

## Investigation of the effect of online education on eye health in Covid-19 pandemic

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**Abstract:** The aim of this research is to evaluate the effect of online education on eye health in Covid-19 pandemic and to present a new scale on this subject. For this purpose, 402 students (257 females, 145 males) with a mean age of 20.26 from different faculties of Pamukkale university were asked about eye health by e-mail between 8-13 July 2020. Also, eye fatigue questionnaire was applied to evaluate eye fatigue. Corrected item-total correlations and Cronbach Alpha internal consistency coefficient techniques were used for reliability analysis. In this study, online education eye health scale in Covid-19 pandemic was found to be positively correlated with eye fatigue questionnaire. According to the results of simple linear regression analysis conducted to determine the predictive value of the online education eye health scale in Covid -19 pandemic to eye fatigue, it was found that the online education eye health scale in covid-19 pandemic significantly predicted eye fatigue. Data analysis were conducted with SPSS 21.0 statistical package program in 0.01 significance level.

## 1. INTRODUCTION

The novel coronavirus originated from a seafood market place at Wuhan, China. The zoonotic resource of SARS-CoV-2 is unclear, but, previous analysis suggested bats as the main key reservoir (Lu et al., 2020). As yet, no hopeful clinical treatments or prevention methods have been developed against human coronaviruses. The main transmission ways of coronaviruses are direct or indirect human contact, and viral droplets (Yuan et al., 2006). These transmission pathways lead to the rapid spread of the disease. Therefore, social distance and hygiene are very important in preventing the spread of the disease.

Coronavirus family had caused outbreaks in the past for example severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) (Wang et al., 2013; Zhong et al., 2003). SARS CoV-2 is responsible for Covid-19 pandemic worldwide. Covid-19 had some common symptoms like sore throat, cough, and fever (Tian et al., 2020). While Covid-19 may be asymptomatic or mild in most patients, it may be severe in some patients, leading to renal failure, respiratory failure and multiple organ failure (Chen et al., 2020; Huang et al., 2020). While typical symptoms were seen at the beginning of the pandemic, then atypical symptoms such as muscle pain, loss of taste or smell, and headache started to appear (Huang et al., 2020; Lee, Min, Lee & Kim, 2020).

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Eye fatigue-asthenopia consists of subjective complaints that cause discomfort in the eye (Gowrisankaran, Nahar, Hayes & Sheedy, 2012). Asthenopia manifests itself with complaints such as eye discomfort, tearing, dryness, blurred vision, inability to focus, foreign body sensation (Neugebauer, Fricke & Russmann, 1992). This is an important condition that affects attention and academic performance. In our age, the use of digital devices is increasing, depending on the technological developments. In addition, this period of use is increasing in the new generation. As a result, the risk of eye strain increases especially in young people. Considering the previous literature, it has been stated that asthenopia may be associated with various psychosocial and environmental factors. Prolonged near work, increased cognitive load, using computer/screen can affect the eye fatigue complaints (Agarwal, Goel & Sharma, 2013; Ostrovsky, Ribak, Pereg & Gatton, 2012).

The prevalence of eye fatigue was observed by previous studies. Han et al., (2013) reported the prevalence of 57% in Chinese students (Han et al., 2013). In another study, the prevalence of asthenopia was found to be 53.3% in collage students. Also workload, time spent on computer per day, sexuality and time spent on handheld digital devices were found significantly related eye fatigue/asthenopia in this study (Xu, Deng, Wang, Xiong & Xu, 2019).

All social layers in society have been seriously affected by the Covid-19 pandemic. Especially people over the age of 65 have been the most restricted socially in this process. On the other hand, the education and training activities of young people were interrupted during this period. During this period, young people also had to stay at home. At the same time, online education activities have increased in this process. Online education has replaced face-to-face education widely all over the world. In this process, students were left alone with the screen for long hours. While this situation shapes their social relations and behavior patterns, it also affects the eye health.

The Covid-19 pandemic is one of the most important social events of the last century worldwide. The pandemic, which first started in China, spread to the whole world in a very short time and has seriously affected our country. Since the first case in our country, serious measures have been taken and the spread rate of the Covid-19 pandemic has been tried to be reduced. Within the scope of these measures, schools were closed and online education-training activities continued. In our study, we aimed to measure the effect of online education on eye health of university students. In addition, we aimed to look at the consistency of the scale we developed with this survey by applying eye fatigue questionnaire.

