YEDİTEPE UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

INVESTIGATION OF CHANGES IN FLEXIBILTY AND LUNG CAPACITY AMONG GIRLS WHO ARE BEGINNER LEVEL SYNCHRONIZED SWIMMING AND FREE STYLE SWIMMING AGED BETWEEN 6-9

MASTER THESIS

FATMA YÜKSEK, PT.

İSTANBUL-2019

YEDİTEPE UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

INVESTIGATION OF CHANGES IN FLEXIBILTY AND LUNG CAPACITY AMONG GIRLS BEGINNER SYNCHROIZED SWIMMING AND FREE STYLE SWIMMING BETWEEN THE AGES OF 6-9

MASTER THESIS

FATMA YÜKSEK, PT.

ADVISER

ASSIST.PROF.DR.FEYZA ŞULE BADILLI DEMİRBAŞ

İSTANBUL,2019

THESIS APPROVAL FORM

Institute : Yeditepe University Institute of Health Sciences

Programme : Sports Physiotherapy

Title of the Thesis : Investigation of Changes in Flexibility and Lung Capacity Among Girls Beginner Synchronized Swimming And Free Style Swimming Between Ages of 6-9

Owner of the Thesis : Fatma YÜKSEK

Examination Date : 23 October 2019

This study have approved as a Master Thesis in regard to content and quality by the Jury.

	Title, Name-Surname (Institution)	(Signature)
Chair of the Jury:	Assoc.Prof.Dr.Tuğba Kuru ÇOLAK	
Supervisor:	Ass.Prof.Dr.Şule Badıllı DEMİRBAŞ	
Member/Examiner:	Ass.Prof.Dr.Çiğdem Yazıcı MUTLU	

APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated 25/10/2019.. and numbered 2019/17-15

Prof. Dr. Bayram YILMAZ

Director of Institute of Health Sciences

DECLARATION

I declare that this thesis is my own work and that for the best of my knowledge and belief, it does not contain any material previously published or written by another person, or that it does not contain materials accepted for the award of any other, except where the justification is accepted.

FATMA YÜKSEK

ACKNOWLEDGEMENT

I would like to thank my Adviser Şule Badıllı Demirbaş who made it possible for me to do so and did not spare any help during the project.. I am extremely grateful to her for providing her opportunities. I would like to thank Lecturer Elif Üstün Develi for all her supports.

In addition I am thankful to Doğuş university Swimming Club, Fenerbahçe Swimming Club, Anabilim School Swimming Club,Taç Sport Club Coordinators and Swimming Coaches.Thanks to my colleagues Nuray Girgin, Nazan Vural for the support of I owe debt.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

FG	Freestyle Group
SG	Synchronized Group
CRF	Cardiorespiratuar fitness
SRs	Sit and Reach test
BSSR	Back Saver Sit and Reach Test
CSR	Chair sit and Reach test
FVC	Forced Vital Capacity
FEV1	Forced Expiratuar Volume
RV	Reziduel volume
PEF	Peak expiratory flow
PIF	Peak inspiratory flow
FEF25-75	Forced expiratory flow between 25% and 75% of FVC
MVV	Maximum Voluntary Ventilation
VT	Tidal volume
IRV	Inspiratuar rezidüel volume
IC	Inspiratory capacity
ERV	Expiratuar rezidüel volumeIVC Inspiratuar vital Capacity
EVC	Expiratuar vital Capacity
ERS	European Respiratory Society

ABSTRACT

Yüksek, F. (2019). Investigation of changes in flexibilty and lung capacity among girls beginner synchronized swimming and free style swimming between the ages of 6-9.Yeditepe University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, Master Thesis. Istanbul..

The aim of the study was to investigate the effect of swimming on lung capacity and assess the effect of different dry land training in synchronized swimmers on flexibility in girls. The participants were either Synchronized swimmers (SG) (n=12) or Freestyle swimmers (FG) (n=12). The groups were separated according to their swimming style.The study included 24 beginner swimmers (24F;6-9ages)who continue to different swimming clubs in Istanbul, Turkey between January 2019 and April 2019 for three months from beginning evaluation. Pulmonary functions of all the swimmers were evaluated by spirometry, Forced Vital Capacity (FVC) and Forced Expiratuar Volume (FEV1). Flexibility were assessed by Sit and Reach test.

In this study, IBM SPSS Statistics 22 for statistical analysis (SPSS IBM, Turkey) programs were used. There was no statistically significant difference between the values FVC and FEV1 of synchronized and freestyle swimmers before and after ($p > 0.05$). And also that showed no statistically significant changes between the groups in terms of the amount of increase seen in the last flexibility levels compared to the first flexibility levels ($p > 0.05$). But in both groups there was a significiant difference between the previous and the last evaluation. . As a result of this study if there will be a longer-term study with more participants, more meaningful results can be achieved.

Key Words: Synchronized swimming, freestyle swimming, pulmonary function, FVC, FEV1, flexibility, sit and reach test, dry-land exercises.

ÖZET

Yüksek, F. (2019) "6-9yaş arası senkronize yüzme ve serbest stil yüzmeye başlayan kız çocukları arasındaki flexibilite ve akciğer kapasitesi değişimlerinin incelenmesi" Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Spor Fizyoterapisi ABD., Yüksek Lisans Tezi. İstanbul.

Bu çalışmayla 6-9 yaş arası kız çocuklarında yüzmenin akciğer kapasitesine etkisi ve senkronize yüzmede farklı olarak yapılan kara antremanlarının esnekliğe katkısının olup olmadığının araştırılması amaçlanmıştır. Gruplar yüzme stillerine göre ayrılmıştır.Çalışmaya Ocak 2019 -Nisan 2019 tarihleri arasında İstanbul'da farklı spor klüplerinde, Senkronize ve serbest stil yüzmeye yeni başlamış 6-9 yaş arası 24 kız çocuğu dahil edilmiştir. Senkronize yüzücüler Grubu (SG) (n = 12) ve Serbest stil yüzücüler Grubu (FG) (n = 12). İlk değerlendirme olarak spirometre ile FVC, FEV1 parametreleri ve Otur Uzan testi ile de flexibilite değerlendirmesi yapılmıştır. 2. ve son değerlendirme 3 ay sonra yapılmıştır.

