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College Students' Eye Strain Caused by Eye Health Behaviors

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ABSTRACT

This study has the aim to investigate the college students' eye strain caused by their eye movements. In this study, we used a developed questionnaire comprised of 88 questions including eye strain. The data was collected from February 4, 2012 until February 22, 2012. The participants were 273 undergraduates who were resident in Jeolla and Gyeonggi provinces of Korea. The collected data was analyzed by SPSS 19.0. The results of this study as follows. 67% of participants used optical aids such as eye glasses and contact lenses. For them, the initial age of using the optical aids was 14.27. They experienced sensitivity (61.2%), dryness (58.6%), itching (44.6%) of their eyes. They purchased contact lenses at the optician's shop (94.4%), and they used contact lenses with the object of both correction and beautification (43.4%). The initial age of wearing contact lenses was 18.38. The mean score of eye strain was 16.36. There were significant differences in gender (t=-3.171, p=.002), eyesight testing time (F=6.380, p=.002), use of the optical aids (t=-4.096, p<.001), use of the contact lenses (t=-5.988, p<.001), eye disease (t=5.903, p<.001), sitting posture (F=-6.477, p<.001), side effects of wearing contact lenses (t=3.502, p=.001), daily use of contact lenses (t=-2.921, p=004), and weekly use of contact lenses (t=-2.273, p=.024) causing the eye strain. This study confirmed that the participants wearing contact lenses feel more eye strain than otherwise. Therefore, it is necessary to develop nursing interventions and educational program to help manage contact lenses and eye health.

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1. Introduction

1.1 The Need for the Study

Eye is a human sensory organ that plays an important role in accepting external information, which continues to grow and change even after one reaches adulthood. Since the 1980s, the rapid development of the Korean economy and various media have caused eyes to be overused and deteriorate. Loss of vision has caused many inconveniences in everyday life, and the number of people who need vision correction is also growing. According to the 'National Eyeglass Wear Rate in 2005' of the National Eye Optics Association, the number of eyeglass or contact lens wearers, which was 34.8% in 1995, increased by 9.9% in 2005 to 44.7%. According to Kim and Park (2006), approximately one out of two adults is currently wearing glasses or contact lenses for their vision correction.

Lee, Lee, and Lee (2007) claimed that the user range of contact lenses is very broad, from cosmetic colored lenses to direct ocular treatment. Contact lenses are easy and convenient for the first time users because they have less irritation caused by foreign substances and shorter time for adaptation. Also, they are in much use because they are cheap, easy to obtain, and offer safety and advantages for the vision correction. However, despite this upside, poor management of the contact lenses and poor eye hygiene can lead to many adverse effects.

The use of contact lenses requires more expertise and attention, and the role and responsibility of the educator to convey how to manage contact lenses are also important. However, most college students who use contact lenses lack the knowledge of the importance of the contact lens care because they source their lens products from opticians rather than from physicians at hospitals without resorting to appropriate education and training.

College is an important time to develop one's own ability to look after him or herself as a young adult. Checking on the vision in one's 20s is an important factor in the early detection of the eye health problems and awareness of the need for proper care. Until high school, students often rely on their parents or others for their own health care, but from college, independence is emphasized across many aspects of their lives, so the sense of responsibility for health care is naturally prominent, and healthy habits acquired in college might contribute to determining the health conditions of their lives. It is also important to recognize the need for regularized visual acuity testing and eye health care through eye health education since regular vision screening habits would likely have a great impact on the eye health for their lifetime even in the aftermath of their college years.

Recently, many changes have taken place in the living environment for college students. Positive effects that can help change their eye health include improvement of school and family life, improvement of the general public's health consciousness, and the negative effects would consist of a quantitative increase in TV viewing time, an urban environment that easily leads to eye strain, excessive computer use, drinking and smoking. For these reasons, 70% of college students have vision problems, which is about 10% higher than 10 years ago, which is reported to increase every year. In addition, college students are becoming more interested in their looks due to the widening social activities,

so they use contact lenses instead of glasses for cosmetic and vision correction purposes. In the case of having good eyesight, contact lenses are used only for cosmetic purposes in order to make the pupils look bigger.

Nonetheless, the studies on eye health are largely limited to some age groups, such as vision screening studies on pre-school children (Lee, 2007) and older age cataracts and eye diseases, etc. There is little research on the eye health of college students, if any, and most studies are about one-off visual acuity screening and none is engaged in regularized visual acuity testing. Therefore, this study aims to provide basic data for nursing interventions related to the eye health of college students by identifying eye health behaviors and eye strain among them.

