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ORIGINAL ARTICLE

Investigation of the Effect of Using Surgical Face Masks on Aerobic and Anaerobic Performance of Children During Educational Games

MEHMET ŞERIF ÖKMEN[1], YAŞAR KÖROĞLU[2], MEHMET SARIKAYA[3]
[1]*National Education Directorate, Physical Education Teacher, Kayseri*
[2]*Correspondence to: Dr. Mehmet Şerif ÖKMEN*
[3]*Bingol University, Vocational School of Social Sciences, Bingol, Turkey*
Correspondence to: Mehmet Şerif Ökmen, Email: mserifokmen@gmail.com

ABSTRACT

Aim: This study aimed to examine the effect of participating in educational game activities with and without a surgical face mask on the aerobic and anaerobic performance levels of children aged 12-13.

Methods: Two male groups, unmasked (n=22) and masked (n=22), participated in the study. Pre-test post-test experimental model was used in the study. The aerobic performances of the groups were determined by the 20m shuttle test, and the anaerobic performances of the groups were determined by the vertical jump test. After the pretest scores of the groups were taken, educational game activities were applied to both groups three days a week for eight weeks. At the end of the eighth week, post-test scores were obtained. These data were presented as arithmetic mean and standard deviation. Independent sample t test was used to compare independent groups and paired sample t test was used to compare dependent groups.

Results: Significance level was set as $p<0.05$. When the pretest and posttest values of age, height and body weight of the groups were compared between the groups, no significant difference was observed ($p<0.005$). However, when looked at the in-group scores, it was observed that there was a significant difference in the body weight values of the masked group ($p<0.001$). In addition, there was a significant difference between the pretest and posttest aerobic performance ($MaxVO_2$) scores of both groups within the group comparison ($p<0.001$), but no significant difference was found in the groups' anaerobic performance scores ($p<0.005$). However, there was no significant difference between the pretest scores between the groups, while a significant difference was observed between the post-test aerobic ($p<0.001$) and anaerobic ($p<0.005$) scores.

Conclusion: As a result, children's participation in regular educational games activities both with and without masks contributes positively to their aerobic performance and it can be said that the aerobic (16.69%) and anaerobic (1.01%) performance scores percentages of the masked group improved more than the unmasked group.

Keywords: COVID-19, Surgical Face Mask, Aerobic, Anaerobic, Educational Game.

INTRODUCTION

Throughout history, humans have always struggled to survive. This struggle has been in wars, against natural disasters and epidemic diseases. Hundreds of thousands or millions of lives were lost in these disasters. The new coronavirus (Covid19) pandemic, which emerged in Wuhan, China in December 2019 and spread and influenced the whole world, has become the first agenda of life and governments [1]. The new type of coronavirus epidemic, which is seen in the world and in our country and attributed as a pandemic, causes people to die [2]. In order to reduce the negative effects of this epidemic, a series of measures were taken in our country, as in many countries. Undoubtedly, among these measures, the primary one is wearing a mask.

Behavioral, non-pharmacological interventions, including the use of masks, self-isolation, quarantine, and even the lockdown of entire zones and communities, are strategies currently implemented to prevent person-to-person transmission [3,4]. The mask is a simple object but provides a high level of protection. Because the virus mainly affects the respiratory tract (nose, mouth, and lungs), it is highly contagious when people sneeze or cough, or when respiratory droplets are exchanged with other people. This transmission can also occur when a person is doing physical exercise [5].

Due to the epidemic, it is obligatory to wear masks in many open and closed areas, as well as while doing exercise. However, the effect of mask use during exercise is not known exactly [6]. The US Center for Disease Control and Prevention has announced that it is important for all people aged 2 and over to wear a cloth mask during indoor and outdoor exercise during the epidemic [7]. In the statement made by the World Health Organization, it was stated that wearing a mask during exercise may reduce the breathing of individuals comfortably, and the sweat that occurs during exercise may cause respiratory distress and increase the growth of microorganisms [8]. In the USA, it has become mandatory to use masks in sports activities where social distance cannot be maintained [9]. Likewise, the use of masks has been mandatory for the general population in gyms and fitness centers to reduce and prevent the contagiousness of the epidemic [10]. As such, during the COVID-19 epidemic, physical activity practices such as walking, running, gymnastics, dancing, cycling have raised doubts about how wearing a mask and breathing affect, decrease performance or increase the possibility of contamination [11]. In addition, it created the need to learn how the use of masks during exercise affects the maximum exercise level and performance of individuals [12]. Educational games are defined as activities that help children have fun, have a good time, be healthy and protect their health [13]. Children participating in educational games make the best use of their free time, and these games also contribute positively to children's balance, agility, social and emotional development, perceptual and motor development [14]. In addition, educational games have a very important place for the physical and physiological development of children [15].