## **2. METHOD**

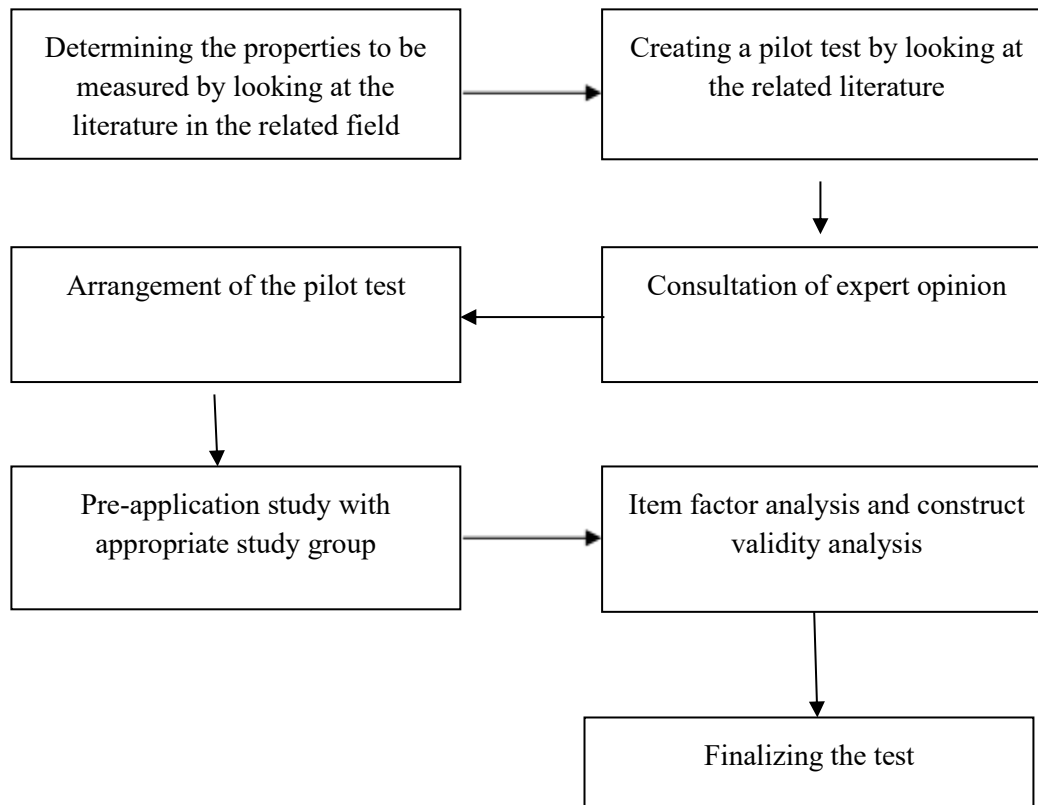
### **2.1. Study Group**

Our study group consisted of 402 university students who receive education in different faculties of Pamukkale University during the 2019-2020 academic year. Participants of this study are students of Faculty of Education, Faculty of Arts and Sciences, Faculty of Engineering, Kale Vocational School, Tavas Vocational School and Faculty of Medicine. 257 (63.9%) female and 145 (36.1%) male students were included in this study. The mean age of the participants was 20.26 years.

### **2.2. Procedure**

First the literature on the concept of eye health in Covid-19 pandemic was reviewed and the knowledge and theories related to this field were analysed. A pilot test was created by looking at the related literature. During the creation of the pilot test, it was asked to 5 field and measurement/evaluation experts to reflect the test to be measured. The pilot test was arranged and applicated to an appropriate sample. The pilot test application was carried out with 78 university students in order to check whether the items in the scale would be comprehensible

to students. This application was carried out by the researcher via online and students' feedbacks were taken into consideration. Based on the analysis performed on students' feedbacks, five items were removed from the draft scale. This way, the scale with four items became ready for test application. The items were determined by item-factor analysis. And also to get evidence construct validity Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were carried out. Finally the online education eye health scale in Covid-19 pandemic was formed. The flow diagram of the study is shown in [Figure 1](#).



