There were 27 studies on compliance, 19 studies on predictors (cross-sectional studies and RCTs) and 13 studies reported reasons for non-wear; 7 used qualitative methods and 6 used structured questionnaires, or details of the methods were not given. (Table 1)

Spectacle compliance

The 27 studies that investigated spectacle compliance were undertaken in the following countries: China (7), India and the USA (6), and one in each of the following countries, Oman and Nepal (Asia), Brazil, Mexico and Chile (South America), Saudi Arabia (Middle East), and South Africa and Tanzania (Africa). The majority of studies were observational with three RCTs.

Spectacle wear was either assessed by direct observation during unannounced visits (n = 15 studies) or during planned visits (n = 2), or was self-reported by interviewing children (n = 5) or children and teachers (n = 1), or was not clearly stated (n = 4). In a trial in China, there was significant difference in the control and intervention arms between self-reported (41% intervention and 26% control) and observed wear (68% intervention and 37% control) respectively.[8] Compliance was defined as either wearing spectacles (n = 16), or wearing or carrying spectacles (n = 7) or was not clearly stated (n = 4).

Using all definitions, compliance levels ranged from as low as 13.4% (wearing) in Mexico[11] to 87.4% (wearing) in the USA. Spectacle wear in studies which defined compliance as wearing spectacles assessed by direct observation ranged from 28% to 73%. Self-reported wear ranged from 58% to 82%.

Factors which influenced compliance with spectacle wear identified in this review can be categorized as biomedical, socio-demographic and other factors. Biomedical factors, which are presented first, include UCVA, degree and type of RE, improvement in VA and headaches/eye strain. This is followed by a description of the socio-demographic factors include age, gender, cost and access to spectacles, parental education and psychosocial issues, including parent, peer and child perceptions regarding glasses wear. Other factors include lost or broken spectacles (which programmes may not be able to replace) also fall into this category.

Biomedical factors associated with spectacle compliance

Age

Age among children in primary and secondary schools was described as a continuous variable (per year increase in age) and as a binary or ordinal variable – comparing children above and below a certain age or those of different school grades. The included studies encompass a range of different age groups and direct comparison of age as a factor for non-compliance of spectacle wear is, therefore limited.

Amongst the quantitative studies, increasing age was associated with lower spectacle wear in four studies[11–14] whereas in two studies, in India and the USA, younger children were less compliant.[15,16] A study in China of school children who reported already owning

Table 1. Spectacle compliance proportions from different studies.

