

Spectacle compliance amongst rural secondary school children in Pune district, India

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Background: Refractive errors (RE) are the most common cause of avoidable visual impairment in children. But benefits of visual aids, which are means for correcting RE, depend on the compliance of visual aids by end users. **Aim:** To study the compliance of spectacle wear among rural school children in Pune district as part of the *sarva siksha abhiyan* (education for all scheme) after 6 - 12 months of providing free spectacles. **Settings and Design:** Cross-sectional follow-up study of rural secondary school children in western India. **Materials and Methods:** The students were examined by a team of optometrists who collected the demographic details, observed if the child was wearing the spectacles, and performed an ocular examination. The students were asked to give reasons for non-wear in a closed-ended questionnaire. **Statistical Analysis:** Chi-square test and multiple logistic regression used for data analysis. **Results:** Of the 2312 students who were dispensed spectacles in 2009, 1018 were re-examined in 2010. 523 students (51.4%) were female, the mean age was 12.1 years 300 (29.5%) were wearing their spectacles, 492 (68.5%) students claimed to have them at home while 211 (29.4%) reported not having them at all. Compliance of spectacle wear was positively associated to the magnitude of refractive error ($P < 0.001$), father's education ($P = 0.016$), female sex ($P = 0.029$) and negatively associated to the visual acuity of the better eye ($P < 0.001$) and area of residence ($P < 0.0001$). Of those that were examined and found to be myopic ($N = 499$), 220 (44%) wore their spectacles to examination. Factors associated with compliance to spectacle usage in the myopic population included increasing refractive error ($P < 0.001$), worsening visual acuity ($P < 0.001$), and higher academic performance ($P < 0.001$). The causes for not wearing spectacles were 'lost spectacles' 67(9.3%), 'broken spectacles' 125 (17.4%), 'forgot spectacles at home' 117 (16.3%), 'uses spectacles sometimes' 109 (15.2%), 'teased about spectacles' 142 (19.8%) and 'do not like the spectacles' 86 (12%). **Conclusion:** Spectacle compliance was poor amongst school children in rural Pune; many having significant vision loss as a result.

Key words: Refractive errors, school eye health, spectacle compliance, visual aids

Uncorrected refractive errors are the commonest cause of visual impairment in school children in most parts of the world including India,^[1,2] Nepal,^[3] China,^[4] and Chile.^[5] Refractive error can be easily and cheaply corrected by a simple pair of spectacles, but only when they are worn. If the child does not wear the spectacles, the efforts to correct refractive errors are not effective. Hence, every effort should be made to remove obstacles to spectacle availability and wear.

The proportion of children who would benefit from spectacles correction and yet do not own or wear glasses has been found to be high in studies conducted in China,^[6,7] Tanzania^[8] and Mexico.^[9] This is despite evidence that provision of spectacles improves vision-related quality of life in adults,^[10] and self-reported visual function in children.^[11] Although peer pressure and misconceptions about spectacle wear have been documented causes of non-wear,^[8,9] there are few studies from India about spectacle compliance and reasons of poor compliance.^[12]

India has one of the largest populations of school children in the world. The union government has launched the *Sarva Siksha Abhiyaan* (SSA - education for all) scheme in 2001 to improve school attendance and to make it universal.^[13] Accordingly, the local government (*Zilla Parishads*, ZP) of each of the country's 600 districts have arranged for visual acuity assessment of ZP school students.

While refractive errors are less common amongst rural than urban children, rural children have lesser access to refractive services.^[1,2] Our study aimed to find the compliance of spectacle wear among secondary school children in rural areas of Pune district who were dispensed free spectacles, 6 months to 1 year prior to this study under the SSA through the district blindness control society (DBCS) and ZP. The study proposed to identify the cause for non-wear in order to improve compliance in future.

Materials and Methods

The study was approved by the ethics committee of Bharati Vidyapeeth Medical College. A list of all the rural school children who had been examined and dispensed spectacles the previous year was collected from the department of education of the Pune ZP. Permission was obtained from the respective authorities, and the major stakeholders (ZP education and health officers and the ophthalmic officers of DBCS who had performed the refraction and dispensed the spectacles) were briefed about the study. The rural Pune district had

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58,924 students studying in ZP-run secondary schools, 29,829 (50.6%) of whom were boys. Amongst these, 56,827 students were examined for refractive error under the SSA, outside the municipal limits of the Pune metropolitan area in 2009; and 2378 (4.2%) students were found to have a refractive error requiring correction, which was defined as myopia $\geq -0.50D$ or hyperopia $\geq +1.00D$. Of these, 2312 (97%) students had been dispensed spectacles. This was similar to results from an earlier study in the same geographic area.^[14]

A closed-ended questionnaire was prepared with demographic details, details of visual examination and the students' perception of spectacles. The questionnaire was first piloted in a rural school near Pune. It was translated into Marathi, the regional language, and then back translated into English to check for validity by 2 independent translators. The final format was kept bilingual to accurately assess the responses and to allow examiners and data entry operators to code the responses with minimal error.