In line with this information, when the relevant literature was examined, it was observed that the effects of mask types on acute performance during the pandemic period were examined, but it was observed that chronic studies were lacking. This study aimed to determine the aerobic and anaerobic performance levels of children aged 12-13 during the pandemic period and to examine the effect of participating educational game activities with and without a surgical face mask on aerobic and anaerobic performance scores for eight weeks.

MATERIAL AND METHODS

Research Group: Male students aged 12-13 studying at Kayseri Kızılören Parlaklar Secondary School voluntarily participated in the study. Volunteers participated in two groups as unmasked (n=22) and masked (n=22). After obtaining written consent from the families of the volunteers and the school administration, the research was conducted.

Experimental Procedure: Two groups voluntarily participated in the study, one wearing a surgical face mask and one not wearing a mask. Anaerobic power measurement scores were taken from the volunteers by the vertical jump method, and the pretest scores were obtained by measuring the max/VO_2 aerobic performance scores in ml/kg/min with the 20-meter shuttle run test. Afterwards, both groups were given an educational game activity, dodgeball

and handkerchief snatch, which lasted 60 minutes, 3 days a week, for eight weeks. At the end of the eighth week, the same pre-test protocols were applied again, and post-test scores were obtained.

Data Collection Tools:

Age, height and body weight measurements: the age of the participants was calculated as years from their identity records. In height measurements, tape measure with a sensitivity rating of 0.01 cm was used. Measurements were taken with the participants' feet bare. Measurements; head is upright, soles of the feet are pressed straight to the ground, knees are stretched, heels are adjacent and the body is taken upright. Their body weight was measured with bare feet and minimal clothing with a floor scale of 0.1 degrees.

Vertical Jump and Anaerobic Capacity: For the measurement of anaerobic power, volunteers are determined by measuring the distance between the most extreme point that athletes can reach by extending their arm on the platform hanging on the wall and the most extreme point they can reach by jumping. The best result, repeated twice in each voluntary test, was replaced in the relevant formula and anaerobic power value was found [16].

Anaerobic power calculation was made with the Lewis formula given below [17] and the result was recorded in kg-m/sec.

P= √4.9*body weight √D

P = vertical jump

D= Vertical jump distance (in meters)

20m Shuttle Run: The shuttle run test was applied to determine the aerobic capacity of the volunteers. The 20 m shuttle run test is a test that starts at 8.5 km.h-1 (9 seconds), in which the running speed increases by 0.5 km.h-1 in every 1 minute, and the 20 m distance is run as a round trip. The running speed was controlled by a computer that gave signals at regular intervals and a speaker connected to the computer. The test application was terminated when the volunteer could not reach the two signals one after the other or when the test was interrupted [18]. As a result of the test, the $MaxVO_2$ values were determined as an estimate in ml/kg/min from the evaluation table of the total number of sit-ups performed by the volunteers [19].

Statistical Analysis: SPSS 22.0 statistical package program was used in the analysis of the data. The normality distribution was analyzed using the Shapiro-Wilk test. Since the data showed a normal distribution, the independent sample T test was used to compare the independent groups, and the paired sample T test was used to compare the dependent groups. The significance level of the data was taken as $p<0.05$.

RESULTS

Table1: Comparison of Intra-Group Descriptive Characteristics

Variables	Unmasked (n=22)				Masked (n=22)		
		x̄±ss	t	p	x̄±ss	t	p
Age (years)	pre-test	12,56± 0,50	0,403	0,689	12,50±0,51	0,403	0,689
	post-test	12,56±0,50			12,50±0,51		
Length (cm)	pre-test	155,60±7,24	0,322	0,749	154,95±6,24	0,322	0,749
	post-test	155,60±7,24			154,95±6,24		
Body Weight (kg)	pre-test	45,36±8,11	3,781	0,001***	41,72±5,36	1,322	0,200
	post-test	44,24±8,51			41,40±5,15		

$p<0.05^{*}$, $p<0.001^{***}$ cm: height; kg: body weight.