Author	Year	Country	Age (yrs)	Follow up (mn)	Sample size	Choice of frames	Definition of compliance	How wear assessed?	Compliance
Khandekar[9]	2002	Oman	6–17	12	571	Not stated	Wearing	Observation, school health staff informed of follow-up visit	73%
Castanon Holguin[8]	2006	Mexico	5–18	4–18	493	No	Wearing or carrying	Unannounced observation	13.4% wearing; 34% carrying
Congdon[10]	2008	South Africa	6–19	4–11	483	Not stated	Wearing or carrying	Unannounced observation	31%
Li[11]	2008	Rural China	ND	3	597	Bought by parents	Self-reported wear among children who bought specs	Self-reported	63.9% (134/210 who bought)
Congdon[12]	2008	Rural China	11–17	Not relevant	948	Children's own	Self-reported wear among existing spec owners	Self-reported	82.1%
Khandekar[13]	2008	Central India	ND	3–4	77	Not stated	Not clearly stated	Not stated	80.5%
Wedner[14]	2008	Tanzania	11–19	3	Free spectacles: 58 Prescription only: 50	Yes in free spectacles arm	Wearing or carrying	Unannounced observation	Free spectacles 47%; prescription only 26%
Yabumoto[15]	2009	Brazil	ND	10	95	Not stated	Not stated	Self-reported	73.7% Self-reported
Zeng[16]	2009	China	12–15	1	Ready-made:243 Custom-made: 245	5 metal frame colours, 3 plastic frame colours	Wearing or carrying	Unannounced observation	Ready-made arm 46.9%, custom arm 51.5% (P = .23)
Keay[17]	2010	China	12–15	1	415	5 metal frame colours, 3 plastic frame colours	Wearing or carrying	Unannounced observation outside the classroom	49.2% (46.5% wearing, 2.7% carrying)
Ethan[18]	2010	US (low income urban)	Grades 1 & 2	Not stated	Free spectacles: 102 Screening only:127	Yes in free spectacles arm	Wearing	Unannounced observation (6 times; 2 pre- & 4 post-intervention)	baseline: free specs group 22%, control 19% follow-up: free specs group 47%, control 19%
Congdon[19]	2011	Rural China	12–17	6	Health education: 2236 Control: 2212	Bought by parents	Purchased spectacles (primary outcome), Wearing or carrying (secondary outcome)	Self-reported	Education intervention 21%; Control 30%
Messer[20]	2012	USA (Native American)	8–14	10–14	247	Yes, over 30 options	Presented with spectacles (not in class)	Unannounced observation with vision testing	33.2%
Manny[21]	2012	USA	6–16	12	798	Not stated	Presented with correction that improves VA >6/12 + 2 ("adequate correction")	Observation. Location, and whether unannounced, not stated.	28%
Gogate[22]	2013	North India	8–16	6–12	1018	No	Wearing	Unannounced observation	29.5%
Aldebasi[23]	2013	Saudi Arabia	7–13	6	631	Not stated	Wearing	Observation at announced visit	66.8%
Pavithra[24]	2014	South India	7–15	3	83	Not stated	Wearing	Unannounced observation	58%
von-Bischhoffshausen[25]	2014	Chile	4–19	12	204	Not stated	Wearing (at interview)	Student and teacher interviews (no direct examination)	Self-report: 58% Teacher reported: 55%
Ma[5]	2014	China	9–12	7–8	3054	Not stated	Wearing	Unannounced observation	Free glasses: 41% Voucher: 37% Prescription only: 26%
Kodjebacheva[26]	2014	USA	6–8	6	15	Yes	Wearing	Unannounced observation	73.30%
Alvi[27]	2015	USA	6–18	1 & 12	565	Not stated	Not stated	School nurse observation/student self-report; teacher input, knowledge of use of spare specs	At 1/12: school mean 85.9%; at 12/12: school mean 70.8% (28 schools)
Yi[28]	2015	Urban China	10–12	6	Intervention arm (free specs & HE & teacher incentive) 341, control arm (prescription only) 352	Not stated	Wearing	Unannounced observation	Intervention arm; 68.3% Control arm: 23.9%

(*Continued*)

Table 1. (Continued).

Author	Year	Country	Age (yrs)	Follow up (mn)	Sample size	Choice of frames	Definition of compliance	How wear assessed?	Compliance
Bhandari[29]	2016	Nepal	7–16	12	170	Not stated	Wearing	Unannounced observation; not assessed in class	28%
Morjaria[30]	2017	India	11–15	3–4	Ready-made arm 232 Custom-made arm 228	Yes in both arms	Wearing spectacles or had them at school	Unannounced observation	Ready-made arm: 75.5% Custom-made arm: 73.6%
Huang[31]	2017	USA	Grades 2 and 3	Not stated	Not stated	Not stated	Wearing	Not stated	87.4%
Bhatt[32]	2017	India	6–15	3	200	Not stated	Wearing	Unannounced observation	39%

spectacles, also reported compliance to be lower in younger children [adjusted OR = 1.39 (95% CI 1.04–1.86) per year increase in age].[17]

Lower compliance with increasing age was significant in three observational studies with similar age ranges: in Mexico [OR 1.19 (95% CI 1.05–1.33) per year decrease in age (range 5–18)][11] and in Chile OR 0.83 (95% CI 0.76–0.92) per year increase in age (range 4–19).[13] A study in the USA compared children younger and older than 12 years (range 6–18)[14]; at one month follow-up younger children were more than twice as likely to be wearing their spectacles [OR 2.26 (95% CI 1.08–4.73)] which had declined by 4 months [OR 1.74 (95% CI 1.11–2.74)]. At one year the differences were no longer significant [OR 1.14 (95% CI 0.42–2.50)]. A further study in India reported compliance to be highest in the youngest of three age groups but did not report complete statistics to support this.[12] Eleven studies found no significant difference in the level of spectacle wear between younger and older children.[18–28]

Three qualitative studies[29–31] with parents and teachers reported that spectacles were for adults or that they should not be worn by children. However, these studies did not explore reasons for differing compliance by age.