A sample size of 1000 subjects was required to estimate a prevalence in spectacle compliance of 35% with an absolute precision of $\pm 4\%$ for its 95% confidence limits, after adjusting for a response rate of 85% and a design effect of 1.5 due to cluster sampling. The sampling strategy involved the random selection of 7 of the 14 sub districts of the rural Pune district. Of these 7 sub-districts (*talukas*), 100 schools were randomly selected. Within the selected schools, every child who was given glasses last year was examined. The team comprised of 2 qualified optometrists and an ophthalmic assistant. The team was briefed about the study and trained for visual estimation and completing the questionnaire.

The schools were visited without prior intimation to the students, and the field staff checked if students were wearing the spectacles. If they were found not wearing the spectacle, they were questioned about the whereabouts of spectacles (in the schoolbag, at home or did not have them at all). They were also asked about the reasons for non-wear and as to when they last used the spectacles. The visual acuity of each eye was checked using the Snellen's chart with (if wearing) and without spectacles. The students' answers about parental education and occupation were re-confirmed with the teachers.

The study was carried out in February-March 2010. The spectacles had been dispensed a year earlier, in February-March 2009 or in June-August 2009.

Compliance to spectacle usage was recorded in a binary format. Compliance rate was reported as percentages. Factors associated with compliance were analyzed initially using Chi-square test, and those found to be significant were included in a multiple logistic regression. Strength of association was described using odds ratio and its confidence limits with a level of significance set at 5%.

Results

Within the sampling frame of the study, 1035 students were identified from 102 schools. Of them, the study team examined 1,018 (98%) students. The remaining 17 students were absent on the day of examination. The sample comprised of 495 (48.6%) boys. The mean age of the children was 12.1 (range 8 - 16 years).

Only 300 students were using their spectacle at the time of the examination. The rate of compliance with wearing

spectacles in rural students of Pune district was 29.5% (95% CI: 26.7% - 32.3%). Of the 718 students not wearing their spectacles at the time of the visit, 15 (2.2%) had the pair of glasses in their bags, 492 (68.5%) claimed to have them at their home while 211 (29.4%) reported not having them at all.

Demographic factors associated with non-compliance are described in Table 1. A significantly higher proportion of boys (365, 73.7%) were not wearing their spectacles compared to girls (353, 67.5%, $P = 0.029$). Spectacles non-compliance was significantly related to lack of education in the father ($P = 0.016$) but not in the mother ($P = 0.08$) nor with father's occupation ($P = 0.232$). It was observed that the maximum non-compliance rates were with children whose fathers were illiterate. The non-compliance rate was significantly higher among students hailing from schools in larger villages or small towns (81%, $P < 0.001$) compared to students from schools in small villages (63.8%). Non-compliance was not related to age of the students ($P = 0.058$), but older children were slightly more non-compliant.

Amongst the 1018 students, the team could refract 912

Table 1: Association of demographic factors and non-compliance of spectacle wear

	Compliant (%)	Non-compliant (%)	Total	P value
Gender				0.029
Boys	130 (26.3)	365 (77.3)	495	
Girls	170 (32.5)	353 (67.5)	523	
Age				0.058
8-10 years	9 (56.3)	7 (43.7)	16	
11-13 years	270 (29.2)	656 (70.8)	926	
14-16 years	21 (27.6)	55 (72.4)	76	
Place				<0.0001
Small villages	224 (36.2)	394 (63.8)	618	
Large villages/ towns	76 (19.0)	324 (81.0)	400	
Father's education				0.016
Post-graduate	8 (44.4)	10 (55.6)	18	
Graduate	13 (31.7)	28 (68.3)	41	
Higher secondary	47 (39.5)	72 (60.5)	119	
Secondary	149 (26)	424 (74)	573	
Primary	54 (30.8)	24 (69.2)	78	
Illiterate	10 (20)	40 (80)	50	
Unknown	49 (35.3)	90 (64.7)	139	
Mother's education				0.08
Post-graduate	3 (60)	2 (40)	5	
Graduate	5 (27.8)	13 (72.2)	18	
Higher secondary	23 (38.3)	37 (61.7)	60	
Secondary	156 (28.8)	385 (71.2)	541	
Primary	58 (24.1)	183 (75.9)	241	
Illiterate	4 (30.7)	9 (69.2)	13	
Unknown	51 (36.4)	89 (63.6)	140	
Father's occupation				0.232
Self-employed	35 (28.2)	89 (71.8)	124	
Farmer	151 (27.6)	396 (72.4)	547	
Service	114 (32.8)	233 (67.2)	347	

