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The effect of resistance exercises performed at home on swimming performance of adolescent swimmers during the covid-19 pandemic period

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Abstract

Aim: to examine the effect of resistance exercises performed at home on swimming performance in adolescent swimmers during the COVID-19 pandemic period.

Method: a total of 114 adolescent swimmers aged between 10-17 years, (N=66) male and (N= 48) female, performing at the Turkish Olympic Preparation Center (TOHM) participated in the research voluntarily. The research was designed as a quasi-experimental study, since there was no control group. The resistance exercise program, which was performed at home for 8 weeks during the pandemic period, was applied for the athletes participating in the research through video conference method and by expert swimming trainers. The pre-test swimming degrees of the athletes were requested from the institution with the archive scanning method, and the post-test values were taken by the expert swimming trainer after the applied training program. To determine the effect of the applied training program, 50m, 100m, 200m and 400m swimming degrees of the athletes were determined in the pool environment with the Castimolap D-308 hand chronometer. The data obtained as a result of measurement, calculation and tests in the research were analyzed in the SPSS 22.00 statistical analysis software. Paired-Samples T test was applied to determine the difference between pretest and posttest in the statistical analysis. The significance level was accepted as $p<0.05$.

Results: as a result of the statistical analysis, a statistically significant difference was determined between the freestyle swimming degrees (50-100-200-400m) pre-test and post-test values of the athletes.

Conclusion: our results demonstrated that resistance exercises performed at home did not have a positive effect on swimming performance. In this respect, it is very important for the athletes in the swimming performance group to train in the pool environment in order to maintain and improve their performance.

Keywords: Adolescent, Pandemic, Covid-19, Resistance Exercises, Swimming, Freestyle.

Introduction

Novel Coronavirus Disease (Covid-19), broke out in the Wuhan state of China in 2019 December, and its most common symptoms are dry cough, high fever, shortness of breath depending on upper respiratory tract infection (Lu et al., 2020). Several global and national precautions have been taken to minimize the negative effects and slow down its spreading speed. These precautions have created declines in the spreading speed of the disease (Remuzzi & Remuzzi, 2020). Correspondingly, while the social isolation process gains importance, society needs to adapt and alleviate the current situation. This leads people to a sedentary lifestyle and individuals develop sedentary behaviors due to isolation and restrictions (Erduğan & Aydoğan, 2021). This also leads to metabolic disorders in the human body for those who were devoided physical activity (WHO, 2009). Physical activity is recommended not to experience such problems depending on this situation. Regular physical activity is an important factor to protect physiological capacity, enhance the immune system, prevent diseases and protect mental health, and influence life quality positively (Çakır, 2019; Dindar & Bilir, 2019; Dindar & Özen, 2020).

A set of precautions were taken not to influence individuals negatively across the world. Especially infants and adolescents had to spend most of their time at home to decrease the spread speed of the pandemic and this caused them to experience several psychological disorders (Direktör, 2021). The infancy and adolescence stages were known to be a stage when mood changes occur drastically. These mood swings may change based on family affairs, social environment, and age groups particularly and it is getting more with the influence of pandemic (Direktör, 2021). World Health Organization defines the adolescence stage as a duration including 10-19 age period. The adolescence stage which is the first phase is puberty is a stage when growing develops rapidly, biological changes and maturation are completed and the child gains an adult appearance. In this stage which is also known as the preadolescent stage intensive physiological and hormonal changes are experienced. Despite these two terms don't have the same meaning entirely, adolescent stage and puberty stages are referred to as synonyms. To mention the difference between these two, the puberty stage includes physical and sexual development of child and adolescence stage includes psycho-social development in addition to physical and sexual development. While the puberty stage lasts a short time, the adolescent stage of a child may last longer (Büyükgebiz, 2013).

