Sports Participation, Vision Care Behaviour, Visual Knowledge and Attitude Influence Vision Performance: A Comparison between Student Athletes and Regular Students of Elementary Schools

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Research Article

ABSTRACT

This study will examine the visual performance of students by investigating knowledge, attitude and behaviour with regards to vision care of student athletes (ball game and non-ball-game players) and regular students of elementary schools in Taiwan. The researchers adopted variance and predictive analyses of geographic variables, and variables of knowledge, attitude and behaviour of vision care, and vision performance. The statistical analysis results reveal that: Athletes of ball-game teams with normal vision were significantly higher in the ratio. There were no significant differences in variables of visual knowledge, attitude and behaviour of vision care between student athletes and regular students. Geographic variables were processed and analyzed with hierarchical regression that four intervals were sequentially incorporated into the model respectively to identify indicators of student's visual performance. The results showed that geographic variables, variables of knowledge, attitude and behaviour of vision care, etc. were unable to predict student's visual performance.

Keywords: Ball games, Non-ball games, Attitude, Behaviour

INTRODUCTION

According to a report by the World Health Organization [1], there were approximately 285 million visually impaired individuals, of which around 43% were identified with ametropia, an avoidable disease. The occurrence of visual impairment among elementary school students in Asia – Taiwan, Mainland China and Singapore, is very common. For instance, the rate of visual impairment of first grade students reaches 21.5%; thus 1 out of every 5 students is visually impaired. Likewise, the occurring rate of visual impairment among sixth grade students is 65.8% [2].

Visual acuity is the clarity and/or resolving capacity of the visual system. It affects the visual focus of the eyes, the transmission of optic nerves, and the analysis and interpretation of vision to the brain, which determines the clarity and sharpness of vision as well as the nerve sensibility of the retina [3-5]. Visual impairment can be critical to a student's learning ability, psychological identification, and environmental adaptation [6]. An accumulated empirical research showed that the development of visual impairment is delayed when outdoor exercise is increased. Thus, the Ministry of Education of Taiwan implements outdoor activities during breaks and 15 min eye exercises in the forenoon and afternoon at school for grade school students in order to prevent their visual impairment [3-5].

Vision can be divided into static visual acuity (SVA) and sports vision [5]. The sports vision has key influence on athletes. Recent researches also revealed that different exercise items possess of different dynamic visual acuity. Taking volleyball exercise for instance, it requires remarkable dynamic visual acuity to ensure reliable determination to spiking and blocking [7]. Quevedo and Sole [8] further indicated that every form of exercise has its own particularity and related visual skills. Visual functions and skills can be strengthened via pertinent motion capture training and then promote exercise performance.

Open motor skill is at a dynamic environment, initiation of motion is limited by external situation [9]. It is no doubt that visual acuity is the most important perception among others in high speed motion ball games such as table tennis, badminton, tennis and baseball because they have the characteristic of perception uncertainty thus athletes must have to handle the visual information in a very short period of time to make response [10]. Dodgeball, table tennis and volleyball are the options in this research. Dynamic visual acuity of athletes is the primary emphasis in open motor skills. Whether the "Far and Near Dynamic Visual Acuity" (i.e., the target is moving straight toward the line of sight) or "Horizontal Dynamic Visual Acuity" (i.e., the target is moving horizontally across the line of sight) are highly necessary in athletics that require eye tracking of high speed moving objects [11]. Evidence based researches on baseball and pigeon shooting also revealed the ability of horizontal dynamic visual acuity of athletes is significantly correlated with their sports performance [12-14].

The traditional frameworks of behavioural science imply knowledge as the primary factor to predict behaviour of health care in the general research. The knowledge of individuals affects their attitudes, and awareness and behavioural reactions to health care; therefore, proper knowledge and positive attitudes can drive their participation in health care then gain better health [15].

Vision care refers to effective precautious behaviours to keep normal vision, which include environment, diet, routine, and outdoor activities [16]. Precautious behaviours of vision care for students are, for instance, avoiding working with eyes for too long or in inadequate distance, to read or write in proper posture and keep the visual distance for at least 35 cm and to prevent writing, reading, watching TV, drawing or playing video games by lying on the stomach or the back [17,18].

Numerous researches indicate that vision impairment among students has become worse over time, which is in the result of insufficient conducts in vision care. Consequently, to immerge adequate knowledge, attitude, and behaviour in the routines is urged for taking vision care in actions and preventing the student's vision health getting worse [19,20].