students to ascertain their refractive error. The refractive power was found to be different in 577 children. Amongst the 912 re-refracted, 499 had myopia of $> -0.5D$ while 8 had hyperopia of $+0.75 D$ or more and 405 were defined as emmetropic (had myopia of $< -0.5 D$, but had been dispensed spectacles last year). 279/499 (55.9%) myopes, 2/8 (25%) hypermetropes and 341/405 (84.2%) emmetropes were non-compliant to spectacle wear. Tables 2A and B shows the median, mean and standard deviation of the refractive errors based on the worse and better eye, respectively. Cylindrical powers were adjusted to spherical equivalents for analysis. The greater the refractive error, the greater was the spectacle compliance ($P < 0.001$) amongst the 499 myopes [Table 3]. Similarly, compliance was higher with worse visual acuity in myopes ($P < 0.001$) as shown in Table 3. Children who had unaided visual acuity $\geq 6/18$ were less likely to wear their spectacles while those with vision $\leq 6/60$ were more likely to use them. 77 (28%) of those tested who were non-complaint (279) had visual acuity of 6/24 or less in their better eye. Among the myopes, the mean academic performance of spectacle wearers (compliant ones) was 65% (SD 11) in the last exam, compared to 61% (SD 11) amongst the non-compliant ones ($P < 0.001$).

Visual acuity, spherical equivalent, age, gender and academic performance were included as factors in a multiple logistic regression where compliance was the outcome variable, which was recorded in a binary format (1 = compliant and 0 = non-compliant). The results are described in Table 4. Similar to the univariate analysis, worsening visual acuity, higher spherical equivalent, and higher academic performance was associated with a higher probability of being compliant with

spectacle usage. A linear, directly proportional relationship was found between the probability of complying with spectacle usage and poorer visual acuity. A similar pattern was detected between compliance and increasing spherical equivalent.

The chief causes for non-wear are shown in Fig. 1. As children were allowed to choose more than one alternative, the percentages are more than 100. 344 (47.9%) of the students used their spectacles 7 months to 1 year ago while 141 (19.6%) children had not worn the spectacles since last 6 months to 3 months, 105 (14.6%) had not used them since last 2 months while 64 (8.9%) had worn them in the last month and 64 (8.9%) in last week. Table 5 shows the correlation between cause of non-wear and the time the children last used the spectacles.

When asked about their attitude towards spectacles, 1,010 (99.2%) students had a positive attitude to spectacle wear in general; only 8 (0.8%) students were of the opinion that spectacle wear was not good for the eyes. But, 498 (48.9%) students were not happy with the quality of spectacles that had been given to them.

Discussion

The compliance to spectacle wear was only 29.5% amongst the rural secondary school children and compared with 19.5%

Table 2A: Refractive errors amongst the examined school children based on worse eye

Refractive error	Based on worse eye					
	N	Mean	SD	Minimum	Maximum	Median
Myopes	499	-1.63	1.83	-14.00	-0.63	-1.00
Emmetropes	405	0.24	0.26	-0.50	0.50	0.25
Hyperopes	8	3.67	3.02	0.75	8.00	3.06
Total	912	-0.96	1.61	-14.00	8.00	0.75

Table 3: Distribution of compliance in the myopic sample

Variable	Vision	Non-compliant		Compliant		Total	P value
		N	Row %	N	Row %		
		Visual Acuity Without Correction	6/6 - 6/9	40	71.4		
	6/12 - 6/18	162	60.4	106	39.6	268	
	6/24 - 6/60	66	51.6	62	48.4	128	
	6/60 - 3/60	10	30.3	23	69.7	33	
	<3/60	1	10.0	9	90.0	10	
Spherical Equivalent	-0.5 to -1.9	247	61.9	152	38.1	399	< 0.001
	-2.0 to -3.0	22	42.3	30	57.7	52	
	-3.1 to -5.9	6	26.1	17	73.9	23	
	≥ -6	4	16.0	21	84.0	25	
Academic performance		61 \pm 11%		65 \pm 11%			< 0.001