**Figure 1.** *The flow diagram of the study.*

The eye fatigue questionnaire consisted of 10 questions (tired eye, sore/aching eye, irritated eye, watery eye, dry eye, eye strain, hot/burning eye, blurred/doubled vision, difficulty in focusing/headache, visual discomfort). The online education eye health scale in Covid-19 pandemic was a four-item and one sub-dimensional scale. The scale was a 3-point Likert type. The items of scale were 1: my eye health has not changed, 2: slight deterioration in my eye health 3: severe deterioration in my eye health. The eye fatigue questionnaire and online education eye health scale in Covid-19 pandemic were applied to university students by an e-mail. Before starting test necessary explanations were made. The tests were applied between 8-13 July 2020.

**Statistical Analysis:** Before starting statistical analysis, it was checked whether there was any missing data in the data set. After determining that the data set had a normal distribution (see Table 2 for skewness and kurtosis), the research data were analyzed. Cronbach Alpha technique was preferred for reliability analysis. Furthermore, Pearson correlation and simple linear regression analysis were used in the analysis of the data. The analysis was tested with the help of IBM SPSS program with a 0.01 level of significance.

### 3. RESULTS / FINDINGS

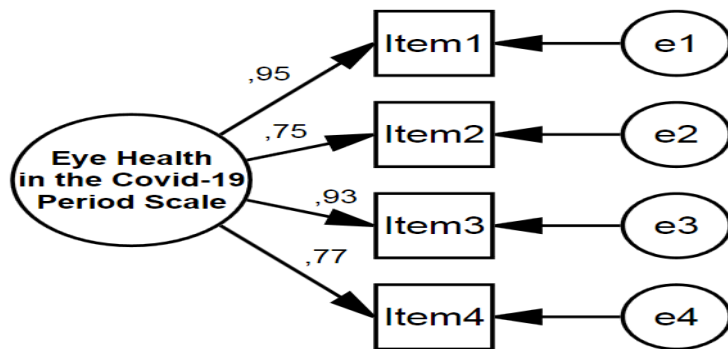
In this part of the study, construct validity analysis, reliability analysis, correlation and simple linear regression analysis are included.

#### 3.1. Construct Validity

In order to determine properties of factorial design, Exploratory Factor Analysis (EFA), Before EFA, to test whether the sample size is sufficient for factoring, Kaise-Meyer-Olkin (KMO) test was carried out. As a result of analysis, KMO value was calculated to be .798. In accordance with this finding, sample size can be acknowledged to be “sufficient” for exploratory factor analysis (Field, 2009). Furthermore, results of Barlett’s Test of Sphericity revealed that chi-square value was seen to be significant  $\chi^2= 922.98$  ( $p<.001$ ). After collecting these evidences about the suitability of the data set, factor analysis performed using the principal components analysis method (Tabachnick & Fidell, 2012). In the consequence of EFA, a single factor structure that explains 76.10% of total variance was obtained. In the result of the study, it was seen that item factor loads ranged from .79 to .83.

**Table 1.** Finding Related to the Psychometric Properties (EFA and CFA) of Eye Health in the Covid-19 Period Scale

Item No	EFA	CFA	
	$\lambda^2$	Standardized Coefficient	t-value (C.R)
1	.83	.95	4.91
2	.79	.75	10.29
3	.81	.93	6.02
4	.81	.77	10.22



**Figure 2.** Path Diagram and Factor Loadings of Eye Health in the Covid-19 Period Scale

In the evaluation of the Confirmatory Factor Analysis (CFA), various fit indices are used. The frequently used ones are; chi-square fit ( $\chi^2$ ) and the ratio of chi-square to the degree of freedom ( $\chi^2/sd$ ), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Adjustment Goodness of Fit Index (AGFI) and Standardized Root Mean Square Residual (SRMR) (Bayram, 2016; Brown, 2006). Less than 3 calculated  $\chi^2/sd$  ratios, lower than .08 RMSEA and SRMR values, and bigger than .90 GFI, AGFI, and CFI values indicate the model data compatibility (Bayram, 2016; Brown, 2006; Schumacker & Lomax, 2010). The results of confirmatory factor analysis demonstrated that scale yielded a single factor ( $\chi^2/sd= 0.22$ ,  $p<0.001$ , RMSEA=0.00, SRMR= 0.00, GFI=1.00, AFGI=0.99, CFI=1.00). According to the obtained results, it can be stated that the Eye Health in the Covid-19 Period Scale possesses an acceptable level of model-data compatibility. In order to determine

