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An Intervention of Acupressure and Interactive Multimedia to Improve Visual Health Among Taiwanese Schoolchildren

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ABSTRACT ***Objective:*** Myopia is a significant health issue but it can be alleviated and prevented by several interventions. This study aimed to construct an intervention of acupressure and interactive multimedia for visual health and to evaluate the effect of its application on schoolchildren. ***Design:*** A pre-posttest experimental research design with a control group was used. The experimental group received a 15-week visual health intervention, whereas the control group received none. ***Sample:*** 70 children with visual impairment were recruited from 1 elementary school in Taipei, Taiwan. ***Measurements:*** The data of demographic factors, visual health knowledge, visual acuity, and refractive error were collected before and after the intervention. ***Results:*** After the intervention, the experimental group demonstrated improvements in visual health knowledge, visual acuity, and refractive error. ***Conclusions:*** The outcomes of using the intervention seemed to be promising, but broader studies exploring its effects on children in different school years as well as its longitudinal effects are required.

Key words: acupressure, multimedia, myopia, refractive error, traditional Chinese medicine, visual acuity, visual health.

Myopia, derived from the Greek word *myōpia*, meaning nearsightedness, is a vision condition called *neng-jin-chiue-yuan* (clear in the nearness but blurred in the remoteness) in traditional Chinese medicine (TCM). There are two types of myopia, simple (or axial) myopia and pathological (or refractive) myopia. The former is associated with the length of the eye, whereas the latter refers to a condition with increased refraction of cornea and crystalline lens. As the prevalence of simple myopia increases, the incidence of pathological myopia may also increase. The burden of myopia is particularly large in some East Asian countries (Chung, Mohidin, Yeow, Tan, & O'Leary, 1996; Edwards & Lam, 2004; Lin et al., 2001; Saw, Katz, Schein, Chew, & Chan, 1996). According to epidemiological evidence, the prevalence of myopia among students 7–15 years old in Taiwan has increased from 10% to 60% in the past five decades (Chen, 1997). In particular, among 12-year-old students, the proportion of myopia rose from 36.7% in 1983 (Lin, Shih, Chen, & Hung, 1983) to 60.7% in 2000 (Lin et al., 2001). In the United States, the prevalence of myopia was 25% in 1971–1972 (Sperduto, Seigel, Roberts, & Rowland, 1983) and 25.4% in 1999–2000 (Kempen et al., 2004). Thus, the issue is worse in Taiwanese schoolchildren than in Western ones (Robaei et al., 2005; Shin et al., 2005). This phenomenon may be strongly associated with a parental history of myopia,

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social and environmental characteristics such as emphasis on academic achievement, lack of outdoor activities, and prevalence of TV and computer, leading to prolonged close-up work and eye strain, widely regarded as causes aggravating visual disability and impairment in school-aged children (Saw, Carkeet, Chia, Stone, & Tan, 2002; Weng, Wang, Wang, & Jin, 2006).

Myopia not only costs an individual normal vision, it also costs society by imposing an economic burden. For instance, the annual cost for treating myopia in the United States was estimated to be US$4.6 billion (Fredrick, 2002). In Taiwan the annual cost for treating myopia was US$11.8 million, with 10- to 14-year-old children accounting for almost half of the total spending (US$5.1 million) for myopia treatment (Department of Health, Executive Yuan, Taiwan, 2005). Although the latest evidence does not provide sufficient information to support interventions to prevent the progression of myopia (Saw, Shih-Yen, Koh, & Tan, 2002), a child at a younger age with earlier-stage myopia and better baseline visual status at diagnosis may obtain a better efficacy of treatment in slowing down or even preventing further myopic progression. In other words, early detection and treatment of initial myopia are associated with better outcome of visual improvement and correction. With increasing knowledge of underlying mechanisms and factors affecting ocular growth, it is believed that an intervention able to even reverse the myopic progression and restore healthy vision will be available one day (Chen, 1997; Cheng, 2005; Javitt & Chiang, 1994). Thus, for all students, an intervention to preserve visual health is necessary because they are at the beginning of their school lives.