Table 2B: Refractive errors amongst the examined school children based on better eye

Refractive error	Based on better eye					
	N	Mean	SD	Minimum	Maximum	Median
Myopes	499	-1.42	1.77	-14.00	0.00	0.75
Emmetropes	405	0.20	0.26	-0.50	0.50	0.00
Hyperopes	8	3.08	3.25	0.00	8.00	1.50
Total	912	0.84	1.52	-14.00	8.00	0.50

Table 4: Factors associated to compliance in the myopic sample using logistic regression

Factor	Category	P value	Odds Ratio	95% Confidence Limits	
				Lower	Upper
Vision without correction	6/6 - 6/9	Reference			
	6/12 - 6/18	0.123	1.7	0.9	3.4
	6/24 - 6/60	0.041	2.2	1.0	4.6
	6/60 - 3/60	0.034	3.8	1.1	12.7
	< 3/60	0.135	6.2	0.6	67.2
Sph_Eq.	≥ -6	0.038	4.0	1.1	15.2
	-3.1 to -5.9	0.058	3.0	1.0	9.2
	-2.0 to -3.0	0.033	2.3	1.1	5.1
Gender	-0.5 to -1.9	Reference			
	Males	Reference			
	Females	0.244	1.3	0.8	1.9
Age	Per 1 year increase	0.926	1.0	0.8	1.2
Academic performance	Per 1 % increase	< 0.001	1.0	1.0	1.1

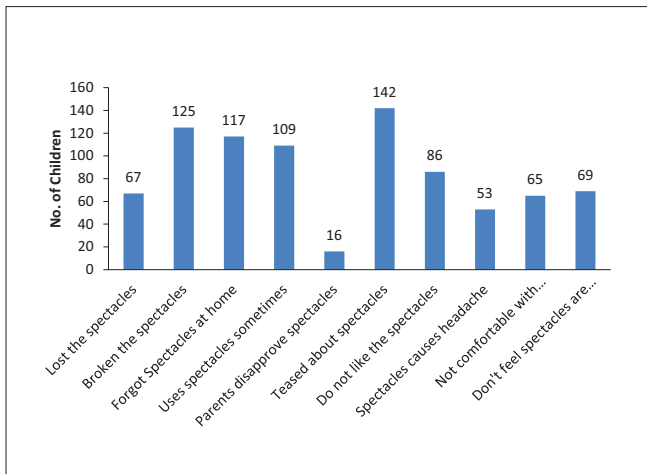


Figure 1: Causes for non-wear of spectacles

compliance from rural central India,^[12] 13.4% from Mexico,^[9] 30% from Baltimore USA^[15] and 37.7% from rural China.^[6] The compliance may have been low due to the surprise check as only those actually wearing the spectacles at the time of the visit were termed compliant. Therefore, this accurately gauged non-compliance. But, the free spectacles provided by ZP and DBCS were not used by most children.

The study has some limitations. Only ZP's program in 1 rural district was studied. The study excluded children who were out of formal schools and those in unaided and private schools. Hyperopia may have been underestimated as cycloplegic refraction, was not done on all children. The causes for non-wear were reported by the students who were around 10 to 12 years of age. We had to believe the child's word when they reported that they had the spectacles at home and also when they reported that they lost them.

We found boys to be more non-compliant in wearing spectacles, similar to observations from Mexico,^[9] Oman,^[16] and China.^[6] Perhaps it could be that the spectacles make the face look more studious and made the child stand out in the class, which may be more acceptable to girls. Or perhaps boys were engaged in more outdoor sports in rural areas. 15 children had their spectacles in the school bag, therefore, there was some parental pressure to use the pair of spectacles, but the children were not enamored about wearing them. 15.2% children not wearing the spectacles at the time of the visit, nonetheless, reported using them sometimes. This was akin to results from rural China where more than half the students reported that they used the spectacles occasionally or for special occasion.^[6]

These spectacles had been distributed 1 year ago, a shorter duration after dispensing may have shown a higher figure of compliance, but nearly half of the children who were not wearing the spectacles did not use them for more than 6 months. In most villages, the children and their parents had no access to refractive correction services; in case the child lost or broke his spectacles, it would be very difficult to get a replacement.