Bu çalışmada elde edilen bulgular değerlendirilirken, istatistiksel analiz için IBM SPSS Statistics 22 (SPSS IBM, Türkiye) programları kullanılmıştır. Senkronize ve serbest stil yüzücülerinin FVC ve FEV1 değerleri arasında, öncesi ve sonrası istatistiksel olarak anlamlı bir fark saptanmamıştır ($p > 0.05$). Ayrıca, gruplar arasında, son esneklik seviyelerinde ilk esneklik seviyelerine kıyasla artış miktarında istatistiksel olarak anlamlı bir fark yoktur($p>0.05$) .Ancak 2 grupta da grup içi öncesi ve sonrası arasında anlamlı bir farklılık görülmüştür. Çalışmanın sonucu olarak baktığımızda daha uzun süreli ve daha çok katılımlı bir çalışma yapılsa daha farklı ve anlamlı sonuçlar çıkabilir.

Anahtar Kelimeler: Senkronize yüzme, serbest yüzme, solunum fonksiyonu, FVC, FEV1, esneklik, oturma ve uzanma testi, kara antremanlar

1. INTRODUCTION AND PURPOSE

Sport is necessary for physical, physiological and personality development of children in the age of growth [1].

Regular exercise makes every system in the human body more functional. Muscle strength , such as respiratory muscles, is developed through systematic training and as a result has a positive effect on respiratory functions. Participating in a sporting activity regularly before and after adolescents ,provides mentally developing and also improves circulation and respiration [2].Recent studies have shown that athletes have larger lung capacity than the same age group of sedanters.Especially some sports such as swimming,water polo,rowing improve lung capacity more than other sports[3]. Swimmers have larger lung volume and higher cardiorespiratory capacity than other athletes. All muscles in the body are activated during swimming. Therefore, the oxygen consumption of muscles in swimmers is higher. The water pressure acting on the rib cage makes breathing difficult. Respiration is not free in the sport of swimming with respect to other sports. Combination of breathing is synchronized with swimming strokes [4]. Regular swim training increases the elasticity of the chest wall and improves the respiratory function of swimmers[5]. Aerobic exercises enable the respiratory muscles to work more effectively and increase the heart rate to provide more efficient oxygen uptake of the lungs [6,7].

Regarding these reasons, the aim of the study is to evaluate the effects of swimming antremans on lung capacity on synchronized and free style swimmers and also the effect of adding extra stretching ,weighted land training programs on flexibility with duration 3 months.And also try to fill the lack of studies about synchronized swimming programs . The hypothesis this study was following:

Hypothesis 0 (HO): Addition of land training to the training programme of synchronized swimmers helps to increase lung function and flexibility compared to FG group.

Hypothesis 1(H1): Addition of land training to the training programme of synchronized swimmers does not help on increasing lung function and flexibility compared to FG group.

1.1. Swimming

Swimming is a kind of exercise unique in many dimensions. It is performed under the water and compared to air,under water performance presents different resistive gravitational forces. It requires a horizantal position, which changes gravitational effects on circulation. Breathing is limited by blow mechanics and aquatic environment [8].

Swimming has beneficial effects on different systems of the body if performed regularly. It improves systems functions.Furthermore,it is thought to be the best exercise for keeping physical fitness, health and it has important benefits especially with respect to lung functions. This can be seen in good swimmers and they tend to have lung capacity more than average. Swimming practices increase vital capacity and total lung capacity through breast development [4].

Swimming is a kind of aerobic exercise. Different studies show that swimming is a very good activity for children with many health benefits:

- Children who swim regularly have physical advantages over others because of increasing muscularity and strength.It increases also their joint mobilisation. Swimming movements are useful for their body.
- Their muscles are flexible and strong.
- Eye coordination,problem solving and socializing are advanced.
- The swimming patterns stimulate nerve fibres in the brain and they also develop physiomotor facilities.This advances their intellects.
- Perception and social skills are increasing [9].

The swimming involves the ability of maintaining the body in water and moving against the water with the rthymic movements of arms, legs and body. There are four swimming techniques: Crawl, breaststroke, backstroke and butterfly. Swimming includes 5 basic elements;

1.Performing technique movements properly

2.Energetic capacity

3. Muscle contraction capacity

4. Joint mobilisation

5. Tactics[10].

1.2. Synchronized swimming

Figure 1.1 : Synchronized swimming

Synchronized swimming includes varies activities such as gymnastics,swimming and dancing. Swimmers (in team,solo,duet events) act synchronized characteristic moves in the water by music. Synchronized swimming became an olympic sport in 1984 ,that began with solo and duet modes in 1996, team competition was returned in duet competitions at the 2000 Olympic games. In each program junior level must act both a free routine and a tehnical. They are completed in a particular order and last 2 minute for solo technic, 2:20 minutes for duet technic, 2:50 minutes for the technical team. The free routine lets more flexibility to establish elegance, artistry and orjinality. It continues 3 minutes for free solo, 3:30 minutes for free duet and 4 minute for the free team [11].

Figure1.2: Artistic component

Synchronized swimming is an aquatic sport which includes artistic components and aerobic capacity with muscular strength,power and endurance (Figure1.2) [12].

Training for competititons focused on strength, flexibility, aerobic as well as anaerobic capacity [13]. Synchronized swimming athletes combine technically, physically, esthetically figures, lasting 2-4 minutes, performed both free breathing and holding breath. The half of the time,apnea is present [14]. This sport requires high level of aerobic and anaerobic endurance, and also breath control when upside down under the water (Figure 3) [15]. Synchronized swimmers have the ability to control their breath on the move to perform sports routines and figures to get high scores. Routines are divided into 2, techniques and solo, while the figures include specific lifting , throwing and movements, routines vary in terms of duration, apnea episodes and degree of immersion in different parts of the body [16].