METHODS

Participants

The subject of the study is 350 students of the elementary schools in Chiayi, Taiwan; there are 150 student athletes in ball games, 150 student athletes in non-ball games and 50 regular students participate in survey research through randomly sampling process. Physical education teachers of the selected schools were informed prior to the survey regarding the nature of the study; the researchers obtained consent from the participants and their parents before they were acknowledged the relevant notice before the surveying process. The population distributions of the student athlete participants are 195 boys (55.7%) and 155 girls (44.3%), among which, 187 (53.4%) are the 6th grader and 163 (46.6%) are the 5th grader, where there are 98 of them (28.0%) take exercise for 60 min every week, 118 (33.7%) for 60-90 min and 84 (24%) for 91 min and over (Table 1).

Table 1. Description of participant's demographic variables.

Variables	Groups	n		Variables	Groups	n	
Gender	Boys	195	55.7	Sport items	Dodge ball	50	14.3
	Girls	155	44.3		Volleyball	50	14.3
Grader	5th grader	163	46.6		Table tennis	50	14.3
	6th grader	187	53.4		Track and field	50	14.3
Exercise times for every week	Under 60 min	98	28		Dances	50	14.3
	61~90 min	118	33.7		Taekwondo	50	14.3
	Over 91 min	84	24		Regular students	50	14.3

Measures

Vision performance

The traditional C chart appears to be more difficult to pronounce and to tell the notch; therefore, the primary implementation of the E chart to examine vision at school for the student keeps 6 m as measuring distance, and classifies the student who has either eye under 0.8 as vision impairment [21]. The researchers have the participants, regular students and student athletes in ball teams and non-ball teams to the health center of the school to measure the student's vision with a sight list box by the nursing staffs, which uploads the measuring data to the health care system.

Knowledge, attitude, behaviour of vision care scale

The knowledge, attitude, behaviour of vision care scale is conducted as per the authorization of the Ministry of Education of Taiwan that applies "vision care issue" as research instrument. The scale content is two-fold, the geographic information of the research subject and the related questions on vision care that include total 29 entries of "personal information", "knowledge of vision care", "attitude of vision care", "behaviour of vision care".

The geographic information includes gender, grade in elementary school, category of sport, year of playing the sport, and hours of per practice. Besides, there are three parts of the related questions on vision care; one is knowledge of vision care, includes 10 yes/no questions; another is attitude of vision care, includes 9 yes/no questions; the other is behaviour of vision care, includes 10 yes/no question. The subject answers the questions based on his/her own experience according to the description of each question, gets one point when the answer is yes/agree and gets no points when the answer is no/disagree.

Data Analysis

The SPSS 21.0 is applied on the collected data of survey to precede data analysis; frequency distribution and percentage rate are processed with descriptive statics and the difference of vision performance, and knowledge, attitude, and behaviour of vision care of between regular students and student athletes are tested by the Pearson's chi-square analysis. The data is consequently proceeded correlation analysis between groups and categories of vision performance with contingency coefficient C.

RESULTS

The Analysis of Vision Performance of the Regular Students and the Student Athletes of Elementary Schools

Visual acuity of either eye that is lower than 0.8 or higher than 0.9 is vision impairment; according to **Table 2**, vision performance of all the students, there are 131 (37.4%) students have normal vision in both eyes, 42 (12.0%) have vision impairment in either eye and 177 (50.6%) have vision impairment in both eyes. The result shows that over 60 percentages of students have vision impairment condition. Vision performance of the student athletes in ball games, there are 52 (34.7%) have normal vision in both eyes, 21 (14.0%) have vision impairment in both eye and 77 (51.3%) have vision impairment in both eyes.

Vision performance of the student athletes in non-ball games, there are 69 (46.0%) have normal vision in both eyes, 14 (9.3%) have vision impairment in both eye and 67 (44.7%) have vision impairment in both eyes. Vision performance of the regular students, there are 10 (20.0%) have normal vision in both eyes, 7 (14.0%) have vision impairment in one eye, and 33 (66.0%) have vision impairment in both eyes.

Table 2. The analysis of vision performance of the regular students and the student athletes of elementary schools

Vision performance	Student athletes in ball games	Student athletes in non-ball games		Regular students		Total	
	N=150	N=150		N=50		N=350	
	N	N	%	N	%	N	%
Normal vision in both eyes	52	69	46	10	20	131	37.4
Vision impairment in one eye	21	14	9.3	7	14	42	12
Vision impairment in both eyes	77	67	44.7	33	66	177	50.6

Variance Analysis of Vision Performance and Knowledge, Attitude, Behaviour of Vision Care of Student Athletes and Regular Student of Elementary Schools

Visual acuity of either eye that is lower than 0.8 or higher than 0.9 is vision impairment. The researchers transmit vision performance into groups to categorize vision performance of the participants in 3 groups, normal vision in eyes, vision impairment in one eye and vision impairment in both eyes.