If the children from the preadolescent stage participate actively in-game activities, this may have positive contributions to the motor skill development of children. Such activities that make children physically active are associated with basic movement skills including speed and agility playing a determining role in success in the sports branch during the adolescent stage (Lloyd & Oliver, 2012; Reilly et al., 2000). Developments in basic movement skills indicate more rapid developments in children between average 6 age and adolescent stage. In this stage, the child develops his/her skills which he/she gained previously and movement performance skills depended on that become more fixed and stabilized. As children get into the adolescent stage, their motor skills including power, speed, endurance also increase in a positive way and this increase contributes to an increase in their performance as well (Wade & Smith, 2014). The power development of children increases directly proportionated to age (Muratlı, 2013).

With the effect of Covid-19 all over the world, an unprecedented crisis broke out in the sports community (Türkmen & Özsarı, 2020). Competitions, tournaments, and training in many countries have been canceled indefinitely. There was a great risk of exposure to virus in mass communities gathered through sports organizations (Yanagisawa et al., 2018). Sports organizations held in larger stadiums caused a convenient setting for the virus to spread (Halabchi et al., 2020). For this reason, organized activities which gather communities are closely associated with important health issues. In parallel with it, postponing national and international sports activities left a negative physical-mental impression on athletes, therefore athletes came up against the danger of being affected negatively by this situation (Türkmen & Özsarı, 2020).

In order to prevent the negative impact of swimming performance in these processes, it was reflected in the research results that resistance training performed on land is important October in addition to water training (Garrido et al., 2010; Page & Ellenbecker, 2005). This, on the other hand, indicates that it will help the swimmer to achieve additional gains that can give him an October advantage over other competitors (Salo & Riewald, 2008). It has been found that an increase in the strength and mass of the muscles in the region applied, especially in training with resistance bands, has been observed November (Rosania, 2004). By the definitions, this research was carried out to investigate the effects of resistance training performed at home during the Covid-19 pandemic in adolescent swimmers.

Methodology

Study sample

This original research was carried out with the determination of the differences, by revealing the effects level of training programs applied by determining freestyle swimming ranks of youth performance swimmers (10-17 age, throughout 8 weeks) from Turkey Olympic Preparation Center

(TOHM). 114 athletes who did not sustain a serious injury in the last six months and applied to a regular home training program from the TOHM Kayseri youth performance group were recruited in research. Participants voluntarily performed resistance training at home within the program continued throughout 8 weeks and 6 days in a week and the effect level of training was determined. Those who posed an obstacle and had a health problem were excluded from the study. The sample and population of the research consisted of TOHM performance group swimmers and 114 adolescent swimming performers from the Turkish Olympic Preparation Center Kayseri region. Individuals who have a 4-year sports history in the swimming branch and do not have a health problem that would interfere with the implementation of the training program were included in the study, while people who are physically obstructed in the implementation of the tests and have health problems were not included in the study.

Within research, an information form is used to obtain demographic information of participants. In the study, first data were collected (2021 July) through archive research (competition ranks from club's archive); and at the final phase, maximum capacity of swimmers in a swimming pool setting and 50m, 100m, 200m, and 400m swimming scores were determined through Castimolap D-308 hand chronometer. Before tests, participants were informed about the research and thus they were provided to be more productive during the training. Warm-up exercises were performed to make the organism prepared before the training. Athletes participated in the program (male and females separately) via video conference method at specified hours and days. Authentication information was taken as a basis in determining participants' ages.

Height measurement

The height measurements included in the physical characteristics of the athletes participating in the research were made with a Rodi Super Quality meter, in bare feet, with the head in an upright position, with the head in the Frankfort plane, with the measuring table facing the vertex of the head, following a deep inspiration and the distance between the vertex of the head and the sole of the foot was recorded in cm with a sensitivity of 1 mm. The performance values obtained in the research were made by swimming coaches who are experts in their field.

Swimming rankings

Swimming rankings of athletes were taken in terms of minute and second. Swimming style, synchronized right arm, left arm, and varying kicks (6 kicks, 4 kicks, or 2 kicks). Attention paid for a correct arm technique. The athlete needs to catch the furthest water and sweep it backmost. The position of the head should be in the linear position of the body, and the eyes should look forward and downward.