1.2 The Purpose of the Study

This study aims to provide basic data for nursing interventions related to the eye health of college students by identifying their eye health behaviors and eye strain among them, and the specific objectives of this study are as follows. First, identify the eye health behaviors and eye strain of the subjects. Second, identify the contact lens wearing and management conditions of the subjects. Third, figure out the general characteristics of the subjects and the eye strain caused by their eye health behaviors. Fourth, understand the eye strain depending on the actual conditions of the contact lens care handled by the subjects.

1.3 Research Hypothesis

First, there will be difference in feeling the eye strain depending on the general characteristics and eye health behaviors of the subjects. Second, there will be difference in feeling the eye strain depending on the contact lens care conditions of the subjects.

2. The Method of the Study

2.1 The Design of the Study

This study is a descriptive research to investigate the eye health behaviors, the actual condition of contact lens management, and eye strain in college students.

2.2 Subjects and the Method of Data Collection

This study used the G power 3.1 program to consider the moderate effects' size, calculating 252 minimum samples as the power of 95% at the significance level of .05. The subjects of this study were college students who reside in K and J provinces. The researchers explained the purpose of the study and distributed and collected the questionnaires from 300 people who agreed to participate in the study. Of them, 273 were used for this study except for 27 of them. The data collection

took place at the private tutoring institutes, libraries, and dining halls where college students were concentrated. The data collection period was from February 4, 2012 to February 22, 2012.

2.3 Research Tools

The questionnaire consisted of 88 items including 15 general items, 44 eye health behavior related items, 10 eye strain related items, and 19 actual conditions of contact lens care related items.

2.3.1 Eye health behaviors

The contents of the subjects' eye health behaviors were developed through the preceding literature, and they were revised and supplemented by the help of a nursing professor. In order to verify the reliability and validity, 30 college students living in J province were randomly selected for conducting the preliminary surveys and examined as to whether the developed items reflect the eye health behaviors of the college students.

2.3.2 Eye strain

To measure the eye strain, we used the tools of Beak (2002), which consisted of 10 questions concerning eye-aware symptoms and ocular symptoms. Each question was measured from a minimum of 10 to a maximum of 40 on a 4-point scale consisting of 'Not at all', 'Somewhat agreeable', 'Frequently agreeable', and 'Always agree', and the higher the score, the higher the degree of strain in the eye. The reliability of the study tool was Cronbach's α = .73, but the reliability of the study was Cronbach's α = .85.

2.3.3 Actual conditions of the contact lens care

The contents of the subjects' eye health behavior were developed through the preceding literature, and they were revised and supplemented with the help of a nursing professor.

2.4 The Method of Data Analysis

The SPSS 19.0 statistical program was used to analyze the data for this study as follows. First, the general characteristics of the subjects were analyzed by frequency, percentage, mean, and standard deviation. Second, the subjects' eye health behaviors were analyzed by frequency, percentage, mean, and standard deviation. Third, the contact lens wear and the actual care conditions of the subjects were analyzed by frequency, percentage, mean, and standard deviation. Fourth, differences in the eye strain depending on general characteristics and eye health behaviors of the subjects were analyzed by t-test and ANOVA, while Scheffe's method was used for post-test. Fifth, the subjects' eye strain caused by their contact lens caring method was analyzed by t-test and ANOVA.

2.5 The Limitations of the Study

The limitations of this study are as follows.

First, this study is meaningful in understanding the eye health behaviors and the actual conditions of the contact lens care by college students, but there is a limit to generalizing the findings because these college students live only in K and J provinces, which is not sufficient.

Second, there is a limit to the fact that the survey was conducted not by actually examining the visions and general eye health but by asking symptoms perceived by each individual subject.

Third, there is a limitation in the differences of the overall lifestyle such as drinking, sleep time, TV, smartphone, and computer usage time because the data collection period included breaks.

3. Results and Discussion

3.1 General Characteristics of the Subjects

The general characteristics of the subjects are as follows.

The subjects were 103 males (37.6%) and 170 females (62.4%). The average age of the subjects was 22.04 ± 2.08 years old. 101 people (37.0%) were humanities majors, 62 people (22.7%) were science course majors, 96 people (35.2%) were herbal medicine majors, and 14 people (5.1%) were arts and physical education majors.

The subjects were comprised of 35 (12.8%) freshmen, 62 (22.7%) sophomores, 96 (35.2%) juniors, 14 (5.1%) seniors, and 9 (3.2%) seniors doing an extra year. The number of juniors is the largest.

Non-religious people occupied most of the categories with 121 people (44.3%), followed by 89 (32.6%) Christians, 22 (8.1%) Buddhists, 26 (9.5%) Catholics, and 10 (3.5%) Won Buddhists.

Unmarried people comprised most of the category with 271 (99.3%) people, and there were only 2 (0.7%) married. 114 (41.8%) people had opposite-sex friends and 159 (58.2%) people did not. In terms of their residential types, the majority of 166 (60.8%) students resided in their houses, followed by 35 (12.8%) students at dormitories, 67 (24.5%) students living on their own, 4 (1.5%) people in boarding houses, and others being 1 (0.4%) person.