Sex

Boys were less likely to wear spectacles than girls in eight studies.[17,18,22,25–27] One study did not provide statistics to support this,[32] while another reported a *p*-value that was not significant.[15]

Odds ratios for greater compliance in girls were reported in an observational study, a cluster RCT in China and in an observational study in the USA [OR 1.72 (95% CI 1.10–2.68) and OR 1.78 (95% CI 1.21–2.62); OR 1.8 (95% CI 1.1–3.2)], respectively. In another study in China, among children who already owned spectacles, girls were almost three times more likely to wear spectacles than boys [OR 2.82 (95% CI 1.77–4.51)].[17]

Nine studies found no significant difference in compliance by sex,[11–13,16,19–21,23,24] and no quantitative studies reported lower spectacle wear amongst girls (Table 2).

In the qualitative studies, barriers to spectacle wear were identified for boys and girls, but more frequently for girls. Amongst students in Tanzania,[33] spectacles were considered feminine and less acceptable for boys. In India, three studies all identified girls as facing additional societal and psychological barriers to spectacle wear.[31,34,35] These included concerns about their marriage prospects[34] and being subject to more negative comments than boys for wearing spectacles.[31] These factors led to some parents discouraging their

Table 2. Studies reporting age and/or gender as barriers to spectacle wear.

Author	Year	Country	Age	Gender
Khandekar[9]	2002	Oman	6–7 years: 65.5%; 12–13 years: 64.4%; 16–17 years: 79.3%. $p = .0004$	Girls more compliant: girls 78.4% vs boys 65.2%, $p = .21$
Castanon Holguin[8]	2006	Mexico	OR 1.19 (1.05–1.33) per year less in age	No significant difference
Congdon[10]	2008	South Africa	No significant difference between 3 age groups	Girls more compliant; $p = .0004$
Congdon[12]	2008	China	Not reported	Girls more compliant: Adjusted OR 2.82 (1.77–4.51)
Khandekar[13]	2008	India	No significant difference: <10 years vs ≥10 years	No significant difference
Li[11]	2008	China	Not reported	Not reported
Wedner[14]	2008	Tanzania	Not significant	Not significant
Yabumoto[15]	2008	Brazil	Not significant	Not significant
Keay[17]	2010	China	Not significant	Girls more compliant: OR 1.72 (1.1–2.68)
Congdon[19]	2011	China	Not significant	Girls more compliant: OR 1.78 (1.21–2.62) $P = .003$
Manny[21]	2012	USA	OR 1.12 (1.03–1.22) per year increase in age	Not significant
Messer[20]	2012	USA	Not reported: compared school levels but no stats	Girls more compliant: OR 1.8 (1.1–3.2)
Aldebasi[23]	2013	Saudi Arabia	Older age (7–9 years vs 10-13years) $p = .052$ chi square test	Boys more compliant: $p = .032$ chi squared test
Gogate[22]	2013	India	8–10 years: 56.3%; 11–13 years: 29.2%; 14–16 years: 27.6%. $p = .058$	All: boys compliance 26.3% vs girls 32.5%.p = .029. Myopes only, girls more compliant: OR 1.3 (0.8–1.9)
Pavithra[24]	2014	India	7–9 years higher compliance than 10–12 years and 13–15 years. No stats	Not reported
von-Bischh-offshausen[25]	2014	Chile	Per year increase: 0.83 (0.76–0.92)	No significant difference
Alvi[27]	2015	USA	<12 vs >12 years at 1/12: OR 2.26 (1.08–4.73), at 4/12 OR 1.74 (1.11–2.74), at 12/12 OR 1.14 (0.42–2.50)	Not reported
Yi[28]	2015	China	Not significant	No significant difference
Bhandari[29]	2016	Nepal	Not reported	Boys more compliant, but no data
Bhatt[32]	2017	India	6–9 years 46.2%; 10–12 years 42.7%; 13–15 years 27.1%; $p = .077$	Not reported

daughters from using their spectacles.[35] Greater apprehension was also expressed by girls about long-term spectacle wear.[31] Focus group discussions with children, parents and teachers in Nigeria, the USA and China did not address gender-related barriers.[29,30,36]

In a study of six picture pairs tests undertaken in the United States of America by boys and girls wearing and not wearing spectacles, children wearing spectacles were selected by boys and girls as "looking smarter" than non-wearers. In a within-group comparison, girls wearing spectacles were more likely to say that girls wearing spectacles were better looking and more honest and girls not wearing spectacles.[37]