Practicing methods of the movements

To enhance the efficiency of the training program, it is important to perform planes of motion at certain angles. Following states were paid attention related to movements practiced. The training program was conducted to athletes by the instructions by expert trainers via video conference method in-home setting. Movements were practiced throughout 8 weeks with a 1-day break for 3 days of training following the days of the week with correct angle, sets, and repeat methods (1-day break given following 3 training units).

Home exercise training content

Stretching 5-10 min.
Basic exercise program 20-40min: endurance, resistance, flexibility and balance exercises.
Recovery after exercise (stretching) 5-10 min.

Table 1. Weekly training program sample.

Days	Weekly Unit Training	Applied Movements	Sets x Reps	Rest Intervals Between Sets & Load
Monday	I. Unit Training*	Jumping Jack* Theraband Butterfly** Theraband Rowing** Theraband Lat Pull Down** Theraband Shoulder Press** Theraband Biceps** Theraband Triceps** Crunches ***	3x30* 3x15** 3x25***	30 s & 1st week: 60% 2nd week: 65% 3rd week: 70% 4th week 75% 5th week: 75% 6th week: 80% 7th week: 80% 8th week: 80%
Tuesday	II. Unit Training**	Jumping Jack**** Pull-up (sn)* Squat*** Lunge*** Burpees*** Theraband (leg)** Stretching (sn)** Shuttle-Reverse Shuttle ****	3x10* 3x15** 3x20*** 3x30****	30 s & 1st week: 60% 2nd week: 65% 3rd week: 70% 4th week 75% 5th week: 75% 6th week: 80% 7th week: 80% 8th week: 80%
Wednesday	III. Unit Training***	Jumping Jack* Skipping rope **** Pushup * Plank(sn)** Plank Leg Raise Right(sn)** Plank Leg Raise Left(sn)** Side Plank(sn)** Dead Bug(sn)** Bird Dog(sn)** Cook Hip Lift Rigt(sn)** Cook Hip Lift Left(sn)** Plank Flow(sn)** Plank Flow Leg Lift Right(sn)** Plank Flow Leg Lift Left(sn)**	3x10* 3x25** 3x30*** 3x70****	30 s & 1st week: 60% 2nd week: 65% 3rd week: 70% 4th week 75% 5th week: 75% 6th week: 80% 7th week: 80% 8th week: 80%

Days	Weekly Unit Training	Applied Movements	Sets x Reps	Rest Intervals Between Sets & Load
Thursday	Rest	Rest	Rest	Rest
Friday	I. Unit Training*	Applied Movements	Training sets	30 s
Saturday	II. Unit Training**	Applied Movements	Training sets	30 s
Sunday	III. Unit Training***	Applied Movements	Training sets	30 s

Data analysis

Measurement results were analyzed with the SPSS 24 package program. Data obtained were given as arithmetic mean and standard deviation. To find out whether data were distributed as normal or not, the Kolmogorov-Smirnov test was used. According to the Kolmogorov-Smirnov test, data were determined to show normal distribution. For determining the difference between measurements paired t-test was applied. The significance level was taken as $p<0.05$.

Results

Table 2. Demographical characteristics of male and female swimmers.

Parameters	Gender	N	Min	Max	X±SD
Age (years)	Female	48	11,00	17,00	13,43±1,88
	Male	66	10,00	17,00	13,68±1,81
Height (m)	Female	48	1,13	1,75	1,53±0,12
	Male	66	1,15	1,89	1,54±0,13
Weight (kg)	Female	48	30,00	57,00	44,06±8,04
	Male	66	30,00	64,00	46,39±8,74

In table 2, age averages of female swimmers were as 13,43±1,88 age (year), and male swimmers were as 13,68±1,81 age (year), height averages of females were as 1,53±0,12 cm and males were as 1,54±0,13 cm, average body weights of females were as 44,06±8,04 kg, and males were as 46,39±8,74 kg.