The subjects' allowance amounts are as follows. 38 (13.9%) students get less than 200,000 Won, 146 (53.5%) people receive more than 200,000 Won and less than 400,000 Won, 89 (32.6%) people receive more than 400,000 Won, resulting in the average of 31.24±16.72 Won. There are 237 (86.8%) non-smokers, 30 (11.0%) smokers, and 6 (2.2%) people who have already experienced smoking before hand. The majority of 242 (88.6%) people drink alcohol, and in terms of sleep time, 143 (52.4%) people seemed to sleep less than 8 hours, and 130 (47.6%) people seemed to sleep more than 8 hours.

3.2 The Eye Health Behaviors of the Subjects

The eye health behaviors of the subjects are as shown in <Table 1>.

Table 1. Subjects' eye health behaviors

(*N*=273)

Item	Variable	n(%)	M±SD	Item	Variable	n(%)	M±SD
Vision perception				Symptom experience *	Pain	44(16.1)	
	Presence	152(55.7)			Itch	121(44.3)	
	Absence	121(44.3)			Dry	160(58.6)	
Vision check					Feeling of a foreign object	83(30.4)	
Time	Less than 1 year	169(62.0)			Burning sensation	13(4.8)	
	Over 1 year	90(32.9)			Sensitivity of stimulation	167(61.2)	
	Never	14(5.1)			Congestion after drinking	102(37.3)	
					Stiffness after sleep	23(8.3)	
Place					Other	11(4.0)	
(n=259)	Ophthalmology	83(32.1)					
	Opticians	144(55.6)		eye strain			16.36±4.36
	school	11(4.2)					
	Public Health Care Center	7(2.7)		Environment			
	Etc	14(5.4)		Posture during study	Sitting at a desk	154(56.4)	
Aids					Lie down	11(4.0)	
Whether to wear	Wearing	183(67.0)			Sitting at a desk	86(31.5)	
	Non-worn	59(21.6)			All wrong		
	Wore in the past	31(11.4)		Study lighting	Use ceiling light only	102(37.4)	
Kinds*	glasses	166(60.8)			Use light bulb only	7(2.6)	
	Transparent Soft Lens	96(35.3)			Use stand only	30(11.0)	
	Color Soft Lens	47(17.2)			Ceiling light and stand	134(49.0)	
	Hard lens	18(6.6)			Used together		
	Etc	3(1.1)		Time of book reading	in 1 hour	32(11.7)	
Glasses + lens	Yes	96(52.5)			Within 1 hour ~ 2 hours	61(22.3)	
(n=183)	No	87(47.5)			Within 2 hours ~ 3 hours	79(28.9)	
					More than 3 hours	101(37.1)	
First wearing time	Under 12 years old	55(20.2)	14.27±4.07	Weekday TV and computer hours			3.82±2.362.
	12 to 15 years	73(27.0)		TV viewing distance	Within 50cm	6(2.3)	
	16 to 18 years	52(19.3)			Less than 50cm ~ 1m	56(20.6)	
	19 years or older	34(12.5)			1m ~ 2m	137(50.3)	
					2m ~ 3m or more	73(26.8)	
Eye surgery experience	Yes	30(11.0)		Perception			
	No	243(89.0)		Perceived Importance of eye health	Important	220(80.6)	
					Not important	53(19.4)	
Experience with eye drops	Yes	67(24.5)		Perceived Eye health condition	Healthy	142(52.0)	
	No	206(75.5)			Unhealthy	131(48.0)	

*Duplicate response question

152 (55.7%) people seemed to know how good or bad their eye visions are, but the other half of 121 (44.3%) people did not. The majority of 169 (62.0%) had their eyes checked less than a year ago, 90 (32.9%) people had theirs checked more than a year ago, and 14 (5.1%) people seemed to not ever have had their eyes checked. The Choi and Jun (2010) research showed that most of the subjects get their eyes checked within a year as in the previous research.

Also, the number of subjects who did not ever get their eyes checked was less than the number shown in the Choi and Jun(2010) study which had 12.2% of people who have not checked their eye vision.

The majority of 144 (55.6%) people had their eyes checked at the eyeglass stores, followed by 83 (32.1%) people who checked their eyes at the ophthalmic, 14 (5.4%) people who checked their at their schools, and 7 (2.7%) people checked their eyes at the public health centers. The Choi and Jun (2010) study showed a difference in this research in terms of the number of people who have been to the ophthalmic, representing 193 (62.1%) people. This seems to be due to the accessibility and convenience of the optician.