Type of uncorrected refractive error

Only a few quantitative studies have investigated whether the type of RE (i.e., myopia, hyperopia or astigmatism) effect spectacle wear. There was no significant difference between RE types in Chile, Oman and Brazil.[13,15,21] However, in Tanzania, compliance was zero amongst hyperopes and astigmats compared with 43% in myopes.[20] Another study in India reported differences between myopes, hyperopes and emmetropes (better than -0.50D) but did not provide statistical analysis.[26]

The severity of RE is reported more frequently as a predictor of spectacle wear, but the definition of ametropia differed between studies.

In Oman, the proportion of compliant children was significantly higher in myopes with -2.50D or more compared those with less than -2.50D.[15] In India, a significant trend of increasing compliance was reported across four categories of myopia of increasing severity.[26] Another Indian study reported significantly better compliance in myopes of -1.00D or more compared with lower levels of myopia but did not provide statistical analysis.[12] In one Chinese study, children's self-reported wear was categorised as 'usually', 'sometimes' or 'seldom'. The proportion of children with myopia higher than -2.00D in both eyes reported significantly more frequent spectacle wear.[28]

In Mexico, the odds of compliance for myopia higher than -1.25D were 3.97 (95% CI 1.98–7.94) times greater than that for myopia of -1.25D or less and the odds for hyperopia higher than +0.50D were 3.63 (95% CI 1.02–12.9) times greater than for hyperopia of +0.50D or less.[11] In Chile, the same analysis was carried out using a cut-off of -0.75D and +0.75D. For myopes, the odds ratio was 4.93 (95% CI 2.28–10.67) and 2.37 (95% CI 1.06–5.31) for hyperopes.[13]

Two studies in the USA treated RE as a continuous variable in 1.00D units. In one study the odds ratio for increasing myopia in the better eye was 2.5 (95% CI 1.7–3.7) per 1.00D increase in myopia, and astigmatism in non-myopes had an odds ratio of 1.4 (95% CI 1.1–2.0) per 1.00D increase in cylinder.[38] The second

study investigated spectacle compliance at one month and one year, for better and worse eyes. At one month, higher better and worse eye hyperopia had higher odds of compliance of 1.69 (95% CI 1.05–2.71) and 1.57 (95% CI 1.02–2.42) respectively. Better eye myopia also gave a significant odds ratio at one month of 1.35 (95% CI 1.07–1.72). At one year only higher myopia was significantly associated with greater compliance, with a better eye odds ratio of 1.49 (95% CI 1.09–2.08) and worse eye odds ratio of 1.75 (95% CI 1.27–2.44).[14]

Studies in South Africa and Brazil found no significant difference in compliance with differing levels of RE,[18,21] and a study in China reported no significant difference between the mean spherical equivalent RE of right and left eyes of children who did or did not have their spectacles at school.[17]

A qualitative study in China found that children, parents and teachers were not in favour of spectacle wear for low amounts of myopia for practical reasons as well as concerns that wear would increase myopic progression.[30]

Uncorrected visual acuity and lines of improvement in visual acuity

Seven studies reported higher compliance with lower levels of uncorrected visual acuity.[16,17,22,23,26,28,38] An eighth study reported compliance to be better with 'poor VA' compared to 'better VA', but no analyses were reported.[32] Two studies found no significant difference in compliance according to uncorrected visual acuity.[14,21] No studies reported better compliance with better uncorrected refractive error.

Uncorrected visual acuity was reported as a continuous variable, per line change in VA, in four studies.[16,17,22,38] In two USA studies, the odds of compliance increased by 1.13 (95% CI 1.06–1.20) and 1.6 (95% CI 1.4–1.8) per line (0.1 logMAR) worse uncorrected visual acuity in the better eye.[16,38] An observational study in China also reported an odds ratio per line logMAR increase [OR = 1.46 (95% CI 1.26–1.69)] although the authors used the mean-uncorrected visual acuity score of right and left eyes.[17] In a cluster RCT in China, the odds of compliance was lower with worse uncorrected visual acuity in the better eye [OR = 0.287 (95% CI 0.106–0.774)]; however, the unit of change was not reported.[22]