Table 3 shows the vision performance of the regular students, student athletes in ball games, and student athletes in non-ball games. The result of chi-square test approaches significant differences that χ^2=12.27 (p<0.05); the correlation analysis is adopted to proceed grouping and categorization of vision performance with contingency coefficient C, which approaches significance that shows correlations between grouping and categorization of vision performance. Based on the findings of revised multiple regression, the percentage of normal vision in both eyes of the student athletes in non-ball games is apparently higher, when it is comparatively much lower of the regular students and have apparently higher percentage of vision impairment in both eyes.

Table 3. Cross tabulation of vision performance of different groups (χ^2=12.27*; df=4; contingency coefficient (C)=184*; *p<0.05)

			Vision performance			Total
			Normal vision in both eyes	Vision impairment in one eye	Vision impairment in both eyes	
Groups	Student athletes in ball games	Count	52	21	77	150
		% within group	34.70%	14.00%	51.30%	100.00%
		% within vision performance	39.70%	50.00%	43.50%	42.90%
		% of Total	14.90%	6.00%	22.00%	42.90%
		Adjusted Residual	-0.92	1	0.25	
	Student athletes in non-ball games	Count	69	14	67	150
		% within group	46.00%	9.30%	44.70%	100.00%
		% within vision performance	52.70%	33.30%	37.90%	42.90%
		% of Total	19.70%	4.00%	19.10%	42.90%
		Adjusted Residual	2.87	-1.33	-1.91	
	Regular students	Count	10	7	33	50
		% within group	20.00%	14.00%	66.00%	100.00%
		% within vision performance	7.60%	16.70%	18.60%	14.30%
		% of Total	2.90%	2.00%	9.40%	14.30%
		Adjusted Residual	-2.75	0.47	2.36	
Total		Count	131	42	177	350
		% within group	37.40%	12.00%	50.60%	100.00%
		% within vision performance	100.00%	100.00%	100.00%	100.00%
		% of Total	37.40%	12.00%	50.60%	100.00%

The result of variance analysis of vision performance, and knowledge, attitude and behaviour of vision care of regular students, student athletes in ball games, and student athletes in non-ball games of elementary schools is showed in Table 4. The result of F-test reveals that the student athletes in non-ball games have better vision performance of the left

eye than the regular students do (F=4.11, p<0.05). The variables of knowledge, attitude and behaviour of vision care of the regular students and the student athletes in ball games have not approach significant differences (p<0.05).

Table 4. Variance analysis of knowledge, attitude and behaviour of vision care of regular students and student athletes in ball games and student athletes in non-ball games of elementary schools.

Independent variables	Groups	N	Mean	Standard deviation	F
Knowledge of vision care	Student athletes in ball games	150	9.48	0.8	1.26
	Student Athletes In Non-Ball Games	150	9.59	0.7	
	Student In Elementary Schools	50	9.64	0.6	
Attitude of vision care	Student athletes in ball games	150	8.44	0.89	2.05
	Student athletes in non-ball games	150	8.64	0.83	
	Student in elementary schools	50	8.56	0.84	
Behaviour of vision care	Student athletes in ball games	150	7.43	2.21	0.18
	Student athletes in non-ball games	150	7.45	2.12	
	Student in elementary schools	50	7.64	2.23	

The Predictive Analysis of the Influence of the Geographic Variables and the Variables of Knowledge, Attitude and Behaviour of Vision Care of Elementary School Students on Vision Care

The results of predictive analysis of the four intervals that merges in the model accordingly via hierarchical regression analysis on vision performance of elementary students are collated in **Table 5**. According to model 1 in **Table 5**, the indicator of student's gender, grade in school, and hours of practice, etc. of the geographic variables does not approach explanatory significance after merging into the model, R^2=0.020F=2.018p>0.05. Consequently, the indicator of student's gender, grade in school, and hours of practice, etc. of the geographic variables cannot predict vision performance of elementary students.

In model 2, the variables of knowledge do not approach explanatory significance on vision performance after initiating into the model, R^2=0.022, F=1.656, p>0.05. A. and the increasing explanation of variance, R^2=0.002, F=0.580, p>0.05, showed the initiation of the variables of knowledge of vision care cannot promote the explanation effectively.