There are currently 183 (67.0%) people who are wearing eye aids, the majority of 166 (60.8%) people wear glasses, followed by 96 (35.2%) people who wear soft lenses. The average age for the first application of eye aids was the age of 14.27±4.07, and the middle to high school years represented almost half with 125 (46.3%) people.

In this study, the wearing rate of eye aids was higher than that of the Korea Optics Association in 2005 (44.7%), suggesting that the visual acuity is getting worse in the recent 7 years. In addition, this research is similar to the Choi and Jun(2010) research in terms of the first eye aid wearing times with the Choi and Jun research presenting 129 (41.0%) middle to high schoolers wearing eye aids for the first time, and this research has 125 (46.3%) people represented in the ages between 12 to 18 wearing eye aids for the first time.

This research was also similar to the Kim et al. (2004) research in terms of the number of subjects wearing glasses and contact lenses together with this research representing 96 (52.5%) people, and the Kim research showing 46.2% of people wearing both objects at the same time.

The contact lenses' convenience and the beauty seem to be the reason as to why there seems to be an increase in the number of people wearing contact lenses simultaneously with their eye glasses. There were 30 (11.0%) people who have undergone eye surgeries, and 67 (24.5%) people have experienced eye drops because of their dry eyes.

The majority of 167 (61.2%) people felt very sensitive about eye related symptoms, followed by 160 (58.6%) people who felt dryness, 121 (44.3%) people who felt itchiness, 102 (37.3%) who recognized congestions in the eyes after ingesting alcohols, 83 (30.4%) people who felt foreign substances in their eyes, 44 (16.1%) people who felt pain, 23 (8.3%) people who felt stiffness in their eyes after sleep, 13 (4.8%) people who felt burning sensations, and 11 (4.0%) people, among others. This showed a difference to the Park (2008) research on people who wear contact lenses which showed that the majority of people felt stiffness in their eyes rather than dryness. This suggests that the results of this study include the subjects who did not wear contact lenses.

The average score of eye strain of the subjects was 16.36 ± 4.36, which was higher than the average eye strain score of 13.33 in the Baek (2002) research. Compared with the reference paper

for elementary school students, the subjects of this study were college students and seemed to have a high incidence of unhealthy lifestyle and polluted environmental stimuli.

The majority of 154 (56.4%) people sat at desks when studying in terms of environmental characteristics, followed by 86 (31.5%) people who study at their desks but not in a correct posture. 134 (49.1%) people used ceiling lights as well as stand lights when studying. 101 (37.0%) people read more than 3 hours a day, 79 (28.9%) people read 2 to 3 hours a day, 61 (22l.3%) people read 1 to 2 hours a day, and 32 (11.7%) people read less than an hour a day.

The average time spent on using TV, smartphone and computer were 3.82 ± 2.36 hours. The majority of 137 (50.3%) people watched TV from 1 to 2 meters away, followed by 73 (26.8%) people watching from 2 to 3 meters away, and 62 (22.9%) people watching from less than a meter away.

Of the cognitive characteristics, 220 (80.6%) people thought that their eye health is important, but 53 (19.4%) people did not. 142 (52.0%) people acknowledged that their eyes are not healthy, and 131 (48.0%) did not. This shows that many people perceive their own eye health as important, and more than half of them perceive that their eyes are not healthy.

3.3 Subjects' contact lens wear

Of the total of 273 subjects, 161 (59.0%) were the contact lens wearers and Table 2 shows the actual state of wearing contact lenses. 152 (94.5%) of the respondents answered that they bought the contact lenses at the optician's office, and the average age at first wearing contact lenses was 18.38 ± 2.40. Those who responded that they wore contact lenses for 2 years or less was the highest rate, and the average duration of wear was 3.39 ± 2.26 years. The study of Choi et al. (2004) reported the age at which the lenses were first worn at 19 to 22 years of age, which was similar to the results of this study. The subjects wearing contact lenses in the present were 115 (71.5%), and 46 subjects (28.5%) used to wear lenses in the past. 63 people (39.2%) responded that they intended vision correction for the purpose of wearing contact lenses, 28 people (17.3%) for cosmetic purposes, and 70 people (43.4%) responded that they wore contact lenses for both corrective and cosmetic purposes.

As for the contact lens types according to the material, 97 people (60.2%) responded that they use transparent soft lenses, 44 people (27.3%) use color soft lenses, 13 people (8.0%) use hard lenses, and 7 people (4.3%) answered that they use RPG lenses.

As for the type of lens according to period of use, lenses that were made to be used for 6 months had the highest rate of use with 91 people (56.52%), and 24 people (14.9%) responded that they wore disposable (single use) lenses, 23 people (14.28%) responded 12 months, 19 respondents (11.8%) answered "other", and 4 people (2.48%) responded that they used lenses that had the period of use for 2 weeks in order.