Multiple categories of uncorrected visual acuity were compared in a study in India which showed a significant trend of increasing compliance across five categories of decreasing uncorrected visual acuity[26] A cluster RCT in China compared two categories of uncorrected visual acuity where the odds of compliance were 1.70 (95% CI 1.14–2.53) times greater amongst children with uncorrected visual acuity less than 6/18 in both eyes compared with those with 6/18 or better.[23] A Chinese observational study compared the mean-uncorrected visual acuity scores of children (mean uncorrected visual acuity of right and left eyes) who self-reported that they wore spectacles 'usually', 'sometimes' or 'never'. As in the other studies, there was a statistically significant inverse trend between uncorrected visual acuity and self-reported spectacle wear.[28]

A study in South Africa investigating compliance and various prescribing protocols also reported on lines improvement in VA. There was no significant difference in spectacle wear between children with 0, 1–2 or 3 or more lines of improvement.[18] An RCT in India, which compared ready-made and custom-made spectacles, used two or more lines of improvement in the better-seeing eye as the indication for prescribing. Spectacle wear in both arms of the trial (76% and 74%, respectively, 75% overall) was higher than most other Indian studies.[39]

Socio-demographic factors associated with spectacle compliance

Cost and accessibility of spectacles

The majority of studies examining predictors of spectacle wear provided free spectacles and so factors associated with cost and accessibility were not addressed. Four trials comparing different financing mechanisms have been undertaken, one of which did not have a randomized design. All three randomized controlled trials (RCT) showed that free spectacles significantly improved compliance.

In Tanzania, children in schools randomized to receive free spectacles were almost two and half times more likely to wear their spectacles than in the prescription-only arm of the trial.[20] In another cluster RCT with a factorial design in China, schools were randomized to a prescription only, a voucher for free spectacles, or free spectacles were delivered to the schools. Compliance with spectacle wear was a secondary outcome. Using the prescription only group as the comparator, children issued a voucher or given free spectacles had significantly higher compliance with spectacle wear: voucher; adjusted relative risk 1.44 (95% CI 1.19–1.76) and free spectacles 1.55 (95% CI 1.30–1.85).[8] The RCT in the USA also showed significantly higher compliance among children randomized to free spectacles compared with referral (46% vs 19%).[40] A second study in the USA also investigated the effect of providing free eye spectacles versus referral only: in this study, there was no significant difference in

compliance with spectacle wear, but children were not randomly allocated.[16]

Qualitative studies revealed cost and accessibility to be barriers to spectacle wear when spectacles (or replacement spectacles) were not supplied free of cost at schools. Cost was reported to be a concern amongst most parents in Nigeria, India and minority groups in the USA. Issues such as frequent replacement and lack of use were highlighted in India, while spectacles were considered a luxury in Nigeria, especially for large families.[29,34,36] Parents in rural China did not frequently report cost to be a barrier to spectacle wear – instead, they were more likely to be too busy to buy them; this was also the main reason given by parents for not attending the optometrist in higher socio-economic groups in Nigeria.[29]

One group of children in China discussed cost as a barrier whereas their parents did not,[8] and a study with Indian children reported cost as a barrier in almost one-fifth of participants.[34] Children in Tanzania also felt spectacles were often not affordable and should be freely available to those who could not purchase them.[20]

Access to quality, trustworthy local optical services were raised as a concern by students in Tanzania where distance to the local hospital was a barrier.[20] Parents in the USA reported several issues with accessibility; a lack of services in minority communities with resulting lengthy and costly trips to appointments and difficulty in taking time off work to attend.[36]

Less than half (12/26) of the studies on compliance indicated whether children were offered a choice of spectacle frames, but the majority of studies did not provide details on the selection of frames available. Compliance ranged from 22% to 75% when there was a choice (seven studies), from 21% to 30% when parents bought the spectacles or children used existing frames (three studies), and from 13.4% to 30% when no choice was offered.

Parental level of education

Parental level of education was assessed in nine studies (seven quantitative and two qualitative). Four of the quantitative studies reported no significant difference in spectacle wear by level of parental education.[15,19,26,30] Two studies, in Nepal[32] and India,[24] reported lower levels of spectacle wear with lower levels of parental education. However, in Nepal, this was not supported by any data while the results from India were not adequately described. In a second Indian study[26], compliance was similar amongst children of fathers and mothers educated to secondary level and above (29% and 30%, respectively), but amongst less educated parents, compliance was better amongst poorly educated fathers than mothers (50% and 25%, respectively).