Table 3. Distributions related to pretest measurement values of male and female swimmers.

Parameters	Gender	N	Min	Max	X±SD	95% C I	
						Low	Upper
50m Freestyle Swimming (s)	Male	66	27,59	60,00	38,41±7,41	-0.998	5.829
	Female	48	29,00	90,00	41,01±10,89		
100m Freestyle Swimming (s)	Male	66	46,00	144,00	87,90±20,03	-6.365	10.297
	Female	48	62,00	179,00	90,58±24,71		
200m Freestyle Swimming (s)	Male	66	92,00	324,00	192,18±48,98	-14.703	23.381
	Female	48	133,00	361,00	198,29±52,13		
400m Freestyle Swimming (s)	Male	66	260,00	683,00	408,16±99,63	-19.487	52.029
	Female	48	281,00	587,00	425,37±88,27		

In Table 3, pretest values of male swimmers were as: 38,41±7,41 sec. 50m freestyle; 87,90±20,03 100m freestyle; 192,18±48,98 sec. 200 m freestyle; and 408,16±99,63 sec. 400m Freestyle; and pretest values of female swimmers were as 41,01±10,89 sec. 50m freestyle; 90,58±24,71 sec. 100m freestyle; 198,29±52,13 sec. 200m Freestyle; and 425,37±88,27 sec. 400m freestyle.

Table 4. Distributions related to post-test measurement values of male and female swimmers.

Parameters	Gender	N	Min	Max	X±SD	95% C I	
						Low	Upper
50m Freestyle Swimming (s)	Male	66	29,49	119,00	47,61±13,37	-3.150	7.084
	Female	48	33,32	105,00	49,89±13,74		
100m Freestyle Swimming (s)	Male	66	62,00	185,00	108,45±23,54	-7.982	11.114
	Female	48	70,00	190,00	110,70±27,36		
200m Freestyle Swimming (s)	Male	66	139,00	420,00	223,96±48,74	-2.831	35.350
	Female	48	150,00	371,00	241,52±52,50		
400m Freestyle Swimming (s)	Male	66	305,00	710,00	464,07±92,08	-30.504	35.144
	Female	48	316,00	605,00	467,29±79,64		

In table 4, post-test values of male swimmers were as 47,61±13,37 sec. 50m freestyle; 108,45±23,54 100m freestyle; 223,96±48,74 sec. 200 m freestyle; and 464,07±92,08 sec. 400m freestyle; and post-test values of female swimmers were as 49,89±13,74 sec. 50m freestyle; 110,70±27,36 sec. 100m freestyle; 241,52±52,50 sec. 200m freestyle; and 467,29±79,64 sec. 400m freestyle.

Table 5. Comparison of pretest and post-test measurement values of male and female swimmers.

Parameters	Gender	Grup	X±SD	t	p	95% C I	
						Low	Upper
50m Freestyle Swimming (s)	Male	Pre-Test Post- Test	38,41±7,41 47,61±13,37	7,41	,000	-10.686	-7.332
	Female	Pre-Test Post- Test	41,01±10,89 49,89±13,74	-8,31	,000		
100m Freestyle Swimming (s)	Male	Pre-Test Post- Test	87,90±20,03 109,11±25,30	8,44	,000	-23.564	-17.190
	Female	Pre-Test Post- Test	90,58±24,71 110,70±27,36	10,73	,000		
200m Freestyle Swimming (s)	Male	Pre-Test Post- Test	192,18±48,98 223,96±48,74	7,36	,000	43.369	-30.245
	Female	Pre-Test Post- Test	198,29±52,13 241,52±52,50	-8,51	,000		
400m Freestyle Swimming (s)	Male	Pre-Test Post- Test	408,16±99,63 464,07±92,05	7,99	,000	-59.750	-40.320
	Female	Pre-Test Post- Test	425,37±88,27 467,29±79,64	-6,46	,000		

In table 5, freestyle swimming rankings of male and female swimmers at different distances, there was a statistically significant difference in pretest and post-test test averages in either group (p<0,05).