83 people (30,4%) answered that the reason for replacing contact lenses was to replace one, followed by discomfort for 36 people (13.3%), with the damage of lens was voted next with 18 people (6.6%), while 17 people (6.3%) answered that they lost their lenses, 5 (1.9%) with decreased visual acuity, and one person (0.4%) changed the contact lenses for the desire of another shape or color.

Table 2. Subjects' contact lens wear

(*N*=161)

Items	Variables	n(%)	M±SD
Where to buy	Optician	152(94.5)	
	Ophthalmology	8(4.9)	
	Internet	1(0.6)	
First wearing time			18.38±2.40
Wear period	2 years or less	68(42.2)	3.39±2.26
	3 ~ 6 years	62(38.5)	
	6More than 6 years	31(19.3)	
Currently worn	Yes	115(71.5)	
	No	46(28.5)	
Purpose of wearing	Purpose of correction	63(39.2)	
	Beauty purpose	28(17.3)	
	both	70(43.5)	
Lens type (Material)	Transparent Soft Lens	97(60.3)	
	Color Soft Lens	44(27.3)	
	Hard lens	13(8.0)	
	RPG lens	7(4.3)	
Lens Type (Lifespan)	1 day	24(14.9)	
	For two weeks	4(2.5)	
	For 6 months	91(56.5)	
	For 12 months	23(14.3)	
	Etc	19(11.8)	
Why replace lenses	It's time to replace	83(30.5)	
	Uncomfortable	36(13.3)	
	Lens damage	18(6.6)	
	Lost	17(6.3)	
	Vision loss	5(1.9)	
	Want a different look or color	1(0.4)	

3.4 The contact lens care status of the subjects

<Table 3> shows the contact lens care status of the subjects in this study.

In contact lens management of college students, 82 people (50.9%) had the experience of being educated on the management method of contact lenses, and 79 people (49.1%) did not have such an educational experience.

The subjects who answered that they wash their hands before wearing the lens were 147 people (91.3%), and 149 people (92.5%) answered that they cleansed their lenses. As for the cleansing method, 86 people(53.2%) immersed the contact lenses in the washing solution, 72 people (44.7%) rubbed them with their hands, 58 people (36.0%) washed them in a running solution, and 5 people (0.1%) answered "others".

Table 3. Subjects' actual condition of contact lens management

(*N*=161)

Items	Variables	n(%)	M±SD
management training experience	done	82(50.9)	
	not done	79(49.1)	
washing hands before wearing lens	done	147(91.3)	
	not done	14(8.7)	
lens cleaning			
done or not done	done	149(92.5)	
	not done	12(7.5)	
way *	rubbed with hand	72(44.7)	
	cleaned with running fluid	58(36.0)	
	immersion in fluid	86(53.2)	
	etc	5(0.1)	
type of cleaning fluid*	saline fluid	20(12.4)	
	washing fluid	30(18.6)	
	preservative fluid	25(15.5)	
	mixed fluid	110(68.3)	
	tap water	4(2.2)	
cleaning fluid replacement time(months)			2.64±1.78
lens case			
type of cleaning fluid*	saline fluid	15(9.4)	
	washing fluid	15(9.4)	
	preservative fluid	31(19.2)	
	mixed fluid	110(68.3)	
	tap water	6(3.7)	
Fluid exchange time(days)			2.45±3.25
Side effect experience	present	114(70.8)	
	absent	47(29.2)	
side effect symptoms*	dryness	94(58.3)	
	stiffness	77(47.8)	
	congestion	71(44.0)	
	feeling of foreign matter	67(41.6)	
	itchiness	45(27.9)	
	cloudy vision	41(25.4)	
	etc	4(2.4)	
lens usage after side affect	Continue to use	36(31.6)	
(n=114)	Replace lens	50(43.9)	
	Stop wearing	28(24.5)	

* Duplicate response question

In the study of Kim et al. (2004), 4 hours of immersion were reported to be a more effective cleansing method than rubbing for the prevention of disease, which seemed to be the reason that the subjects of this study are choosing such washing method.

For the type of cleansing fluid, subjects using mixed alcohol showed the highest rate with 110 people (68.3%), 30 people (18.6%) used washing solution, 25 people (15.5%) answered preservative solution, 20 people (12.4%) used saline solution, and tap water was the least favorite with 4 people (2.2%). The average period to replace the washing solution was around 2.64 ± 1.78 months.

Lens case solution showed a similar result with 110 people (68.3%) using mixed alcohol, followed by preservation solution with 31 people (19.2%), 15 people (9.4%) for saline and washing solutions, and 6 people (3.7%) for tap water. The mean solution exchange time of the case was 2.45 ± 3.25 days. In the study of Oh et al.(2007), the results were similar such that 57% of the lens wearers used mixed alcohol, and this must be the case as the mixed solution serves both as a washing and preservative solution which makes the lens care easier and more effective.

