Lag in optimal optical correction of urban elementary school students in Taiwan

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Abstract: The occurrence of the lag in optimal optical correction was investigated in three geographically different urban elementary schools in Taiwan. The results showed that among the schools in Tamsui (N=606), Taichung (N=702), and Tainan (N=586), Tainan had the highest proportion of students with correction (47.9% of all students), followed by Taichung (26.2%), and Tamsui (20.8%). Tamsui appeared to have the most lag in optimal correction: 55.3% needed further correction, yet only 20.8% had been corrected, or a lag of 34.5%. In contrast, the lag in Tainan and Taichung was 16.3% and 28.9%, respectively. Based on linear regression analysis, the lag or unmet needs could result in the worsening of myopia. To reduce the lag, follow up with the parents after student vision screening was supplemented with public health education or direct provision of any optical devices to the students.
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1. Introduction

Annual vision screening is a mandated physical exam for Grades 1 through 6 in all elementary schools in Taiwan. It is usually conducted in a basic mode, i.e., measurement of visual acuity, often supplemented with color vision test and body height and weight determinations. The screening is performed by school nurses and assisted by teachers. The results are then communicated directly to the parents with re-commendation for further action, if warranted.

Indeed, the principal purpose of vision screening is for a timely correction of significant refractive error. It is not known, however, as to what extent this has been accomplished. There is now evidence from studies conducted in China of an unmet need for vision correction in both urban and rural areas [1-4]. The barriers included parental unawareness, neglect, and economical hardship. Even in low myopia prevalence areas, there is also an unmet need, and the rate is higher among urban than rural children [5-8], made worse by a long-held mistaken belief that spectacle-wear can further cause myopic progression [9].

To examine the extent of the lag, its prevalence, and the possible underlying factors, a survey of three geographically separate urban elementary schools in Taiwan was conducted, and the results reported here.

2. Material and Methods

2.1 Methodology

Students from three urban schools from the north to the south of Taiwan were selected. The location of these schools and the number of participating students (N) were Tamsui: 25°00′40″N; 121°26′45″E, and N=606; Taichung: 24°8'35"N; 120°40'37"E, and N=702; and Tainan: 23°1'29"N; 120°10'5"E, and N=586. These schools belonged in the same educational system with similar didactic and physical education hours, and vacation times.

Prior to the start of the study, informed consent was obtained from the parents. The mode of current myopia correction, including spectacles, contact lenses, and night-wear orthokeratology lenses, was reported in a questionnaire, also completed by the parents. This information was further verified on site during screening.

Vision screening was performed and completed within 4-5 school days in each school with the methodology established previously [10,11]. Relevant to the present study, the following were conducted: (1) for preliminary testing, non-cycloplegic refraction with an autorefractor (Nikon, Speedy-1, Japan) recorded in the minus cylinder form; (2) lensometric determination of current spectacle correction; and (3) confirmation of current refractive error with (i) distance retinoscopy followed by (ii) subjective refraction - all in the minus cylinder form. These procedures were performed by 3rd and 4th year optometry students under the supervision of faculty members.

Myopia that needed correction was defined as having a refractive error of -1.00D or worse based on

the best correctable spherical equivalent (defined as the spherical correction plus ½ of the minus cylindrical correction) from the final subjective refraction. Previous refractive error at the time of screening was determined from current optical correction and a difference of equal to or worse than -1.00D spherical equivalent was regarded as that needing further, new correction.

2.2 Statistical analysis

Linear regression analysis of the unmet needs for correction and the best correctable spherical equivalent was performed with SPSS 18 package.

3. Results

3.1 Characteristics of current correction:

First, the three schools showed a disparity in the current modes of correction, with the school in Tainan having the highest use of optical correction in all three categories: spectacles, contact lenses, and orthokeratology lenses. Not surprisingly, spectacles remained the principal corrective device followed by orthokeratology lenses and conventional contact lenses. The results are shown in Table 1.