Figure 1.3: Breath control

Synchronized swimming athletes strengthen muscles by dry land training that improve stability and special adaptations to advance movement and injury preventation [17].

1.3. Dry-land exercises

The combined effects of conditioning and stretching exercises during warm-up influence flexibility. Warm-up exercises include submaximal aerobic activity, stretching of the main muscle groups, and application of sport-specific movements (Figure 4), (Figure 5) [18] . The routine elite synchronized swimmers training in water is 8-10 session per week. Every training session continues 2-4 hours. They train on land for 4-6 session, each session is 45-90 minute in duration. Dry-land strength training is used for performance enhancement and injury prevention [19] .

Figure1.4: Dry-land exercises

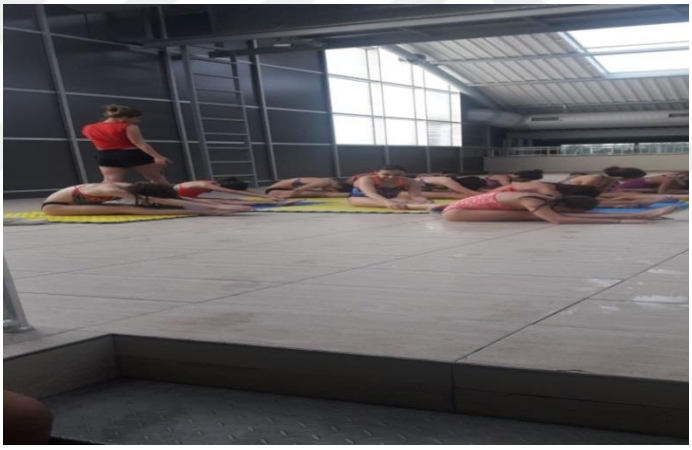


Figure 1.5: Stretching Exercises

The training programs includes flexibility, aerobic and anaerobic endurance, core strength, sport specific skills, choreography skills, strength endurance and artistic expressions[20]. Flexibility is the most important of all physiological characteristics in synchronized swimmers [21]. They spend long periods of time to stretch different parts of their body during land training [22].

1.3. Physical fitness

Physical fitness is explained as an individual's ability to perform daily tasks without having excessive fatigue, sufficient energy in leisure time, the capacity to cope with unexpected emergencies [23]. Children and adolescents's increased physical activity level effect the physical fitness positively. The high level of physical fitness in childhood has a long-term effect on later life[24]. Physical fitness level contains important information for present and future cardiovascular, skeletal and mental health [25] Physical fitness, is a term that defines maximal aerobic capacity specified for body size and composition, is a combined assessment of cardiorespiratory and neuromusculoskeletal function [25,26]. Physical fitness includes muscular endurance, cardiorespiratory fitness (CRF) and strength, agility, flexibility and body composition [27].

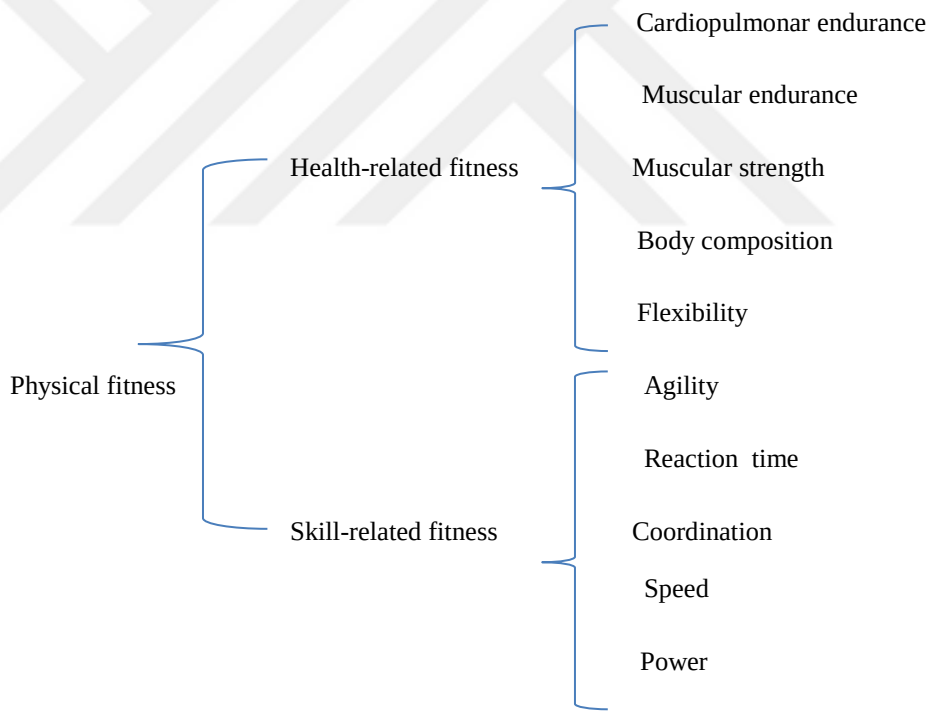


Figure1.6: Physical Fitness Components [28]

Physical Fitness is divided into two groups: skill related and health related fitness (Figure 6) [28]. Physical fitness can be objectively measured in laboratories.

Nonetheless, in practice the use of this type of tests is limited as a result of insufficient equipment, time constraints and qualified technicians . Field testing is a viable alternative because it requires low-cost equipment, has the capacity for evaluating more people at the same time and requires less time [29]. There are currently more than 15 test batteries used to assess the physical fitness of children and adolescents worldwide (Table 1) [30].