TCM treatments believed to be beneficial in improving circulation, reducing eye strain, and relaxing eye muscles have been proposed to help slow or prevent the progression of myopia. According to the viewpoint of TCM, stimuli on meridian points can be transmitted to the brain and particular organs in the rest of the body via nerves and meridian lines so as to modulate physiological reactions (Yeh, Chen, & Lin, 2004b). Acupressure is an ancient healing art modulating and alleviating ill-health conditions by stimulating acupoints and meridians distributed in other parts of the body. Acupressure on ears can enhance microcirculation around the eyes and help to release eye fatigue, cramp, and ischemia of ciliary muscle, leading to restoration of the controlling function of ciliary muscle and, as a result, improvement of vision (Oleson, 2003). Such acupressure has been applied as a simple, noninvasive intervention to preserve the visual acuity of school-aged children (Cheng & Chu, 2003; Li, 1991; Liu, Lu, Dong, & Zhong, 1994; Yeh, Chen, Chen, & Liao, 2005). Facing today's ever-changing information technology and the arrival of knowledge-based economy, healthcare professionals need to embrace a high degree of flexibility and adaptability in their practices. So-called computer-based multimedia is a new communication tool especially popular with younger generations. For example, interactive computer-assisted instruction produced by advanced videodisk techniques can use multimedia (word descriptions, images, animation, Internet linking, and so on) to provide users with multiple visual and auditory stimulations (Yeh & Chen, 2002; Yeh, Chen, & Chang, 2002). Numerous studies using such multimedia learning programs to enhance learning effectiveness and cognition have reported promising results (Bosworth, Espelage, DuBay, Daytner, & Karageorge, 2000; Chen & Yeh, 2005; Chen, Yeh, & Yang, 2005; Wydra, 2001; Yeh & Chen, 2005; Yeh, Chen, Chen, et al., 2005; Yeh, Chen, & Liu, 2005).

This study was intended to develop a visual health intervention of acupressure on auricular and meridian points with interactive multimedia for children. The effectiveness of this intervention was then evaluated by knowledge of visual health, visual acuity, and refractive error of children participating in this study. The research hypotheses were as follows:

1. There would be a significant difference in visual health knowledge between the experimental and control groups after the intervention.
2. There would be a significant difference in visual acuity between the experimental and control groups after the intervention.
3. There would be a significant difference in the refractive error between the experimental and control groups after the intervention.

Methods

Design and sample

This study adopted a pre-posttest experimental research design. Children in the fifth grade with a visual acuity of Snellen equivalent ranging from 6/30 to 6/9.6 in at least one eye were recruited on a voluntary basis from an elementary school in Taipei,

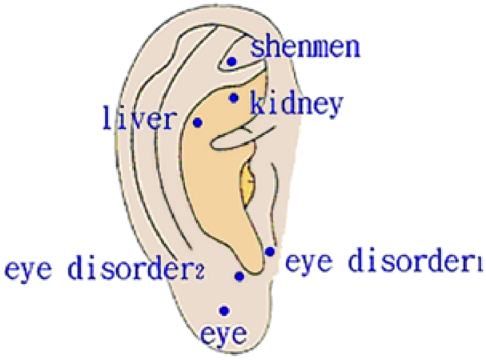

Figure 1. Diagram of Auricular Points on Ear

Taiwan. Children who met the criterion of visual impairment were randomly assigned to either the experimental or the control group. The experimental group received a 15-week visual health intervention, whereas the control group received no intervention. Power analysis using WHO Sample Size Determination in Health Studies software estimated that a sample size of 35 for each group was sufficient to provide a power of 0.8.