Table 2: Comparison of Intra-Group Aerobic and Anaerobic scores

Variables		Unmasked (n=22)			Masked (n=22)		
		x̄±ss	t	p	x̄±ss	t	p
$MaxVO_2$ (ml/kg/min)	pre test	40,03±9,87	7,198	0,001***	36,30±6,85	4,843	0,001***
	post-test	50,81±11,66			39,29±8,36		
Anaerobic Power (kg-m/s)	pre test	51,38±10,22	1,885	0,072	46,23±8,18	1,502	0,148
	post-test	52,58±10,13			46,85±7,89		

$p<0.05^{*}$, $p<0.001^{***}$ $MaxVO_2$: maximum oxygen consumption.

Table 3: Comparison of Descriptive Characteristics Between Groups

Variables	Groups	pre test (n=22)			post-test (n=22)		
		x̄±ss	t	p	x̄±ss	t	p
Age (year)	unmasked	12,56±0,50	0,403	0,689	12,56±0,50	0,403	0,689
	masked	12,50±0,51			12,50±0,51		
Length (cm)	unmasked	155,60±7,24	0,322	0,749	155,60±7,24	0,322	0,749
	masked	154,95±6,40			154,95±6,40		
Body Weight (kg)	unmasked	45,36±8,11	1,829	0,740	44,24±8,51	1,397	0,170
	masked	41,72±5,36			41,40±5,15		

$p<0.05^{*}$, $p<0.001^{***}$ cm: height; kg: body weight.

Table 4. Comparison of Aerobic and Anaerobic scores Between Groups

Variables	Gruplar	pre test (n=22)			post-test (n=22)		
		x̄±ss	t	p	x̄±ss	t	p
$MaxVO_2$ (ml/kg/min)	unmasked	40,03±9,87	1,517	0,137	50,81±11,66	3,844	0,001***
	masked	36,30±6,85			39,29±8,36		
Anaerobic Power (kg-m/s)	unmasked	51,38±10,22	1,660	0,104	52,58±10,13	2,375	0,022*
	masked	46,23±8,18			46,85±7,89		

$p<0.05^{*}$, $p<0.001^{***}$ $MaxVO_2$: maximum oxygen consumption.

When the in-group descriptive characteristics of the groups are examined as shown in Table 1; While it was observed that there was a significant difference in the body weight values of the unmasked group within the group ($p<0.001$), there was no significant difference in the variables of age and height ($p>0.05$). There was no significant difference in age, height and body weight in the masked group ($p>0.05$).

When the in-group aerobic and anaerobic scores of the groups are examined as shown in Table 2; while it was observed that there was a significant difference in the $MaxVO_2$ values of the unmasked group ($p<0.001$), there was no significant difference in the anaerobic power value ($p>0.05$). While there was a significant difference in $MaxVO_2$ values in the masked group ($p<0.001$), there was no significant difference in anaerobic power scores ($p>0.05$).

When the descriptive characteristics between groups are compared as shown in Table 3; It was observed that there was no significant difference between the pre-test and post-test age, height and body weight variables of the groups ($p>0.05$).

When the aerobic and anaerobic scores of the groups were compared as shown in Table 4 ; While it was seen that there was no significant difference in the pretest scores of the groups ($p>0.05$), there was a significant difference in the $MaxVO_2$ value ($p<0.001$) and anaerobic power value ($p>0.05$) in the post-test results.

DISCUSSION

In this study, it was aimed to determine the aerobic and anaerobic performance levels of boys studying in secondary school, and the effect of children's participation in educational play activities with surgical face masks and unmasked for eight weeks, 3 days a week, on aerobic and anaerobic performance scores was examined.

In the study, when the descriptive feature values of the masked and unmasked groups were compared between the groups, no significant difference was found in the variables of age, height and body weight. In addition, when the in-group pre-test and post-test descriptive feature values were compared; no significant difference was found in the age, height and body weight variables of the masked group. However, while no significant difference was found in the age and height variables of the unmasked group, a significant difference was found in the body weight variables. It is observed that there is a significant difference in the formation of this difference in body weight because the post-test scores of the unmasked group were lower than the pre-test scores. It is thought that this is due to the regular educational games activities.

Playing games, especially those ones requiring physical power, running, jumping, climbing and crawling, ensures the regular functioning of the child's body systems (such as breathing, circulation, digestion, and excretion). Fulfillment of growth-related functions such as burning excess fat in the body, strengthening the muscles, and more regular functioning of the endocrine glands are provided by games that require the movement of the body [20]. It was determined that sports activities play an active role in the physical development of children aged 11-12. Accordingly, it was determined that sports activities affect children's height and weight development significantly [21].