Discussion

This research was carried out to investigate the effects of resistance training performed at home during the Covid-19 pandemic in adolescent swimmers; some differences in performance values of swimmers were reflected in research results. Research hypothesis: do exercises performed at home during the pandemic period have an effect on swimming performance? Based on this hypothesis, the study we conducted revealed that resistance exercises performed at home do not have a positive effect on swimming performance. In general, it shows that exercises performed both on land and in water in the swimming branch produce more effective results on distance-oriented swimming performance. According to Deyirmenci and Karacan (2107), elastic tapes are one of the functional equipment used for strength development.

The purpose of this study was to determine the effects of resistance band trainings on swimming performance in 11-13 year old male swimming athletes. As a result, it was found significant decreases in 25m, 50m freestyle swimming degrees and 200m swimming degrees ($p<0.05$). Similar content in a different study, Senol and Gülmez (2017) with functional exercise band (TRX) investigated the effect of resistance training on body weight applied by using the swimming performance and functional exercise using resistance band swimmers who work; as a result, the degree of transition 200m swimming ($p<0.05$) have found significant results at the level. Our results we can explain the significant level of performance decreases in our findings compared to different studies as a result of the participants in the study doing training without the water environment caused by the pandemic period.

During the pandemic, athletes were deprived of in-water training and only land training and home training's positive effects were reflected in current research's results. During the Covid-19 pandemic, athletes cannot do a comprehensive exercise, however, home exercises prepared by experts (conditioner, trainer, physical education teacher) can be expressed as an important process to adapt training again, not to get injured and overcome this period with the least performance loss and to maintain significant performance properties like endurance, speed, strength, and mobility (Jukic et al., 2020). It can be seen that athletes abstained from training for a long time due to being infected by Covid-19. This indicates healthwise anxieties of swimming athletes in various research (Batu & Aydın, 2020; Sönmez et al., 2020). Like other communities, Covid-19 has been influencing the sports community as well. The decision taken for postponing national-international competitions and tournaments indicates the effect of the Covid-19 process on athletes' anxiety levels as they might get infected by the virus (Demir et al., 2020).

Chen et al. (2020) examined epidemiological and clinical characteristics of the pandemic in terms of several variables. They revealed that this situation may have negative influences on both sedentary individuals and athletes, particularly acute respiratory tract syndromes may cause mortalities and as a result of these, athletes' training and competition programs can hinder. Generally, negativities experiences during pandemics have deprived athletes of training conditions for a long time. This period can be considered as a *detraining* period (Mujika & Padilla, 2000). Detraining period is explained as decreasing the number of training or a decrease in the frequency, intensity, and duration of exercise (Hyaat et al., 2019; Silva et al., 2015). The regaining of physiological adaptations gained through training is based on the training status, genotype, intensity, velocity, and frequency components of exercise and training discontinuation periods (Hyatt et al., 2019; Joo, 2018; Letieri et al., 2018; Sarto et al., 2020). Our research results show results that support this situation. It can be seen that these results are similar in other research as well. Christensen et al. (2011) have examined the degree of effect of intensive training program following detraining period, and they found out that there were decreases in VO2max capacities of athletes in periods without training, and in parallel with it, there were also decreases in oxygen consumption amounts in athletes.

Mujika and Padilla (2000) reported that a four-week duration without training caused 4-11% declines in oxygen consumption amounts of athletes. In another research with similar content, Nakamura et al. (2012) determined that extra duration without training had negative effects on the aerobic capacities of athletes. Gelen et al. (2020) reported decreasing characteristics of the organism during the detraining period (four weeks); these were maximum oxygen consumption, maximum respiratory capacity, endurance capacity, etc. They also reported the increasing characteristics of an organism as maximum and sub-maximum heart rate, ventilation threshold level, average blood pressure, maximum respiratory change ratios. There were declines in maximal oxygen consumption, muscle glycogen level, and strength-power performance output during the long-term (4-8 weeks) detraining period. All of these studies indicate common results. Some performance changes which were not only specific to swimming were observed in others sports branches as well. Thomassen et al. (2010) studied the effects of the intensive training program on soccer players' performance and they concluded that there was a difference in aerobic capacity in soccer players between the intensive training program and durations without training. Koundourakis et al. (2014) have studied several parameters related to detraining period and revealed that there were decreases in vertical jump performances in athletes following the 6-8 week detraining period. On the other hand, Caldwell and Peters (2009) reported declines in agility and flexibility performances in athletes following an 8 week detraining.