The qualitative studies highlighted a perceived lack of understanding of RE and spectacles by parents in Nigeria and China,[29,30] while parents in minority groups in the USA recognised the short term and long-term benefits of spectacle wear.[36]

Other factors

Thirteen quantitative and six qualitative studies sought children's perspectives on spectacle wear, with the different methodologies sometimes giving different findings. Overall, the main reasons why children did not wear their spectacles can be categorized as follows: being teased and/or bullied,[11,28,34,41–43] they did not like their spectacles,[26] they were lost or broken,[11,21,40,44] they forget to wear them,[17,40,43,44]

Table 3. Four most common-reported reasons for spectacle non-wear in children.

			% children reporting a reason for non-wear			
Study	Country	Sample size	Lost/Broken	Bullying/Teasing	Headaches/ Eyestrain	Parental Disapproval
Castanon Holguin[8]	Mexico	493	14.0	16.6	6.1	1.6
Congdon[12]	China	376	5.3	3.2	6.4	Not reported
Khandekar[13]	India	15	20.0	Not reported	20.0	6.7
Yabumoto[a15]	Brazil	25	40.0	Not reported	64.0	Not reported
Messer[20]	USA	165	80.2	Not reported	Not reported	Not reported
Gogate[22]	India	718	26.7	19.8	7.4	2.2
Aldebasi[23]	Saudi Arabia	422	11.1	4.0	3.6	30.3
Dhoble[43]	India	242	Not reported	Pretest 36%, post-test 22% (p = <0.001)[b]	Not reported	Not reported
Pavithra[24]	India	35	25.7	5.7	8.5	11.4
Von-Bischhoffshausen[25]	Chile	83	27.7*	2.4	6.0	Not reported
Bhandari[29]	Nepal	122	46.7	6.5	8.2	3.2
Huang[a31]	USA	Not reported	Not reported	20.2	Not reported	Not reported
Bhatt[32]	India	122	16.4	31.1	5.7	0.0

[a]Abstract only [b]Before and after a one group health education intervention *Calculated by the authors.

parental disapproval,[34,43] and misconceptions that using spectacles would make their vision worse.[17,20,28]

In the quantitative studies 'lost or broken spectacles' was often the commonest reason for non-wear (Table 3), but the proportion varied between studies (5.3% to 80.2%). However, concerns about lost or broken spectacles, and headaches or eye strain were not raised by children in the qualitative studies.

In the Tanzanian study, different findings were reported in the quantitative and qualitative components of the study. In the survey, less than 10% of students reported being teased, but in the focus group discussions most students described negative experiences and some degree of bullying.[33] Three qualitative studies with children in India also reported teasing to be an important reason why they did not wear their spectacles.[31,34,35] In contrast, children in the USA who did not need spectacles did not have negative opinions of their spectacle wearing peers, perceiving them to be more intelligent.[37] Studies in Nigeria[29] and China[30] did not report any teasing or bullying.

In the quantitative studies parental disapproval was the least frequently reported reason except in Saudi Arabia, where 30% of non-compliant reported this as a reason. Parental disapproval was voiced as a barrier to spectacle wear by children in qualitative studies in Nigeria and Tanzania,[29,33] and in India, children reported that parents did not believe that they had vision problems or needed spectacles and preferred to ignore the problem (two studies).[31,35]

Discussion

This review reports the findings from 25 studies which were undertaken in 11 countries, 20 more than in the earlier review.[10] There were a range of study designs, and most only reported a few of the outcomes of interest. Heterogeneity in the definition, measurement and reporting of compliance with spectacle wear precluded a meta-analysis, and the small number of studies reporting each of the outcomes of interest limits generalizability of the findings.