Intervention

The intervention in this study included acupressure and interactive multimedia. First, acupressure intervention was delivered onto auricular and meridian points. As shown in Figure 1, six common auricular points for improving visual health were used, including *eye*, *liver*, *shenmen*, *kidney*, *eye disorder1*, and *eye disorder2* (Cheng & Chu, 2003; Yeh, Chen, & Chen, 2004; Yeh, Chen, & Chen, 2005; Yeh, Chen, & Lin, 2004). A seed-embedding method was used to give stimuli on the auricular points. The adhesive patch with seed was renewed weekly by the authors. In addition, as shown in Figure 2, eight common meridian points associated with eye function were used, including *zanzhu* (UB.2), *jingming* (UB.1), *chengqi* (St.1), *sibai* (St.2), *taiyang* (Ex.2), *baihui* (Du.20), *fengchi* (GB.20), and *hegu* (LI.4) (Yeh, Chen, & Chen, 2004; Yeh, Chen, & Chen, 2005; Yeh, Chen, & Lin, 2004).

The second part of the intervention was provided by interactive multimedia. The interactive multimedia format contained files of text, images, film, and sound, to provide instructions (Yeh et al., 2004a). The major content of interactive multimedia included structure and function of the eye, and acupressure on auricular and meridian points. The interactive multimedia also instructed the children to press each of the selected auricular and meridian points for at least 1 min per time, and three times per day for 15 weeks. The validity of the instruction content was assessed by two experts, and achieved a content validity index (CVI) of 1.00 (Yeh, Chen, Chen, et al., 2005).

Measures

The children's assessment in this study included a demographic sheet, a visual health knowledge questionnaire, and examinations of visual acuity and refractive error. The visual health knowledge questionnaire contains 15 true-false questions (Chen, 2005). Higher scores on the questionnaire indicate higher levels of knowledge about visual health. In this study, Cronbach's α for the questionnaire was .63, with CVI of 1.00. A remote-controlled vision inspector (SP-015E, Taipei, Taiwan) with the Snellen chart and a viewing distance of 6 m was used for the visual acuity examination. The Snellen chart consists of a series of block letters in lines. The first line has one very large letter and subsequent lines have increasing numbers of letters that decrease in size. The distance of 6 m from the Snellen chart is the numerator and the last line

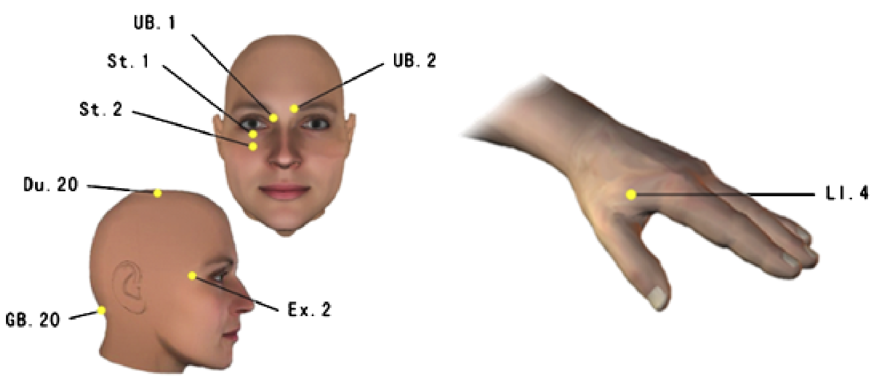

Figure 2. Diagram Showing Location of Meridian Points on Face and Hand

that the eye would be able to read is the denominator. Refractive error was measured by autorefraction measurement with autokeratorefractometers (Topcon KR-8100, Tokyo, Japan).

Procedure

Ethical approval was obtained from the school where the children were enrolled. All children in the fifth grade of the elementary school who met the criteria were recruited and randomly assigned to either the intervention or the control groups. Before the study took place, informed consent was obtained from all guardians of children. All children were free to withdraw from the study at any time during its course.