Table 1.1. Physical Fitness Test Batteries [30]

Age(years)	Acronym	Society/Organisation	Country/Region
6-18	EUROFIT[31]	Council of Europe Commitee for the Development of Sport	Europe
5-17	FITNESSGRAM[32]	The Cooper Institute	USA
6-17	PCHF[33]	Presidents Challenge:Health Fitness. The President's Council on Phyical Fitness and Sports/American Association for Health, Physical Education, and Recreation(AAHPER)	USA
6-17	PCPF[34]	Presidents Challenge:Physical Fitness. The President's Council on Phyical Fitness and Sports/American Association for Health, Physical Education, and Recreation(AAHPER)	USA
6-17	AAUTB[35]	Amateur Athletic Union Test Battery. Chrysler Foundation/Amateur Athletic Union	USA
6-17	YMCAYFT[36]	YMCA Youth Fitness Test	USA
5-17	NYPFP[37]	National Youth Physical Phrogram. The United States Marines Youth Foundation	USA
5-18	HRFT[38]	Health-Related Fitness Test, American Association for Health, Physical Education, and Recreation(AAHPER)	USA
5-18	Physical Best[39]	American Association for Health,Physical Education, and Recreation(AAHPER)	USA
9-19	IPFT[40]	International Physical Fitness Test(United States Sports Academic/General Organization of Youth and Sport of Bahrain)	USA
7-69	CAHPER-FPTII[41]	Fitness Performance Test II. Canadian Association for Health, Physical Education and Recreation(CAHPER)	Canada
15-69	CPAFLA[42]	The Canadian Physical Activity, Fitness&Lifestyle Approach(Canadian Society for Exercise Physiology)	Canada
9-19+	NFTP-PRC[43]	National Fitness Test Program in the Popular Republic Chine(China's National Sport and Physical Education Committee)	China
6-12	NZFT[44]	New Zealand Fitness Test. Rusell/Department of Education	New Zealand
9-19	AFEA[45]	Australian Fitness Education Award. The Australian Council for Health, Education and Recreation, ACHER	Australia

The literature showed that showed that the most common applied test batteries are ‘Eurofit’,’FitnessGram’, and ‘Alphafit’ [31].

The Eurofit test battery is accepted by most European countries and is also used in non-European countries. Based on the results of this test battery, it is possible to estimate the physical health of children and adolescents [32].

The Fitnessgram test battery is used to determine the physical fitness of children aged 5-17 years. The Fitnessgram test battery began to be used in the US in 1977 and is now a test battery used worldwide [32].

The Alphafit has started to be used for the comparative evaluation of physical activity and physical fitness levels among European countries [32].

1.5. Flexibility

Human movement is impossible without the flexibility.In this regard, many exercise and sports programs integrate activities for improving flexibility is crucial safe and effective movement [33]. This decrease in physical activity results due to the sedentary behavior of the early age [34].

Flexibility is one of the basic element of physical fitness. Flexibility has been described as the capacity to make full range of movement. Flexibility exercises can decrease pain after muscular exercise hurt after the stretching of muscle. Static stretching exercises improve performance. It reduce stiffness ,increase the usage of elastic tensile energy during the recovery movement [35]. Flexibility and agility are two important parameters of fitness for athletes and also important selection criteria for athletes of competition. It is necessary for athlete’s performance [36].

There is no test that fully evaluates the flexibility of the individual. The sit-and-reach test is the most commonly used test for assessing flexibility. The sit and reach test was initially used to measure trunk and lower extremity flexibility to prevent waist problems, but over time AHHPERD became part of the physical fitness protocol [37]. The different variations of the SR test are often applied in health-related fitness programs for athletes, schools, wellness clubs, hospitals and sport clinics[38]. The sit-and-reach test is usually accepted as a measurement test of lower back and hamstring flexibility. Different sit-and-reach tests (SRs) are usually used to asses the flexibility of

harmstring and lower back in health-related and physical-fitness test batteries [39]. The choice of the test to be used usually varies according to the auditor's preference, ease of use, professionalism and traditionality [40]. Fitnessgram evaluation battery recommended back-saver sit-and-reach test (BS). The evaluation of BS test is alike to SR. The difference from the sit and reach test is only that one leg is extended against the test box and the other is flexioned [41]. The Chair Sit and Reach Test is a variance of back saver sit and reach test [42]. SR and BSSR tests have limitations with people who have low back problems and hard to sit level surface with extended leg [43]. Especially CSR Test is an alternative test for elderly people [42]. Other tests for flexibility include the assessment of normal joint movements of specific joints. The most commonly used devices for this are goniometers, electrogoniometers, leighton flexometers and inclinometers [44]. The standard universal goniometer, a common and valid instrument, is used by clinicians to measure the range of motion. Easy to apply, low cost and portable. Another instrument for measuring range of motion is the digital inclinometer. The inclinometer is lightweight and portable, as is the goniometer [45].

1.6. Respiratory system

The four main functions of the respiratory system;

1. Inhalation and exhalation of air between atmosphere and alveoli(lung respiration)

2. The exchange of Oxygen and Carbondioxide between the alveoli and blood .

3.Transport blood, body fluids and oxygen and CO2 between tissues.

4. Regulation of ventilation. [46].

1.6.1 Pulmonary ventilation mechanism

The lungs can be expanded and contracted in two ways;

1. Chest with the movement of the diaphragm up and down cage lengthens and shortens,

2. the anterior and posterior diameter of the chest increases or decreases as the ribs go up and down [46].