whether these values are acceptable, the C.R. (critical ratio) values, which are accepted as t-values in the AMOS program, were examined and each item was determined to be above the lower limit of 2.56 for significance at the .01 level. The t-values of the items on the scale ranged from 4.91 to 10.29. Accordingly, it can be stated that there is no need to remove any item from the scale and also the results of the confirmatory factor analysis indicated that the single factor structure fits well (Brown, 2006; Çokluk, Şekercioğlu, Büyüköztürk, 2014; Schumacker & Lomax, 2010).

**Table 2.** Reliability Analysis of Eye Health Scale in Covid-19 Period

Item No	Corrected item-total correlation	M (SD)	Skewness	Kurtosis
1	.84	2.05	-0.11	-1.71
2	.80	2.11	-0.23	-1.59
3	.80	2.08	-0.16	-1.62
4	.83	2.07	-0.15	-1.67

\*Cronbach Alpha = 0.92

Corrected item-total correlations and Cronbach Alpha internal consistency coefficient analysis were used for the reliability of the online education eye health scale in Covid-19 pandemic. The adjusted item-total correlations of the scale have a value between 0.80 and 0.84. According to the analyzes, Cronbach Alpha reliability coefficient of the scale was obtained as 0.92 (Table 2).

**Table 3.** Correlation Values Indicating Relationships Between Eye Health and Eye Fatigue in the Covid-19 Period

	Eye Fatigue
Eye health in the Covid-19 period	.78**

\*\* $p < 0.01$

According to the results of the analysis, a positive ( $r = .78, p < .01$ ) correlation was found between eye fatigue and online education eye health scale in Covid-19 pandemic (Table 3).

**Table 4.** Simple linear regression analysis results regarding the power of online education eye health scale to predict eye fatigue survey in Covid-19 period

Predictor variable	R	R <sup>2</sup>	F	B	Standart error B	t	p
Eye health in the Covid-19 period	.78	.62	652.44	4.20	0.16	25.54	.000

$p < 0.01$

According to the simple linear regression analysis results, it was observed that the eye health scale significantly predicted eye fatigue in Covid-19 period. According to these analyzes, eye health in covid-19 period explained 62% of the total variance related to eye fatigue ( $R^2 = .62$ ;  $F_{Reg} = 652.44$ ;  $p < .01$ ) (see Table 4).

#### 4. DISCUSSION and CONCLUSION

The Covid-19 pandemic has profoundly affected all societies in the world, and has had many social, economic and psychological results. One of these results is the social isolation measures have been taken to slow the course of the disease. Schools and universities, where interpersonal distance cannot be maintained, are among the most easily spread environments. For this reason, it is very important to take necessary measures regarding education to reduce the speed of

transmission of the epidemic (Afacan & Avcı, 2020). Accordingly, the Board of Higher Education has decided to close schools all over Turkey for three weeks from the date of March 16, 2020. Schools remained closed due to the continuing outbreak, and the Spring term was completed with online education. Although online education has the effect of reducing the transmission rate, it may have negative effects on eye health.

In this study, the effect of online education on eye health in Covid-19 period was investigated and a scale was developed on this subject. In addition, the relationship between eye health and eye fatigue in online education was investigated in Covid-19 period using scale. First of all, according to the analysis conducted for the scale, scale has been brought to the literature as a valid and reliable tool (see [Tables 1, 2](#) and [Figures 1, 2](#)). With the developed scale, it was observed that the eye health of the university students was negatively affected by the online education of the Covid-19 pandemic process. In addition to this result, in the Covid-19 period, a positive correlation was found between the deterioration of eye health and eye fatigue in online education. In other words, eye fatigue increases as the result of online education deteriorate eye health.