According to the result obtained in this research, it is observed that there is a decrease in body weights in both groups thanks to educational games. However, when looked at the decrease scores, it was observed that the value of the unmasked group is better and more significant than the value of the masked group. It can be thought that the use of masks during educational games by children in the formation of this significant decrease may cause disadvantageous situations such as moistening and getting wet of the mask during breathing, thus negatively affecting the physical activity level of children. Because there was no significant decrease in the scores of the masked group participating in the same exercise type and duration. This may cause them to get tired early and thus not be able to demonstrate the level of physical activity they want, since wearing a mask during educational games limits breathing comfortably. For this reason, it can be thought that the calorie level that children need to spend and with it, the necessary energy deficit may not occur.

While the mask holds the breath a person exhales, exercise will create a warm and humid microclimate around face [22]. With the progress of the activity, the pace will be slower and fatigue will appear more quickly, associated with the unpleasant feeling of moistening of the mask. Compared to normal breathing, wearing any protective mask reduces airflow to the lungs. Less oxygen in the lungs means less oxygen in the blood and muscles, making training more difficult. There is less oxygen available during exercise to convert glucose (sugar) into energy. Therefore, physical activity or any other facial care with a mask is more difficult, because it is necessary to breathe more in order to get the same amount of air in the lungs [22,23].

In this study, when the pre-test and post-test aerobic and anaerobic performance scores were compared; a significant difference was found in the aerobic ($MaxVO_2$) scores of both the masked group and the unmasked group. It was observed that there is a significant difference because the post-test scores of both groups were higher than the pre-test scores. However, no significant difference was found in the intra-group anaerobic performance scores of both groups. In addition, when the pre-test scores between the groups were examined, while there was no significant difference when both aerobic and anaerobic performance scores were compared, when the post-test scores were compared, a significant difference was found in both aerobic and anaerobic performance scores. While regular educational play activities for children contribute positively to the aerobic performance of both groups, it was observed that only the unmasked group has a positive increase in anaerobic performance. When looked at the percentage value of these changes of the groups; a difference of 8.23% was observed between the pre-test and post-test scores of the aerobic performance of the masked group, and an increase of 1.32 in their anaerobic performance. It was observed that there was a 26.92% increase in the aerobic performance of the unmasked group between their pre-test and post-test scores, and an increase of 2.33% in their anaerobic performance. Thus, it can be said that both groups' aerobic and anaerobic performances improved, but the use of masks limited the development of their performance level.

Regardless of which motoric feature is dominant in an educational game, it is possible to develop other motoric features. Only the proportion of developed features differs. From this point of view, it is understood that educational games are an important tool in terms of multi-faceted development of both motoric features and nerve, muscle and joint coordination [24]. In the fighting games, the child is constantly struggling with movement activities and body features such as running, climbing, jumping, grappling, pulling, pushing and carrying. As a result of this struggle, together with the mobility that the child enters, it also provides a positive effect on the motoric features such as strength, endurance, quickness, mobility and skill-coordination [25]. When looked at the results of our research in this respect, it was observed that regular educational games make a positive contribution to the performance of the groups. However, it was observed that the developmental levels are different between the mask-wearing group and the non-mask-wearing group.

When looked at the literature on this subject; it is seen that mask use causes discomfort and reduces performance slightly [5]. The fabric mask does not change the oxygen saturation of the air for a runner, but it causes breathing less from this air due to the resistance applied by the mask [5]. It was reported that the N95 mask prevents breathing and gas exchange in healthcare workers and imposes an additional workload on the metabolic system [26]. According to the results of a study examining the changes in heart rate, oxygen saturation and carbon dioxide values during a masked exercise of 6-8 METs, a decrease in the rate of O_2 intake (3.2%) and an increase in CO_2 production (20%) were detected. In addition, while the O_2 saturation value was 97.6% ± 1.5% at the beginning of the exercise, it decreased to 92.1 ± 4.12% after the exercise. It was reported that this dramatic decrease may pose a risk to health and that this decrease may also be related to exercise intensity [27]. While no difference could be detected between the average heart rates of the groups during the masked and unmasked brisk walking activity, it was reported that the oxygen saturation of the masked walking group decreased, but this decrease was not at a level that would adversely affect the health [28]. According to the results of a study to determine the effect of wearing a surgical mask during exercise on the cardiopulmonary function of healthy people, it was reported that wearing a surgical mask during aerobic exercise has some adverse effects on cardiopulmonary function, especially during high-intensity exercise