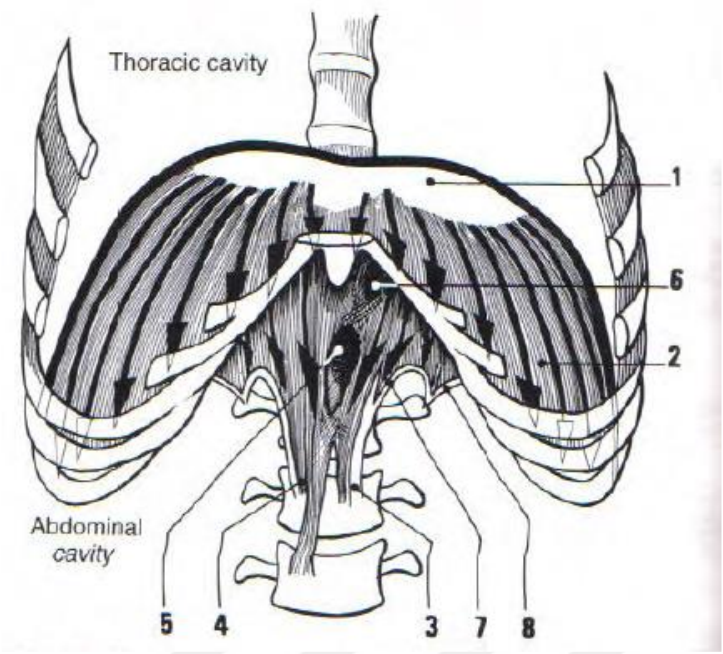


Figure1.7. İnspiration Mechanism [49]

The diaphragm, the parasternal, the external and the internal intercostals, , sternomastoid and the scalene, the abdominal muscles are the main breathing muscles in our body.Oxygen is delivered to the red blood cells and carbon dioxide is exhaled into the environment .They play a very important role during exercise [47,48].

Normal breathing almost completely by the motion of diafragma.During the inspiration,the diaphgram contracts and pulls the lower face of the lung down (Figure 7) [48].In expiration, the diaphragm simply loosens ,chest wall, abdominal structures and lungs elastic recoil that increases pressure on the lungs and the air is thrown out. All of the inspiration muscles lift the rib cage. The most important of these are external intercostal muscles. Other helper muscles , sternocleidomastoid muscle lifts sternum ,serratus anterior lifts most of the costas, while the scalene muscles that help inspiration by lifting up the first two ribs.Rectus abdominis , internal intercostalis are the main expiratuar muscles that pull down the rib cage during the expiration [49]. The rib structure of children is different from that of adults.The ribs were placed perpendicular to the vertebra that prevents the expansion of the restricting thorax. Children ribs are not fully ossified and have cartilage structure.Chest wall compliance is higher,therefore negative airway resistance intrapleural pressure and low lung compliance of the chest wall may cause collapse in the air [50].

1.7. Lung Volumes and Capacities

1.7.1. Static Volumes

Tidal volume (TV): The volume of air taken into or out of the lungs in each normal respiratory movement. Usually determined by the amount of air supplied. Nearly 500ml.

Reziduel volume (RV): After a maximal forced expiration the amount of gas that remains in the lungs which is nearly 1200 mL.We can not measure it by spirometry.

Inspiratuar Reserve Volume (IRV): It is the amount of air taken by forcing the lungs after a normal breath.

Expiratuar Reserve Volume (ERV) It gives the maximum amount of expired air from the lungs with a second exhalation by forcing after a normal expiration.

1.7.2. Lung capacities

The inspiratory capacity (IC) is composed of the tidal volume and the inspiratuar reserve volume,and is nearly 3500 mL (500mL+3000 mL).

IC=Tidal volume+IRV [51].

The Functional Residual Capacity (FRC) is total of the expiratory reserve volume (ERV) and the residuel volume, nearly 2400 mL (1200 mL + 1200 mL).It is the amount of remaining air in the lungs after a normal respiration [51].

Vital capacity (VC) or Forced Vital Capacity (FVC) is the amount of air that removed by a maximal exhalation followed by a maximal inspiration.It is the total of inspiratory capacity and the expiratory reserve volume nearly 4700 mL (3500 mL +1200 mL) [51].

Total Lung Capacity (TLC) contains all of the lung volumes: It is sum of the vital capacity and the residual volume,nearly 5900 mL (4700 mL+ 1200 mL) [51].

Forced Expiratory Volume 1.sec (FEV1): Forced maximal exhalation during the first second outis the volume of air supplied. FEV1 is normally demanding vital capacity 80% (FEV1 / FCV = 0.8) [51].

1.8. Pulmonary Function

Pulmonar functions are defined by the strength of respiratory muscles, conformity of the thoracic cavity, the resistance of the airway and elastic recovery of the lungs. And also varies according to age, height, physical characteristics and body weight. Genetic factors affect pulmonar function.Pulmonary function tests are performed to determine lung development and diagnose lung pathologies in infants and children [52,53,54].

Spirometry is the most widely used volume instrument to measure lung function over time .Static and dynamic spirometries are the types of spirometry . Static spirometer detects lung volume during ventilation. VT, IRV, IC are static volumes. They consist of VT, IRV, IVC, ERV and EVC. The dynamic spirometer defines the connection between volume and time.Assessment is performed during the forced breathing maneuvers and gives the following values. FVC, FEV1, FEV1/FVC ratio, PEF, PIF, FEF25, FEF50, FEF25–75 [54].

2.MATERIAL and METHOD

2.1. SUBJECTS

The sample of study consists of children group who began swimming,at Anabilim Swimming Club, Taç Spor Swimming Club, Fenerbahçe Swimming Club, Doğuş University Swimming Club, Istanbul, Turkey . The study was conducted on 24 beginner level swimmers (6-9ages).

2.1.1.Inclusion Criterias

The groups were separated according to their swimming style. .Participants who have no systemic health problems,between 6-9 ages beginner level girls and trains twice a week.The swimmers who met inclusion criteria are divided into two groups as synchronized swimmers (SG) and free style swimmers (FG) . Swimmers was selected from the groups that have just started swimming, ie those who have been swimming for max 2 months.

2.1.2.Exclusion criteria

Children training more than twice a week and doing another sport or sports are excluded.

The study protocol was approved by the Yeditepe University Ethical Committee at the date of 16.01.2019 and issue number was 164 (APPENDIX 1). Swimmers participated in the study on a voluntary basis. The aim and plan of the study was explained and informed written consent was obtained from each swimmer and their families. (APPENDIX 2). The study was conducted according to Declaration of Helsinki.

2.2. EVALUATION

2.2.1. Structured Questionnaire

The structured questionnaire prepared by researchers applied face to face interviews. The first part of the questionnaire included age, height, weight and body mass index demographic conditions of swimmers. The second part of questionnaire was about having chronic diseases and doing another sport or sports not (APPENDIX 3).