During the period of the 15-week intervention, acupressure and interactive multimedia instruction were provided every Thursday morning. Following the principle (Yeh et al., 2004a), acupressure was provided by the researchers who had accomplished the TCM training program and who have been certified from the Taiwan accreditation facility. Children's compliance and accuracy in their acupressure performance were checked by the record and the researchers every week. Data for the intervention and control groups were collected before and after the intervention using the same procedure by three researchers who performed the examinations of visual acuity and refractive error, and administered questionnaires, respectively. Operation of equipment measuring visual acuity and refractive errors was approved by the ophthalmology physician.

Data analysis

The data were managed and analyzed with SPSS Windows Version 14.0. First, data were cleaned, checked, coded, and entered. Second, scores were calculated. Third, descriptive statistics were performed to shed light on the demographic characteristics of children. Afterwards, inferential statistics (t test and signed test) were conducted to compare visual examination data between and within the groups. In addition, the Wilcoxon signed ranks test was used to examine the difference between the two groups.

Results

Demographic characteristics

There were 35 children in each group. The mean age (±SD) was 11.0 ± 0.5 years. Other demographic characteristics of the two groups are summarized in Table 1. The result of chi square test showed no statistically significant difference in the demographic characteristics between the two groups, indicating that children were demographically homogeneous in both groups.

Impacts on visual health knowledge

The independent t test was used to determine whether or not the two groups were different in visual health

TABLE 1. *Demographic Characteristics of Children in the Two Groups*

	Experimental group (n = 35)		Control group (n = 35)			
Characteristic	n	%	n	%	χ^2	p
Sex					0.23	.63
Male	21	60.0	19	54.3		
Female	14	40.0	16	45.7		
Parental myopia					4.35	.11
None	6	17.6	1	3.0		
One parent	14	41.2	13	39.4		
Both parents	14	41.2	19	57.6		
Reading/writing (hr/day)					2.90	.23
≤ 1.0	8	22.9	6	17.1		
1.5–2.5	11	31.4	18	51.4		
≥ 3.0	16	45.7	11	31.5		
TV watching (hr/day)					5.12	.53
1	11	34.4	12	36.4		
2	9	28.1	14	42.4		
3	8	25.0	4	12.1		
4	1	3.1	2	6.1		
5	3	9.4	1	3.0		

knowledge before and after the intervention. Before the intervention, the average score of visual health knowledge was 11.1(±2.1) in the experimental group and 11.3(±2.7) in the control group. After the intervention, the average score of visual health knowledge increased to 12.6(±2.1) in the experimental group, but decreased slightly to 11.2(±2.5) in the control group. In summation, before the intervention, there was no significant difference between the two groups in visual health knowledge ($t = -0.30$, $p = .765$). After the intervention, visual health knowledge of one group was significantly different from that of the other ($t = 2.59$, $p = .012$). Later, the paired t test was used to investigate whether there was a significant difference between the pretest and posttest results in each group. The experimental group showed a significant increase in visual health knowledge at posttest compared with the baseline level ($t = -3.42$, $p = .002$), but the control group did not ($t = 0.21$, $p = .838$).

Impacts on visual acuity

Before the intervention, the distribution of Snellen equivalent on 6/30, 6/24, 6/18.9, 6/15, 6/12, and 6/9.6 was 20.0% ($n = 7$), 22.9% ($n = 8$), 17.1% ($n = 6$), 11.4% ($n = 4$), 17.1% ($n = 6$), and 11.4% ($n = 4$), respectively, for the experimental group, and was 40.0% ($n = 14$), 11.4% ($n = 4$), 8.6% ($n = 3$), 5.7% ($n = 2$), 5.7% ($n = 2$), and 28.6% ($n = 10$), respectively, for the control group. Figure 3 shows the progression of visual acuity between pretest and posttest, in which the line of the experimental group moved from left to right whereas the line of the control group stayed in almost the same place.