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Concluding the results of hierarchical regression analysis of the influence of the geographic variables, and variables of knowledge, attitude and behaviour of vision care on vision performance of elementary school students, none of the geographic variables, variables of knowledge, attitude, or behaviour of vision care can predict vision performance of elementary school students.

Table 5. Hierarchical regression analysis of geographic variables, and knowledge, attitude, and behaviour variables of vision care on vision performance.

Variables	Model 1			Model 2						Model 3	Model 4		
	Beta	t	p	Beta	t	p	Beta	t	p	Beta	t	p	
Gender	-0.144*	-2.46	0.014	-0.139*	-2.365	0.019	-0.151*	-2.558	0.011	-0.150*	-2.525	0.012	
Grader	0.023	0.401	0.689	0.025	0.433	0.665	0.032	0.556	0.578	0.031	0.524	0.601	
Exercise times for	0.008	0.13	0.897	0.01	0.176	0.861	-0.002	-0.04	0.968	-0.002	-0.028	0.977	

every week											
Knowledge of vision care			-0.044	-0.761	0.447	-0.046	-0.8	0.425	-0.046	-0.785	0.433
Attitude of vision care						0.11	1.897	0.059	0.113	1.867	0.063
Behaviour of vision care									-0.011	-0.178	0.859
R2	0.02		0.022					0.034	0.034		
F	2.018		1.656					2.056	1.713		
P	0.112		0.16					0.071	0.118		
ΔR2	0.02		0.002					0.012	0		
ΔF	2.018		0.58					3.6	0.032		
ΔP	0.112		0.447					0.059	0.859		

DISCUSSION AND CONCLUSION

Vision inspection determines normal vision between 0.9~2.0 in terms of "visual acuity"; vision that is beyond or above this range is regarded as vision impairment [11], which is referred to be the vision grouping standard in the study. Among the 350 participants in the study, 131 of them (37.4%) have normal vision, when 42 (12.0%) have vision impairment in one eye and 177 (50.6%) have vision impairment in both eyes. The result showed that there is over 60% of student has vision impairment, which is higher than the phenomenon in students of the same educational level compare to other countries, and reveals the critical issue in Taiwan [2].

It is found that students who are student athletes in non-ball games showed higher percentage of normal vision in both eyes than those are in ball games; and the percentage of the regular students who do not participate in the school athletic teams have vision impairment in both eyes is higher than others. Sport participation helps promoting a student's eye movement and dynamic vision that provides training to the ciliary muscle, the crystalline lens, and the apparatus suspensorius lentis that improves vision impairment [11]. It also compatible with some relevant research that indicated outdoor activities decelerating vision impairment, as a result, claiming taking part of outdoor activities or exercise of any kinds is helpful to vision [22,23].

The results of the study showed no significant differences in the variables of knowledge, attitude, and behaviour of vision care of the student athletes in ball game and non-ball games, and regular students. Furthermore, the geographic variables and the variables of knowledge, attitude and behaviour of vision care are unable to predict vision performance of grade school students. In spite of the fail to predict vision performance of grade school students in the study, the scores of the student's knowledge, attitude and behaviour are all high, which have shown the effectiveness of vision care knowledge at school.

The reason that leads to vision impairment and the high rate of vision impairment of students is complex, of which the environmental factor is avoidable, such as working long hours, in close distance or insufficient lights, including using computer, smartphone, watching TV, participating in after school lessons, insufficient outdoor activity [24,25]. In Consequence, to improve the student's living environment in terms of vision care is vital to prevent vision impairment. Precautions of vision impairment include keeping reading or writing distance for at least 35 cm, taking at least 10 min break for every 30 min from watching TV or playing video games, participating in outdoor activities for at least 120 min daily and taking inspection and treatment at the eye clinic [21].

Some researchers have claimed to control the use of mobile phones by the school during school hours due to the popular of smartphone that result of worsen the vision through longer-time and closer-distance use. From another perspective on the increasing vision impairment of students is the traditional value that diplomas is the key to better jobs, which results in students spend too much time studying indoors and insufficient time exercising outdoors [23].

Therefore, the researchers suggests schools implement strategies to promote outdoor activities school wide or sport choice for individuals to decrease vision impairment of students worsen [26,27].

Regarding the future research, the researchers suggest adding the variables of time of using 3C electronic product and school works into the model of the influence of sport participation on vision performance in order to understand more factors that affect vision health.

CONFLICTS OF INTEREST

The authors declare that they have no competing interest.

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