in healthy young subjects [29]. It was reported that aerobic exercises can be performed using a surgical mask, and although wearing a mask while exercising is somewhat uncomfortable, the use of a surgical mask has only a minor effect on physiological parameters during exercise. It was also suggested that people with obstructive pulmonary disease and heart disease such as asthma or COPD should undergo careful evaluation before attempting physical activity with masks [30]. It was reported that surgical masks and FFP2/N95 masks have a significant negative effect on exercise parameters such as maximum power output and maximum oxygen uptake (VO_2max/kg). It was reported that both masks significantly reduce pulmonary parameters at rest (FVC, FEV1, PEF) and at maximum load (VE, BP, TV) [31]. According to the results of a study examining the effects of wearing a surgical face mask and N95 type mask, it was shown that wearing a surgical or N95 mask during short-term strenuous exercise is physiologically safe and feasible, and masking has only minor and insignificant effects on physiological parameters during exercise [32]. According to the results of the research conducted to determine the effects of wearing face masks on performance in hockey players, it was reported that there was no difference between the mask-wearing group and the control group in terms of performance, and only minor effects on muscle oxygenation were observed [33]. It was reported that cloth face masks lead to a 14% reduction in exercise time and a 29% reduction in VO_2max, attributed to perceived discomfort associated with mask wearing. Compared to those not wearing masks, participants reported feeling increasingly short of breath and claustrophobic at higher exercise intensities while wearing a cloth face mask. In addition, it was recommended that coaches and athletes change the frequency, intensity, duration and type of exercise while wearing a fabric face mask [34]. According to the results of the research conducted to determine the effects of medical mask types on performance and cardiorespiratory parameters in athletes, it was reported that when the performance scores of the unmasked group were compared to the scores of the surgical mask-wearing group and the FFP2-type mask-wearing group, it was found that there was a significant decrease (almost 6%) in maximum performance, and mask wearing was reported to have a major impact on performance, while submaximal performance was not reported to change. It was also reported that there is a large interaction effect with a decrease in both oxygen consumption and minute ventilation [35].

According to the results of a study investigating the prevalence and reasons for not wearing face masks while exercising during the COVID-19 era, which was conducted between June and July 2020 with athletes from 188 countries (n=633, 84.7% male, 45.8% 20-29 years old) to evaluate the relationship of maximum ambient temperature with performance while wearing a mask, Most of the athletes (70.8%) wore masks while exercising, and 66.8% of the athletes reported that wearing a mask adversely affected their performance, especially among all users using N95, FFP2 or equivalent masks, and 90.9% of those wearing surgical masks. Adverse performance was reported to be significantly correlated with the highest ambient temperature in the respective country. As a result, wearing a face mask during the COVID-19 epidemic negatively affected high-intensity exercise performance in athletes due to discomfort and limitation in breathing, and it was reported that high ambient temperature was also a negative factor [36,38,39,40]. Since Al Attar and Husain's research also evaluates the emotions and thoughts of the athletes through an online questionnaire rather than evaluating the performance levels of the athletes, it can be thought that the result was affected by psychological factors. As a matter of fact, there are studies in the literature in which the results of athletes who have been subjected to some performance tests while wearing masks are associated with psychological effects. It was found that wearing a cloth face mask has several effects on exercise performance. First, since wearing a cloth mask reduces exercise performance, VO_2peak and related variables, the training variables of frequency, intensity, duration and activity type should be changed accordingly. Second, while exercise goals promote safe goal attainment, the modifiable effects of cloth mask wearing, reflecting poor performance and psychological impact, were mentioned [12]. It was investigated the perceived difficulty levels (AZD) of unmasked people and people wearing surgical face masks during 45 minutes of Pilates exercises. According to the results of this study, it was reported that there was a significant difference between the data in every 5 minutes from the 10th minute to the 45th minute between the groups. In addition, although there was a significant difference between the groups, when the mean AZD values were examined, it was reported that wearing a mask did not impose an excessive physiological load, and mask use could be a psychological factor in the occurrence of this situation [37,41,42,43,44].

CONCLUSION

As a result, it can be said that the participation of children in regular educational game activities both masked and unmasked contributes positively to their aerobic performance, and the aerobic (16.69%) and anaerobic (1.01%) performance percentages of the unmasked group improve more than the masked group. In addition, it can be said that the use of masks in short-term exercises has a low effect on the performance of individuals, but the use of masks in long-term exercises may affect the performance negatively by limiting it. In line with these results, it can be suggested that we should pay attention to the use of masks in long-term exercises and change the mask when it gets wet and humid due to breathing.

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