Figure 4 shows the change of visual acuity between pretest and posttest for each group. Ten children (28.7%) in the experimental group increased by 3 lines or more, 7 (20.0%) by 2 lines and 8 (22.7%) by 1 line, and 2 (5.7%) decreased by 1 line and 1 (2.9%) by 2 lines. In addition, 7 (20.0%) had no change in their vision. One child (2.9%) in the control group increased by 3 lines, 5 (14.3%) by 2 lines and 6 (17.1%) by 1 line, and 4 (11.5%) decreased by 1 line and 8 (22.8%) decreased by 2 lines or more. In addition, 11 (31.4%) had no change in their vision. In order to clarify the effectiveness of the visual health interventions in visual acuity, the Wilcoxon signed ranks test was used to examine the difference of pretest and posttest between the two groups. The result showed a statistically significant difference of changing visual acuity between the two groups ($z = -3.72$, $p < .001$).

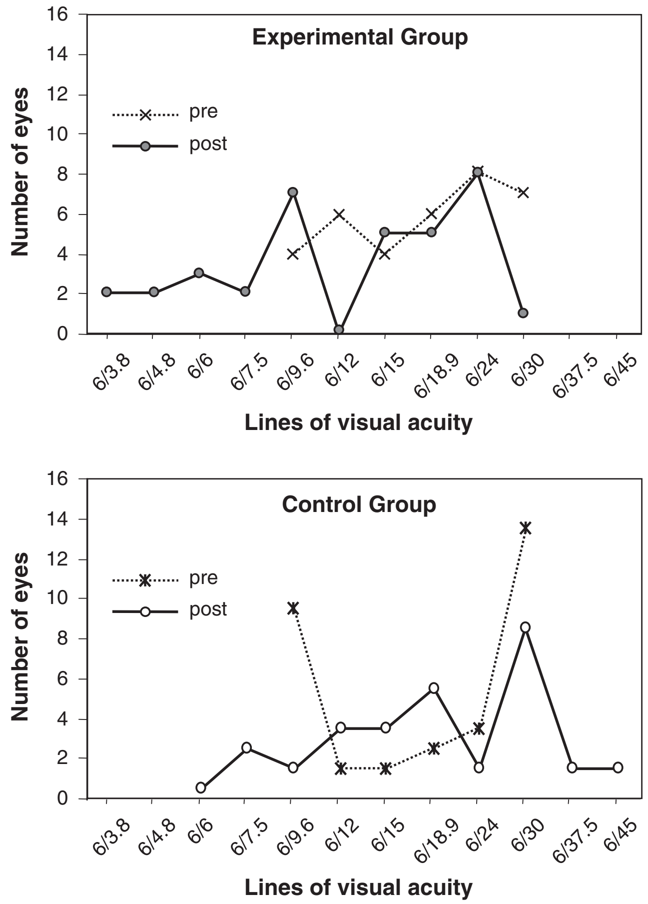

Figure 3. Visual Acuity at Pretest and Posttest for Experimental Group (Top) and Control Group (Bottom)

Impacts on refractive error

The independent t test was used to examine the difference between the two groups. At the pretest, there was no significant difference between the two groups in refractive error ($t = 1.89$, $p = .063$). After the

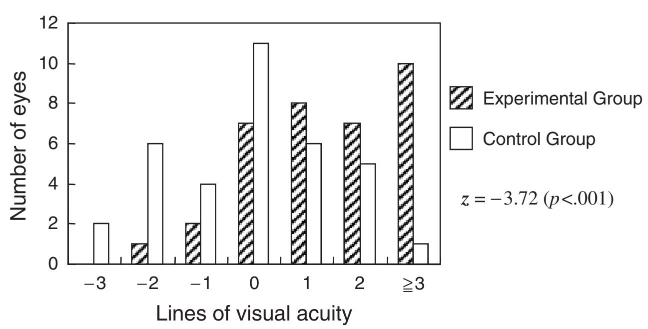

Figure 4. Change of Visual Acuity Between Pretest and Posttest for Experimental and Control Groups

intervention, there was a significant difference of changing refractive error between the two groups ($t = 2.12$, $p = .038$). In addition, the results of the paired t test demonstrated that the difference of refractive error between pretest and posttest was insignificant in the experimental group ($t = 1.86$, $p = .071$) and significant in the control group ($t = 5.44$, $p < .001$).