The subjects who experienced side effects associated with their lens wear were 114 people (70.8%), whose number does not match the report of Park et al. (2007), which showed 100 (90%) people who experienced side effects. Despite the difference, it shows that many subjects are experiencing side effects. The side effects of wearing the lenses are as follows. 94 (58.3%) people felt dryness, 77 (47.8%) people felt stiffness, 71 (44.0%) people felt congestion, and 67 (41.6%) people felt foreign substances in their eyes. This was similar to the Lee (2008) research that showed 59.4% of people with dryness, 39.0% of people with fatigue, and 35.6% of people with congestion as side effects. After experiencing side effects, out of 114 people, 50 (43.9%) people changed their lenses, 36 (31.6%) people kept using them, and 28 (24.5%) people stopped using lenses. In Kim et al.(2004)'s research, most subjects re-used previous contact lenses and showed a difference from this study. This is due to the fact that access to contact lenses has become easier and more popular than in the past, and there is a growing awareness of the interest in health and overall cleanliness.

3.5 Eye strain according to the General Characteristics and Eye Health Behaviors

Table 4 shows eye strain according to general characteristics and eye health related characteristics of the subjects.

The females' eye strain score was 17.00 ± 4.26, which was significantly higher than the males' eye strain score of 15.29 ± 4.35 ($t = -3.171$, $p = .002$). This reflects the fact that the lens wear rate of female students is higher than that of boys, and it seems that the interest in beauty is usually due to the fact that there are more females than males. As Kim et al. (1995) reported that as the number of the make-up of women increased, the probability of experiencing eye disease was high due to cosmetics entering the eye, and they are more likely to feel eye strain due to the eye irritation caused by the makeup than males.

There was a significant difference in eye strain ($F = 6.380$, $p = .002$), Scheffe's post-test results showed that the eye strain of subjects who underwent a vision test for less than one year was 17.02 ± 4.52, which was higher than the eye strain of 15.50 ± 3.98 points for the subjects who had undergone vision acuity test for more than one year. According to the study of Lee (2007),

this represented that the subjects who suffer from eye discomfort are more interested in vision than those who are not, and in light of the results of frequent vision examinations by the suggestions of the opticians and ophthalmologists visited for correction of vision, it is believed that the eye strain of subjects who underwent visual acuity test for less than 1 year is associated with the discomfort of visual acuity.

Table 4. General characteristics of the subjects and eye strain according to eye health

(*N*=273)

Items	Variables	M±SD	t or F	p
gender	male	15.29±4.35	-3.171	.002**
	female	17.00±4.26		
major field	humanities	16.84±4.53	.795	.498
	natural science	15.79±4.01		
	herbal medicine	16.29±3.07		
	arts and physical education	16.22±4.57		
opposite-sex friends	present	16.51±3.90	.491	.624
	absent	16.25±4.68		
smoking status	smoking	16.03±4.68	1.831	.162
	non-smoking	16.31±4.22		
	smoked in past	19.67±7.37		
drinking status	drinking	16.51±4.28	-1.667	.097
	non-drinking	15.13±4.88		
total sleep time	under 8 hours	16.55±4.48	-.754	.451
	over 8 hours	16.15±4.25		
vision test period	under 1 year(a)	17.02±4.52	6.380	.002**
	over 1 year(b)	15.50±3.98	a>b	
	never received	13.70±2.83		
currently wearing aids	yes	17.09±4.43	4.096	<.001**
	no	14.86±3.84		
lens wearing experience	yes	17.60±4.06	5.988	<.001**
	no	14.56±4.17		
eye disease experience	yes	18.86±4.18	5.903	<.001**
	no	15.48±4.09		
lens wear for eye disease (n=53)	yes	19.34±4.00	2.835	.006**
	no	16.87±4.24		
perceived eye importance	not important	16.57±3.95	.132	.895
	important	16.35±4.38		
perceived eye health	not healthy	17.84±4.28	5.686	<.001**
	healthy	14.99±4.00		
studying posture	sitting on desk (a)	15.46±3.94	6.477	<.001**
	lying down (b)	15.91±5.49	a<b<c<d	
	leaning (c)	16.55±4.02		
	Sit at your desk	17.97±4.62		
	Poor posture (d)			
Weekday TV, smartphone, and computer device use hours	Less than 5 hours	16.31±4.38	-.278	.781
	More than 5 hours	16.47±4.36		