2.2.2 Spirometer

The spirometer is device that measures the quantity of air breathed in and/or out and how swiftly the air is inhaled and exhaled from the lungs while breathing through a mouthpiece (Figure 2.1) [54].

Figure2.1. Evaluation

Spirometry measures only inhaled or exhaled volumes of air in a function of time, that is a gold standart pulmonar function test . It is the most important and often made pulmonar function testing method, having become essential for the avoiding, diagnosis and assessment of different respiratory disruption. American Thoracic Society/European Respiratory Society Task Force advices applying spirometre tests [55]. Reference values for age, gender and height were in accordance with the ECSC standards [56].

The following values are measured:

• Forced vital capacity (FVC)

• Forced expiratory volume in one second (FEV1)

• The ratio of the two volumes (FEV1/FVC)(Figure 2.2) [57].

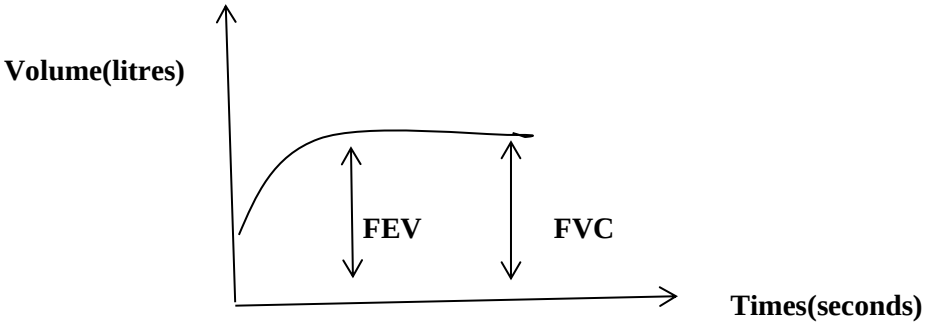


Figure 2.2: Normall Spirometry [57]

Forced Vital Capacity (FVC): It is the volume of air that comes out of deep inspiration with rapid and strong exhalation. Healthy people normally exhaled 80% of their lung volume in 6 seconds or less. Retarding up to 20 seconds in people with severe obstruction.

Forced Expiratory Volume in One Second (FEV1): Expired air volume during the first second of a FVC test, measured in liters (L). Provides information on the restriction of large airways [58].

Forced Expiratory Volume/Forced Vital Capacity (FEV1/FVC): Ratio of FEV1 to FVC in one second expressed as a percentage. Informs about the obstruction in medium and small diameter bronchi. FEF25-75 helps to show airway obstruction when the FEV1 / FVC ratio is at the limit [59].

When FEV1 is decreased more than FVC remarks an obstructive defect. FEV1/FVC < 70 % (Figure2.3) [57].

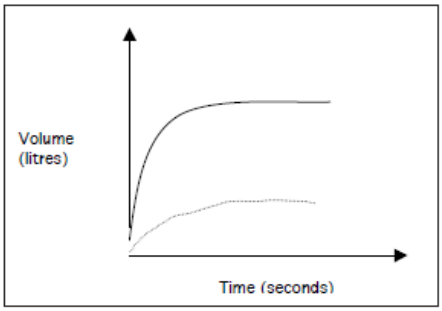


Figure 2.3. Obstructive defect

If FVC is reduced more so than FEV1 is seen in restrictive defects FEV1/FVC> 70% (Figure 2.4) [57].

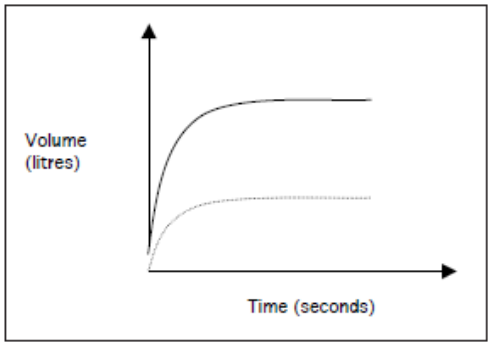


Figure2.4. Restrictive defect

2.2.3. Flow Volume Curves

Flow volume curves are created after performing maximum expiration maneuver followed by maximum inspiration maneuver. The graph is produced from a positive expiratory limb and a negative inspiratory limb (Figure 2.4) [57].

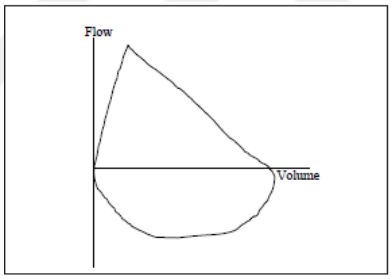


Figure2.5: Flow -Volume Curve [57]

Those with obstructive pulmonary disease have decreased expiration flow in the distal airways and the expiratory limb typically has a concave appearance descending (Figure2.5) [57].

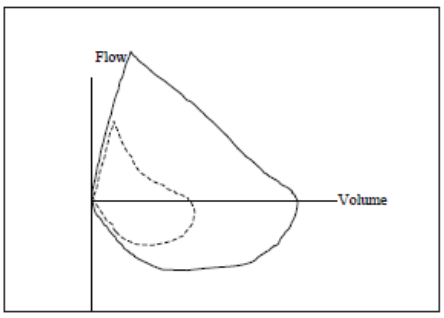


Figure2.6. Flow volume curve obstructive lung [57]

Medical International Research Spirodoc® Spiro, Italy brand named spirometry was used to evaluate pulmonary functions of volunteers. Pulmonary function tests can determine both normal values and deviations of lung volumes. Spirometry has been used over 150 years. It is most commonly used and useful assesment method for pulmonary function in patients with pulmonary diseases [60,61]. The American Thoracic Society (ATS) commit certainty and reproducibility for spirometers and all of them have these properties [60]. Moreover, ATS and European Respiratory Society (ERS) suggest standardizations for spirometers. Normal lung volumes that are affected by ethnicity, gender, age, weight and height are compared to spirometry results of each patients for explication of data [61]. The spirometry tests assess volume and flow of both inspiration and expiration of patients objectively [62].