A Tanzanian study demonstrated that spectacles dispensed free of cost, as it under SSA, were used less as compared to those in which the recipients paid for them.^[17] A study from Mexico

Table 5: Causes of non-wear correlated with the time when spectacles were last worn

Causes	Spectacles worn in last 3 months		Spectacles worn before 3 months to 1 year		Total	
	#	%	#	%	#	%
Lost the spectacles	21	6.4	46	8.8	67	7.9
Broken the spectacles	44	13.5	81	15.5	125	14.7
Forgot spectacles at home	56	17.2	61	11.7	117	13.8
Uses spectacles sometimes	55	16.9	54	10.3	109	12.8
Parents disapprove spectacles	3	0.9	13	2.5	16	1.9
Teased about spectacles	55	16.9	87	16.6	142	16.7
Do not like the spectacles	25	7.7	61	11.7	86	10.1
Spectacles causes headache	15	4.6	38	7.3	53	6.2
Not comfortable with spectacles	27	8.3	38	7.3	65	7.7
Don't feel spectacles are needed	25	7.7	44	8.4	69	8.1

observed that older children were less likely to be complaint than younger ones as it was in this study, but the difference was not statistically significant.^[9] This was in variance with results from rural China where older children were less likely to be non-compliant to spectacle wear.^[6]

Children with less educated parents were more likely to be non-compliant to spectacle wear. Surprisingly, the effect of father's education was more pronounced than that of the maternal parent. This may be due to a patriarchal society or educated women having equal or more educated husbands. Children who were non-compliant with spectacles had an average academic score lesser than their compliant peers. But, there could be confounders for this, like more inclination and aptitude for studies amongst the compliant students, or even some studies have co-related myopia with higher measured IQ. Complaint students were also more highly myopic.

Children from larger villages or small towns were more non-compliant than those from smaller villages. Cosmetics may be less of an issue in small villages, or the teachers may have more authority, and there would not be any other refractive service available. In larger villages and small towns, children could be choosier about their spectacles.

A Mexican study also found the chief causes of non-wear to be lost/broken spectacles (14.0%), teased about spectacles (16.6%), forgot spectacles at home (16.6%) and used occasionally for special occasions (14.2%) like this study.^[9]

Another reason for non-compliance may be because no choice given to child while dispensing the spectacles. A one size fit all strategy was used. Children spectacle frames are not just miniature of adult frames, their esthetics (color, size,

design) and needs are different, and do matter to even rural children. Also, something that was given free, like spectacles, was perceived as having very less value. The round 'Harry Potter' style frames may be popular in urban areas but were associated with 'Gandhiji style' spectacles in rural areas. They may be associated with old age and ancient things and were thus unfashionable amongst the students. The children were not happy about the quality of spectacles provided, they were certainly 'ordinary'. The fitting and centration could have been better, which may have contributed to the complaints of discomfort and headache.

The children wearing spectacles were likely to be teased by peers as was seen in the Avon longitudinal study of parents and children in UK.^[18] The study found that more than a third (37%) of children wearing glasses reported that they had been subjected to verbal and some even to physical abuse. In this study, 'teased by other children' was the single most common cause of non-wear, similar to results from Mexico and Tanzania though it was reported by only 1/5th of the children.^[8,9]

Small refractive errors (< 1.0D) might not be corrected as the children have reasonable uncorrected visual acuity and do not use the spectacles as much though 25% in the -0.50D to -1.9D category were compliant, and their myopia is very likely to increase.^[19] A balance has to be struck between unnecessarily concerning parents and the child feelings of guilt for not wearing spectacles, cost and the benefits of getting used to spectacles as a vision aid – a need that will certainly increase in such children. However, some program managers dispense more spectacles as they consider it a sign of success, with budgets spent and targets over-achieved. The program managers should also educate teachers, parents and even children, wherever possible, about the benefits of spectacle wear as that would improve compliance of wear.

In conclusion, while the free spectacle program within the rural districts of Pune ensured the accessibility to spectacle correction to school children, the compliance to wear was poor. The effectiveness of this program can be improved by providing a greater choice of spectacle frames, educating the benefits of correction to students and their parents and involving the teachers to improve compliance. Success of such programs should account for compliance and not just the delivery of spectacles only. 40% children were not compliant because they were teased about, did not like, or were not comfortable in their spectacles – all societal issues that could and should be addressed.

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