*p<.05, **<.01

The eye strain of the subjects currently wearing ancillary equipment was 17.09 ± 4.43 points, which is significantly higher than that of 14.86 ± 3.84 points (t = 4.096, p <.001) of those who were not wearing them. The eye strain of the subjects with the experience of contact lens wear was 17.60 ± 4.06, which was significantly higher than that of 14.56 ± 4.17 (t = 5.988, p <.001) of those without the experience of contact lens wear. The eye strain of the subjects with eye disease was 18.86 ± 4.18 points, which was significantly higher than that of 15.48 ± 4.09 (t = 5.903, p <.001) of those who without experience of eye disease. Kim (1993) suggested that wearing eyeglasses or contact lenses that do not fit well may lead to eye strain and damage, so it is important to take an eyesight test under the supervision of an ophthalmologist. 144 (55.6%) out of the 259 subjects in the study were believed to have high eye strain because they are currently wearing an unsuitable ancillary equipment by conducting a visual acuity test at the optician instead of the hospital. In addition, it was thought that contact lens wear affects eye strain based on the studies of Jeong (2009) [20] in which he claimed that the contact lenses caused eye related complications and deteriorated eye health, of Lim, Lee, Choi, Jeong and Jo(2009) that showed the contact lens stimulated the eyes, and of Lee (2008) that the contact lens wear changed the thickness of the cornea. The fact that the eye strain of students with the experience of eye disease is higher than that of students without eye disease showed A similar result to that of the study of Kim (1993), identifying that the eyes can easily get tired when eyes have any disease. The eye strain of the subjects wearing contact lens was 19.34 ± 4.00, which was significantly higher than that of 16.87 ± 4.24 (t = 2.835, p = .006) of those who were not wearing them. eye strain of students who perceived that the eyes were not healthy was 17.84 ± 4.28, which was significantly higher than that of 14.99 ± 4.00 (t = 5.686, p <.001) of those who were perceived to be healthy. It is thought that students who feel much eye strain often feel uncomfortable eyes and recognize that their eyesight is not good.

There was a significant difference in the eye strain scores according to the study posture (F = 6.477, p <.001). According to the Sheffe post-test results, the scores were meaningful in the following orders of 17.97 ± 4.62 points for those who study on the desk with wrong posture, 16.55 ± 4.02 points for those who were leaning, 15.91 ± 5.49 for those who were lying, and 15.46 ± 3.94 for those who sat on the desk. This was consistent with what Baek (2002) found that visual acuity was heavily influenced by learning attitudes, however, there was no statistically significant difference between the two groups in the study of Cho (2008), which compared the reading attitudes of normal eyesight group and low vision group, with the opposite findings to this study. This is because the college students who were the subjects of this study are more likely to study than the elementary school students who were the subjects of Cho (2008).

There was no significant difference in the eye strain according to majors, the total number of friends, smoking status, drinking status, total sleep time, perceived eye importance, weekday, TV, smartphone, and the time of use of computing devices.

3.6 Eye strain according to the contact lens caring method

Table 5 shows eye strain according to the contact lens caring method of the subjects. Experience with side effects of contact lens wear is related to eye strain because the eye strain of subjects

who experienced side effects from wearing contact lens was 18.30 ± 3.99, which was significantly higher than that of 15.91 ± 3.76 (t = 3.502, p = .001) without any side effects.

Table 5. Eye strain rate due to contact-lens management

(*N*=161)

items	variables	M±SD	t or F	p
Management training experience	done	17.62±3.98	.062	.951
	not done	17.58±4.17		
hand washing	done	17.63±4.10	.304	.761
	not done	17.29±3.81		
washing	done	17.66±4.03	.607	.545
	not done	16.92±4.56		
side effect experience	done	18.30±3.99	3.502	.001**
	not done	15.91±3.76		
coping	constant use	18.33±3.01	.047	.954
	lens replacement	18.18±3.99		
	stop wearing lens	18.46±5.10		
purpose of wearing	correction	17.87±3.55	.718	.489
	beauty	16.79±3.82		
	both	17.69±4.57		
lens type(life expectancy)	disposable lens	18.29±4.44	1.172	.325
	for 2 weeks	21.25±3.86		
	for 6 months	17.48±3.87		
	for 12 months	16.96±3.80		
lens type(material)	transparent soft lens	17.58±3.88	1.827	.144
	color soft lens	18.30±4.63		
	hard lens	17.08±3.55		
	RGP lens	14.57±2.51		
wear time	under 8 hours	16.42±3.58	-2.921	.004**
	over 8 hours	18.31±4.19		
wearing days(week)	under 4 days	16.50±4.07	-2.273	.024*
	over 4 days	18.07±3.98		
wearing period	under 4 years	17.96±4.09	1.477	.142
	over 4 years	16.98±3.97		

*p<.05, **<.01

The eye strain according to contact lens wear time of more than 8 hours was 18.31±4.19, which was significantly higher than that of 16.42 ± 3.58 points (t = -2.921, p =. 004) of those who wearing less than 8 hours. Park (2009) reported that the recommended wearing time of general contact lenses was 8 to 10 hours, and wearing more than this would cause problems such as eye disease, foreign body sensation, redness, and dry eye, which had similar findings to this study.

eye strain according to the days of wearing contact lenses per week, the mean score for the subjects mainly wearing more than 4 days was 18.07 ± 3.98, which was significantly higher than the score of 16.50 ± 4.07 (t = -2.273, p = .024) of those who wearing less than 4 days. This is similar to the results of Park (2009), who claimed that wearing regular contact lenses over the recommended wearing period of 3 to 4 days or more repeatedly caused eye strain due to the low oxygen permeability.