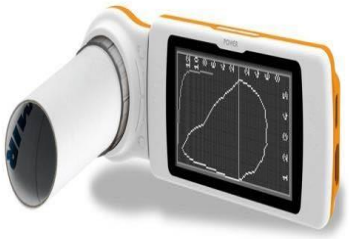


Figure 2.7: Spirometry

ERS indicated that spirometry tests can be used for diagnosis, monitoring and disability [63].We followed up the FVC, FEV1, FEV1/FVC and FEF25-75 parameters of spirometer for the progression of patients after interventions. FEV1/FVC (Tiffeneau index) shows if there is an obstruction or restriction of lungs. Besides, while value of

FEV1 shows to severity of airflow obstruction, FEF25-75 substantiates obstruction of small airways in early period [62,64].

It is not easy to take the measurements in this children age group without any discomfort. Children are usually uncooperative during the assessments [65]. Children should always be explained all the details before the measurement is started. School children are usually more helpful for completing these instructions. İmproving the achievement of examination and keeping high performance, we can use visual interactive computer animations, especially in preschool children [66,67].

The child must sit silently and also continues tidal breathing until stable end-expiratory level is accomplished. Three manoeuvres can usually be performed [68].The child must be instructed, exhorted and shows full commitment particularly during the forced expiratuar manoeuvre [69].

We followed the criteria of ATS/ERS to accomplish spirometry tests. We followed the steps as stated below for spirometry tests:

1. Swimmer sits.

2. Spirometry is explained to the swimmer.

3. Swimmer is instructed as ‘Please keep the head of spirometer inside of your mouth and don’t allow the leak of air flow from your lips.’

4. ‘Breathe from your mouth and keep the clamp above your nose to block breathing through your nose.’

5. ‘Please inhale deeply from your mouth than exhale strongly until hear the noise from the spirometer and again deeply inhale.’

6.The test repeated for three times and the best of values are taken into account before and after interventions [63].

2.2.4. Eurofit test battery

Eurofit Test Battery has been usually applied throughout with cildren and adolescents since 1983. Eurofit test battery was standardized to measure the physical fitness of schoolchildren and also evaluation of the effectiveness of physical

education .It contains different health – performance related performance tests implies; (1) field tests measures cardiorespiratuar (aerobic) endurance, balance, muscle endurance, flexibility, strength, power, speed and agility; (2) antropometric measurement tests mass,height,skinfold thickness at different sites, (3) age, sex identification data [70]. Eurofit test battery contains nine motor tests and basic somatic measurements (Table2.1) [71].

Table 2.1: Components of pyhsical fitness assessed by the test battery EUROFİT [71].

COMPONENT OF PHYSICAL FITNESS	**TEST**
HEALTH-RELATED	
Body Composition	Body Mass Index Skinfold Measurement
Aerobic Capacity	Bicycle Ergometer W_{170}* Endurance Shuttle Run
Muscular Strength &Endurance	Bent Arm Hang Sit-Ups
Flexibility	Sit and Reach
PERFORMANCE-RELATED	
Balance	Flamingo Balance
Power	Hand Grip
Speed&Agility	Shuttle Run 10x5 m Plate Tapping

2.2.5. Sit and Reach test

The sit-and-reach test is usually accepted as a measurement test of lower back and hamstring flexibility [40].

The classic Sit and Reach test is included in most test batteries [72]. Sit and Reach test is an easy and practical field test battery. It provides moderate measurement of harmstring flexibility [73]. Various combinations of body and limb lengths can significantly affect test performance. Sit and reach test is discussed because of the relationship between the flexibility and limb length. This is considered an important intermediate variable in children's testing. Only a test should not be considered to fully reflect the overall flexibility of the person [74].

A specially constructed box is required when testing the classical sit-and-reach test (AAHPERD, 1988) in which the participant sits straight legs together, and placed

feet against the box relatively to the 23-cm point. The participant extends to the point where he can slowly reach and holds in this position for about 2 seconds. The last point the participant reaches is the final score for harmstring and trunk flexibility. The advantages of the classic sit and reach test are that it is simple, easily applicable and manageable by procedure, and requires minimal skill training)Figure 2.7) [75]. For the test to be more practical, we counted the foot level as 0 point, we saved the values as (+) cm if the participant extended after the foot level to and also as (-) cm if the participant extend beyond the foot level.

Figure 2.7: Sit and reach test

SRT score was recorded (in centimeters) as the end position of the fingertips[76].

2.2.6. Flow Chart: Study Process

A total of 24 beginner level swimmers for SG and FG participated in the study according to inclusion criteria. We asked the children and their families if they were willing to be a participant of our study. Children who met inclusion criteria (n=24) were involved in our study. After initial assessment were completed, children were randomly divided into Synchronized Group (SG) (n=12) and Freestyle Group (FG) (n=12). Assessments were made at baseline and 3 months after initial assessment