In recent years, internet and screen usage has been increasing rapidly among the youth. Eye health can be negatively affected due to this increase. Previous studies have shown that eye health related to screen usage may be seriously affected. Digital screens like tablets, computers and mobile phones can cause harm by radiating short high energy waves that may penetrate eye tissues and can finally contribute to photochemical damage to the retinal cells. By this way, harmful waves can cause a variety of eye problems ranging from dry eye to age-related macular degeneration (Bhattacharya, Saleem & Singh, 2020). It has been stated that as the duration of daily internet use increases, asthenopic complaints also increase significantly (Kaya, 2019). Another study indicated that computer use for more than 6 hours led to an increase in eye fatigue complaints (Agarwal, Goel & Sharma, 2013). In addition, it has been shown in previous studies that the symptoms of eye fatigue such as burning sensation, dryness, and tearing in the eyes due to the use of electronic devices such as computers and mobile phones have increased (Kaya, 2019; Kim, Lim, Gu & Park, 2017). In the study conducted by Kim et al. (2017), 59 participants used tablets and smart mobile device for 1 hour. Eye fatigue was evaluated before and 1 hour after using the tablet. According to this study, using tablets for 1 hour significantly increased the complaints of eye fatigue/asthenopia (Kim et al., 2017).

Environmental and social factors can also affect the eye health. In the study of Guo et al. on 1022 students; students' socioeconomic, dietary habits, lifestyles, eye-related symptoms, eye care habits and history of diseases were evaluated. In this study, it was investigated whether there is a relationship between fruit-vegetable consumption and the risk of asthenopia. According to the results of the study, it was found that dark-green leafy fruit consumption is associated with a lower risk of asthenopia (Guo et al., 2018). In the study conducted by Suh et al., (2018) on 60 patients, the patients slept in the laboratory for 3 nights. On the 3rd night, the patients slept in a 5-10 lux light environment. Eye fatigue findings were evaluated in the morning of the third day and on the fourth day. It was observed that eye strain, difficulty in focusing and ocular discomfort increased significantly in patients sleeping at 10 lux light intensity (Suh, Na, Ahn, & Oh, 2018).

#### **4.1. Limitations and Suggestions**

The study includes university students studying at various faculties of Pamukkale University. This can only give an idea about students studying at this university. Multicenter studies can give a wider idea about the subject. Also, trying to determine whether this new scale measures eye health in different age groups can be considered as a new research topic. This study is a quantitative research. In order to test the results of this study, a qualitative research on a similar subject may be proposed in the future.

In summary, it can be said that the validity and reliability of the eye health scale related to online education is sufficient in the Covid-19 period, which we prepared for the students who stayed at home during the Covid-19 period and thought that their eye health would deteriorate due to the use of more screen in addition to their normal use. In addition, it can be said that it was positively correlated with the eye fatigue questionnaire and its predictability was good.

### Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. Permission was received from the Non-Interventional Clinical Ethics Committee of a University (dated 07.07.2020 and numbered 13). The scientific and legal responsibility for manuscripts published in IJATE belongs to the author(s).

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## 6. APPENDIX

If you would like to provide appendices, please provide here. You might put the scale items, if used in the study, or syntax, etc. if you wish to provide them.

### **Online education eye health scale in Covid-19 pandemic**

1. In what way was your eye health affected in general, compared to the time before the epidemic, when you stayed at home and received online education due to the COVID-19 pandemic?

- (1) My eye health has not changed
- (2) Slight deterioration in my eye health
- (3) Severe deterioration in my eye health

2. In what way did watching the lessons on your computer / tablet / mobile phone affect your eye health due to the COVID-19 pandemic?

- (1) My eye health has not changed
- (2) Slight deterioration in my eye health
- (3) Severe deterioration in my eye health

3. How did doing homework on your computer / tablet / mobile phone affect your eye health during the COVID-19 pandemic?

- (1) My eye health has not changed
- (2) Slight deterioration in my eye health
- (3) Severe deterioration in my eye health

4. During the COVID-19 pandemic, how did your use of more television / computer / mobile phones affect your eye health during the days you stayed at home?

- (1) My eye health has not changed
- (2) Slight deterioration in my eye health
- (3) Severe deterioration in my eye health