There was no significant difference in the eye strain according to the educational experience on how to care for contact lenses, hand washing before wearing lenses, whether or not the lenses are cleaned, after the experience of side effects by wearing contact lenses, the purpose of wearing contact lenses, contact lens type and lifespan, and the contact lens wearing period.

4. Results and Suggestions

The purpose of this study was to provide basic data for nursing interventions related to the eye health of the college students by identifying the eye health related characteristics and eye strain, and the actual conditions of the contact lens care.

The results of this study showed that the average age of subjects was 22.04 years old and 62.3% women, more than men. The subjects who did not know the visual acuity of the eye health were 44.3%, and the visual acuity test time was less than 1 year (61.9%), the optical shop was the highest with 55.6% for the place of visual acuity test. 67.0% of the subjects were wearing eye aids, 60.8% wearing glasses, 58.9% wearing contact lenses, and 52.5% wearing glasses and lenses at the same time, and the first time to wear a eye aid was 14.27 yeas old. 11.0% of the subjects have had eye surgery, and 24.5% had the experience of eye drops. Eye related symptom experience was followed by 61.2% of sensitivity, 58.6% of dryness, and 44.6% of itching. In contact lens wear, 94.4% of subjects purchased the contact lens from the opticians, and the first contact lens wear was 18.38 years old. The purpose of wearing was 43.4% for both correction and cosmetic purpose, 39.1% for correction purpose, and 17.3% for cosmetic purpose only. As for the lens type according to the material, the transparent soft lens is 60.2%, the lens type according to the lifespan was 56.5% for 6 months, and the reason for replacing the lens was the replacement period, which was the highest at 30.4%. In contact lens management, 50.9% were trained and 90.3% washed hands before wearing the lenses. 92.5% of the subjects washed their lenses, and the lens cleaning method was followed by 53.4% of immersion in the washing solution, 44.7% rubbed lenses with their hands, and 36.0% washed the lenses in the running solution. The most used lens cleaning solution was the mixed one with the highest of 68.3%, the replacement time for the washing solution was 2.64 months, the preservative solution in the lens case was also the mixed one with highest of 68.3%, and the replacement time of the preservative solution in the lens case was 2.45 days. The subjects who experienced contact lenses' side effects were 70.8%. The most common symptoms of contact lenses were dryness (58.3%), tightness (47.8%) and redness (44.0%). After experiencing contact lens side effects, the rate of the lens replacement showed 43.9%.

The subjects' general characteristics and eye health related characteristics showed significant differ-

ence from eye strain in gender (t = -3.171, p = .002), the timing of the visual acuity test (F = 6.380, p = .002), wearing vision aids (t = 4.096, p <.001), lens wearing experience (t = 5.988, p <.001), presence or absence of eye disease (t = 5.903, p <.001), lens wearing at the time of eye disease, lens wear (t = 2.835, p = .006), and sitting posture (F = 6.477, p <.001). In addition, the contact lens caring method showed significant difference from the eye strain in the experience with side effects from wearing contact lenses (t = 3.502, p = .001), contact lens wear time per day (t = -2.921, = .004), wearing days per week (t = -2.273, p = .024). The results of the above study showed that those who wear contact lenses had a higher eye strain than those who did not wear contact lenses, and the subjects who wear contact lenses more than 8 hours a day and more than 4 days a week were found to have a higher eye strain.

Based on the results of this study, the followings are suggested.

First, with respect to the nursing research, since there is a lack of prior research on the eye health care for college students, more research is needed, and there is a limit to generalize this study because sufficient samples cannot be obtained for this study, so an extensive study of the sample is needed. In addition, it is necessary to conduct an in-depth research on the eye health considering various factors such as lifestyle and environment for the college students

Second, in terms of nursing education, systematic education on the proper care of contact lenses and customized guidelines for the college students are needed.

Third, it is necessary to develop a nursing intervention program such as rhythmic vision strengthening exercise which reduces eye strain in nursing practice.

Fourth, promotions through national campaigns are also needed to encourage the college students to participate in the eye health care for the nursing policy.

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