These results also represented the rate of optical correction before the vision screening. It appeared that the school in Tainan had the highest proportion of students with correction (47.9% of all students), followed by Taichung (26.2%), and Tamsui (20.8%).

Table1 : Modes of current myopia correction in the three elementary schools in Taiwan.

Location		Correction mode				Total
		None	Spectacles	Contact lens	Ortho-k lens	
Tamsui	N	480	122	0	4	606
	%	79.2	20.1	0	0.7	100
Taichung	N	518	179	2	3	702
	%	73.8	25.5	0.3	0.4	100
Tainan	N	305	252	6	23	586
	%	52.0	43.0	1.0	3.9	100
Total	N	1303	553	8	30	1894
	%	68.8	29.2	0.4	1.6	100

3.2 Unmet corrective needs:

After the screening and based on the -1.00D spherical equivalent threshold, students were divided into two categories: (1) those with no need for correction or with already adequate current correction; and (2) those who required correction or new correction. The results are summarized in Table 2.

Table2 : Unmet needs for optical correction in the three schools in Taiwan.

Location		No further needs	Correction needed	Total
Tamsui	N	271	335	606
	%	44.7%	55.3%	100.0%
Taichung	N	315	387	702
	%	44.9%	55.1%	100.0%
Tainan	N	210	376	586
	%	35.8%	64.2%	100.0%
Total	N	796	1098	1894
	%	42.0%	58.0%	100.0%

The school in Tamsui appeared to have the most lag in optimal correction: 55.3% of students needed either correction or further correction, yet only 20.8% of them had been corrected (cf Table 1), or a 34.5% lag. A similar lag was also found in the other two schools; much less so in Tainan (64.2% needed further correction vs 47.9% already corrected, or a 16.3% lag) and slightly less, a 28.9% lag in Taichung (26.2% already corrected vs 55.1% still needed further correction).

3.1 Linear regression analyss

Furthermore, the needs for correction and additional correction could predict the increase in best correctable spherical equivalent, or worsening of myopia, of up to 47.2% (Tamsui), 43.9% (Taichung), and 47.7% (Tainan) (see Table 3, Adjusted R^2):

Table3 : Linear regression of corrective needs and best correctable spherical equivalent.

Location	R	R^2	Adjusted R^2
Tamsui	0.687	0.473	0.472
Taichung	0.663	0.439	0.439
Tainan	0.691	0.477	0.477
Location	**Standard error of estimation**	**F Change**	**Sig of F Change**
Tamsui	1.17148	541.152	0.000
Taichung	1.42149	548.510	0.000
Tainan	1.45918	533.572	0.000

4. Discussion

These results suggest that the lag of optimal correction or the unmet need for correction in the three schools located in geographically different

areas in Taiwan (Tables 1 and 2) is representative of the widespread extent of this lag. In addition, it also raises the issue that the purpose of routine vision screening, i.e., for a timely correction, was, in fact, not achieved.

The goal of a full 100% correction rate at any given time is impossible to reach, owing to the nature of school myopia which progresses at different rates for individual students. Other factors may contribute to the lag, chief among them maybe economical concern and lack of understanding of myopization.

It is possible that since the least lag was observed in the more affluent school in Tainan, as evidenced by the high rate of orthokeratology correction, economic concern can be important. However, it does not seem that this is universally true, as the lag was also seen in other well-supported societies in different parts of the world [12-14].

More important, the parents must be educated to dispel the commonly accepted myths, some of which are, for example, that spectacle-wear further worsens myopia [9], that deliberate under-correction can retard the progression, and that, by extension, less wear time is beneficial for the control of myopia. Our analysis has shown otherwise; in fact the unmet needs may further cause an increase in myopia (Table 3), in support of previous other studies [15,16].

To reduce the lag, some measures can be readily implemented. For example, the screening results can and must be followed up, after informing the parents, to ensure the remedial action is, in fact, taken. The most effective way of maximally reducing the lag maybe a direct provision of spectacles and/or contact lenses to the students through a system of school-based vision care providers.

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