These results indicate that overtime detraining durations cause declines in anaerobic capacity. As swimming makes all the muscles work in a body and is a sport performed in water, it develops individuals' strength and endurance capacity substantially (Hannula & Thornton, 2001). As swimming makes one resist water with his weight, it contributes to enhancing the resistance of the body without exhausting it (Bozdoğan, 2006; Gökhan et al., 2011). When viewed from this aspect, it can be stated that only land training or home-trainings could not enhance the aerobic capacity of swimmers at the desired level. This was also reflected in the research results of Öner et al. (2018). They revealed that training performed on land did not affect the 100m freestyle scores of swimmers. When literature was compared with the results of the current study, similar results attract attention. Current studies' results indicate that performance loss was not only in aerobic capacity but also occurred in anaerobic capacity during detraining. It is possible to say that there were much more performance losses in 400m freestyle swimming rankings (in proportion to 50m, 100, and 200m rankings); and there were also performance losses in anaerobic capacity. Current study results indicate that performance losses do not only occur in aerobic capacity but also there can be losses in anaerobic capacity during the detraining period.

In a quasi-experimental study with similar content, Sever (2021) analyzed the effect of 9-12 years old swimmers on 50m free technical performance before and after covid-19. As a result of the research, it was revealed that the work that swimmers who could not leave the house due to restrictions did not have a positive effect on the performance of 50m freestyle swimming (short distance) athletes with their own body weight and tera tape at home during the isolation period. This study, which has a similar content with the research we have conducted, shows similarities with our results.

This result can be explained through the effect level of training performed in water in swimming. In literature, Karakurt (2020) investigated the effects of static and dynamic core training on swimming performance and motor skills and as a result, they determined that static and dynamic core training did not have effects on 25m and 50m swimming performances. This situation reveals that not only exercises performed on land create positive results in swimming performance parameters, athletes should definitely do land training along with in-water training programs. In the study we have carried out, the fact that athletes are away from the aquatic environment can be shown as a reason for similar results. Sarto et al. (2020) determined that home training was not equal to standard training and they recommended that proper conditions should be provided for athletes to train. In conclusion, a pandemic caused performance loss in athletes and home training programs were not determined to be adequate to prevent these losses.

Conclusion

As a result of statistical information obtained before and after the pandemic, there were much more performance losses in 200 and 400m mid-distance swimming. In this regard, it is suggested that training should be performed in proper conditions and training periods should be well adjusted. In addition to this, it can be suggested that loading factors should be well determined to make home exercise more effective. As a result of the literature search, it was observed that when land training was practiced in addition to swimming activities, this could contribute to swimming performance.

Conducting these studies with more participants and more repetition was considered to contribute literature in terms of establishing norms.

Suggestions

In order to be more beneficial, we will make some suggestions about the future studies on these topics based on the experiences that have been tried during this study:

- It is important that the applied training program be designed according to the principle of loading and rest, and that especially the athletes who perform in the swimming branch work according to the principle of appropriate loading in this period in terms of maintaining their performance.
- Adolescent children should be made aware of the importance of exercise for a healthier future lifestyle by sports scientists and families from an early age.
- A research may be conducted with the swimmers who only do resistance training at home, including different swimming styles (breaststroke, butterfly, backstroke). Thus, the effect level of the resistance training program applied only at home can be observed in a broader scope.
- In addition to the applied training program, a study that will address the motivation levels of children can also be supported by a research in psychological terms.

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