How spectacle compliance was defined (wearing and/or carrying) varied between studies, as well as in relation to the time interval between dispensing the spectacles and assessment (1–12 months), and how compliance was assessed (observed or self-reported). There is a need to standardize all aspects of the assessment of compliance so that the effectiveness of interventions can be compared across settings. To avoid response bias, which is likely to be a particular problem in children, we would recommend direct observation at unannounced visits, where resources allow, several months after the spectacles are dispensed, with compliance being defined as spectacles being worn or the child having them at school. However, in some settings child protection policies and data privacy issues might restrict this approach. While we found no instances of their use, innovations such as motion and temperature sensors would provide more reliable measures of spectacle compliance and might be more acceptable in some settings.[45,46]

The evidence suggests that higher levels of uncorrected RE and lower uncorrected visual acuity are associated with higher levels of spectacle wear, which is to be expected as these factors are highly correlated. However, there was variability in how the degree of RE and the level of uncorrected visual acuity were reported, e.g., as a continuous variable or using different cut-off values. A factor likely to lead to behaviour change – the degree of improvement in VA with correction in the better eye – was rarely reported. Several studies suggest an improvement of two or more lines of VA in the better-seeing eye to define children in need of refractive correction,[17,39,47] and there seems to be an emerging consensus that prescribing in low resource settings should be based on improvement of VA rather than the degree of RE.[48] Prescribing guidelines, which include the management of children with uncorrected anisometropia or hyperopia, have the potential to reduce over-prescribing for simple myopia,[48] and would improve the cost-effectiveness of programmes and reduce out-of-pocket expenditure for parents.

There is some evidence that children become less compliant with spectacle wear with increasing age which was not consistent across settings. Younger and older children may have different motivations or drivers for wearing their spectacles, which requires different strategies by age and context.

Addressing the socio-demographic reasons for non-compliance is more complex as they are context specific and require interventions for children who require spectacles, their classmates who do not, as well as teachers, parents, other family members and the community.[49] The engagement of all these groups is important to ensure behaviour change.

Some quantitative studies indicated that girls were more likely to be compliant with spectacle wear than boys, possibly because girls are more responsive to authority figures.[50,51] However, qualitative studies in some settings highlighted the additional challenges faced by girls who need to wear spectacles, which reflect parental concerns arising from cultural attitudes.

Creating behaviour change is challenging and requires a deep understanding of the cultural context. An RCT of educational interventions to promote

spectacle wear among children in rural China did not demonstrate any effect, highlighting the difficulty of creating behaviour change.[22] It is not enough to embed generic health education within school eye health programmes, as health education interventions need to be developed bearing in mind local cultural and gender norms, and the concerns of parents.

There is some evidence that the lower the level of parental education the lower the compliance, but this is not consistent. Parental disapproval and misconceptions were also identified in some studies, as were teasing and bullying of children by their peers. However, these are sensitive issues which may not have been expressed if reasons for non-compliance were elicited by inadequately trained interviewers, and may not have been included in questionnaire-based assessments. Qualitative methods are recommended to better understand the social and cultural reasons for non-compliance, and the findings used to design health education strategies. Health education including parents, children who do and who do not need spectacles, and teachers may be more effective.

Although no studies specifically investigated the effect of frame choice on compliance, one study which did not offer a choice of frame, to facilitate easier distribution, reported particularly poor spectacle wear.[11] It could be hypothesised that allowing children to choose their own frame from a cosmetically acceptable range may improve compliance through a greater sense of ownership and satisfaction with their appearance.

The provision of good quality, acceptable spectacles at an affordable price is; therefore, essential and the most appropriate options should be determined by preliminary qualitative research. Provision of free spectacles may not be appropriate for every setting and this should be determined before implementing a programme. If a child loses or breaks their spectacles mechanisms for replacement must be put in place to ensure access to spectacles.

However, there is evidence that spectacle compliance can be low in all the settings where this has been studied, and that compliance is lower amongst boys, older children and those with mild RE and better uncorrected visual acuity in these contexts. There is also some evidence that socio-cultural attitudes also influence compliance, which is likely to vary by context, and there is need to assess the biomedical and socio-demographic factors which affect compliance with spectacle wear in a wider range of settings. To make studies undertaken in low resource settings comparable, standard indications for prescribing are recommended, as improvement in best corrected visual acuity is an important determinant of compliance, and we recommend improvement in VA in the better eye with correction for children with simple myopia rather the degree of RE. Qualitative research with several participant groups is recommended in order to understand the socio-ecological context[49] by exploring the attitudes, practices and behaviour of unaffected children, affected children and their parents, teachers, eye care services providers, members of the community and policymakers responsible for the health and eye health of children in schools. Given the different roles of fathers and mothers in child care and household decision-making, particularly in low-income settings, ideally, mothers and fathers should be interviewed separately. Findings from these studies could be used to design a package of comprehensive behaviour change interventions tailored to the local context.

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