Discussion

Most of the children spent 1.5–3 hr reading or writing and 1–3 hr watching TV every day after school. These are close-up activities. More information from the children, the close-up activities in which they most often engaged were doing homework, attending after-school classes, working on the computer, watching television, and playing video games. This was in agreement with many studies describing that such prolonged close-up work were common in schoolchildren and would cause harm to their visual health (Angle & Wissmann, 1980; Chou, Lu, Lin, Pan, & Shih, 2002; Fredrick, 2002; Richler & Bear, 1980; Shin et al., 1993). Perhaps, an intervention to preserve visual health may start at the beginning of students' school lives. In the present study, our visual health intervention combining acupressure and interactive multimedia demonstrated efficacy in improving visual acuity and refractive status for a short-term period for the experimental children.

Effects on visual health knowledge

First, this study verified that after the intervention, there was significant difference in visual health knowledge between the two groups. This is in agreement with the results of other studies (Bosworth et al., 2000; Chen et al., 2005; Wydra, 2001; Yeh, Chen, & Liu, 2005). This indicates that the intervention used in the present study could improve cognition and learning effectiveness on visual health in children. As daily pressing of the points should be performed by children themselves, the interactive multimedia may play an important role to guide and follow. The application of interactive multimedia has been demonstrated to be superior to conventional approaches in many aspects, gain learner's acceptance, and draw learners' attention (Chen & Yeh, 2005; Chen et al., 2005; Yeh & Chen, 2005; Yeh, Chen, Chen, et al., 2005). The characteristics of the interactive multimedia, as previously mentioned, were applied in the present study; therefore, it may elevate learners' interest, motives, and comprehension of the instruction material and enhance their confidence in the treatments they are receiving. It also indicated that the interactive multimedia that contains adequate knowledge and comprehension of the principles and procedures of acupressure might also enhance children's compliance and accuracy in their acupressure performance, thereby enhancing the beneficial effects of this treatment.

Effects on visual acuity and refractive error

The results of this study also demonstrated that the acupressure on auricular and meridian points could improve vision. Visual acuity improved by at least 1 line in more than 60% of the children in the experimental group. This finding supports some studies. For instance, Li (1991) found that of 1,216 myopic cases receiving ear acupressure and qigong, 1,771 eyes obtained improved vision with an efficacy rate of 92.24%. Liu et al. (1994) showed an efficacy rate of 98.5% in 424 myopic cases treated with pressure plaster on otoacupoints. Cheng and Chu (2003) stimulated auricular points of 629 myopic cases and achieved an efficacy rate of 88.5%. However, these studies evaluated therapeutic outcomes only in terms of visual acuity and conducted percentile analysis for it. In the present study, we added refractive error as another indicator for the evaluation of efficacy for certain treatments. The outcome of refractive error could be considered as further insight into whether a certain treatment affects myopic progression.

In conclusion, the children receiving the intervention of acupressure and interactive multimedia displayed better knowledge of visual health and improved vision of the fifth graders. The interactive multimedia could enhance learning effectiveness as well as compliance and accuracy of acupressure performance, thereby contributing positive effects on the efficacy of acupressure.

Some limitations should be considered in relation to this study. First, the children involved in this study are not representative of students in elementary schools, and thus generalization of the results should be of some concern. Second, the study was aimed at investigating the combination of acupressure and interactive multimedia for children, but not either alone. Third, the improvement of visual health was only demonstrated in the short-term period, and the long-term effect is unknown. However, broader studies exploring the effects of this intervention for schoolchildren with larger sample size, in various grades, and including longer-term longitudinal effects, are suggested. In addition, how to decrease the close-up activities may be concerned. For better outcome of using this or other visual health interventions, active participation of parents and teachers may be considered worthwhile.

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