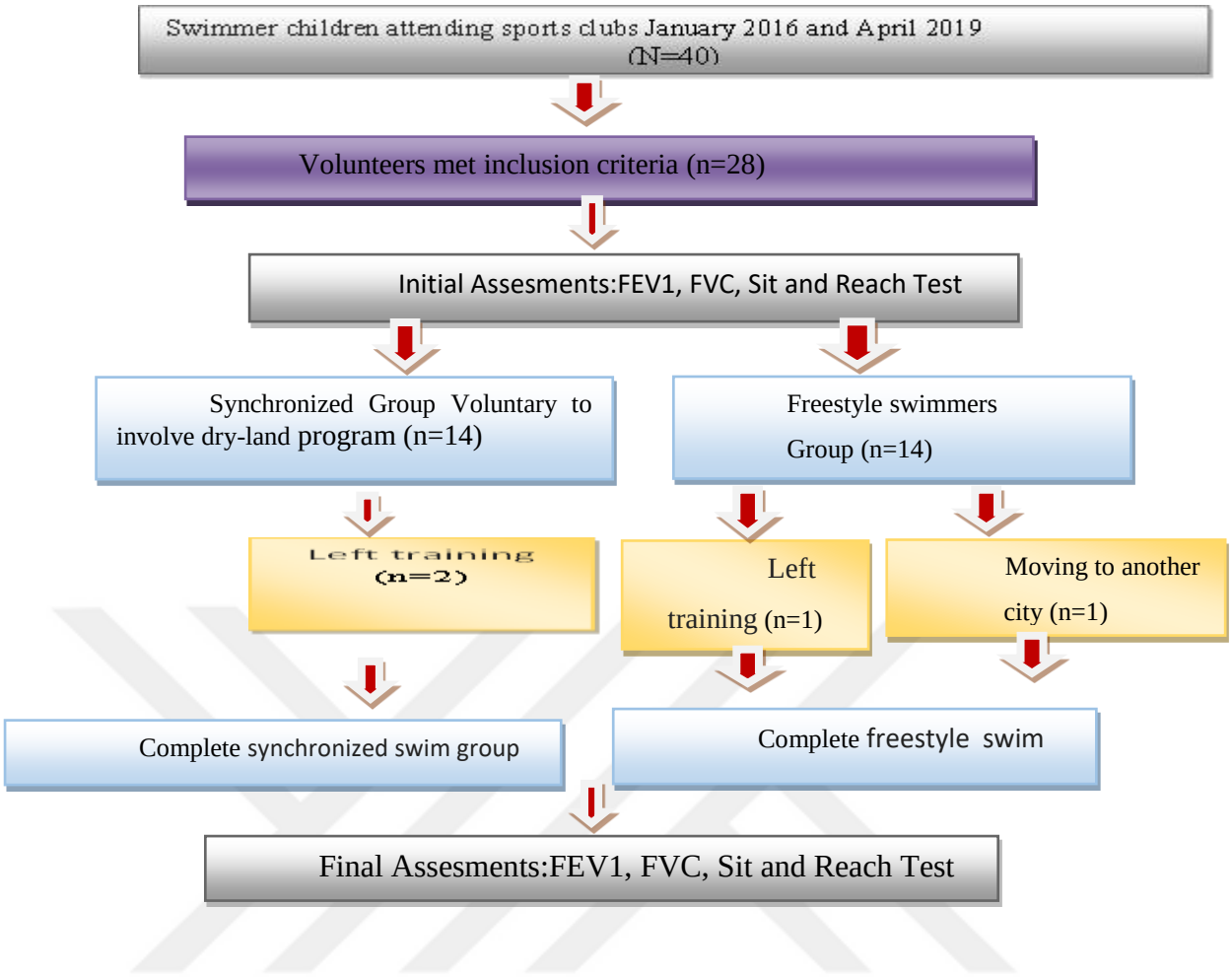


Figure 2.8: Flow Chart

2.2.7. Data Analysis

When obtained findings are evaluated in this study, IBM SPSS Statistics 22 for statistical analysis (SPSS IBM, Turkey) programs were used. When evaluating the study data, the suitability of normal distribution parameters was evaluated with Shapiro Wilks test.When comparing the normally distributed parameters between the two groups ,Student's t-test was used, and also Mann Whitney U test for the non-normally distributed parameters between the two groups,was used. Intragroup comparisons of normally distributed parameters ,Paired sample t test was used and Wilcoxon sign test was used for intragroup comparisons of non-normal distribution parameters. Significance evaluation values are at $p < 0.05$.

3. RESULTS

The study was conducted on a total of 24 girls, whom were either Synchronized Swimmers (n=12) or Freestyle Swimmers (n=12) (Table 3.1).

Table 3.1: In-group and inter-group height, weight, BMI evaluation

	Synchronized Swimmers	**Free style Swimmers**	**p**
	meant±SS	**meant±SS**	
Height(cm)	124,25±8,22	129,42±4,44	0,069
Weight(kg)	25,92±5,68	28,62±6,64	0,295
VKI(kg/cm²	16,75±3,20	17,06±3,94	0,838
Age(years)	7,42±0,79	8,0±0,85	0,097

Student t test

Table 3.2: In-group and inter-group FVC evaluation

	Synchronized Swimmers	**Free style Swimmers**	**[1]p**
FVC	**meant±SS**	**meant±SS**	
Before	1,58±0,44	1,78±0,22	0,182
After	1,59±0,28	1,84±0,36	0,075
Difference	0,01±0,38	0,06±0,25	0,696
[2]p	0,916	0,402	

There was no statistically significant difference between the FVC means of synchronized and freestyle swimmers before and after (p> 0.05).

There was no statistically significant difference between the groups in terms of the amount of change seen in the last FVC means compared to the first FVC means (p> 0.05).

In synchronized swimmers; There was no statistically significant change in the last FVC means compared to the first FVC means (p> 0.05).

In freestyle swimmers; There was no statistically significant change in the last FVC means compared to the first FVC means (p> 0.05).

Table 3.3: In-group and inter-group FEV1 evaluation

FEV1	Synchronized Swimmers meant±SS	Freestyle Swimmers meant±SS	1p
Before	1,4±0,34	1,56±0,17	0,174
After	1,41±0,23	1,61±0,28	0,068
Difference	0±0,29	0,05±0,2	0,655
2p	0,961	0,401	

[1]*Student t test* [2]*Paired Samples t Test*

There was no statistically significant difference between the FEV1 averages of synchronized and freestyle swimmers before and after (p> 0.05).

There was no statistically significant difference between the groups in terms of the amount of change seen in the last FEV1 means compared to the first FEV1 means (p> 0.05).

In synchronized swimmers; There was no statistically significant change in the last FEV1 mean compared to the first FEV1 means (p> 0.05).

In Freestyle swimmers; There was no statistically significant change in the last FEV1 mean compared to the first FEV1 means (p> 0.05).

Table 3.4:In-group and inter-group Sit and Reach evaluation

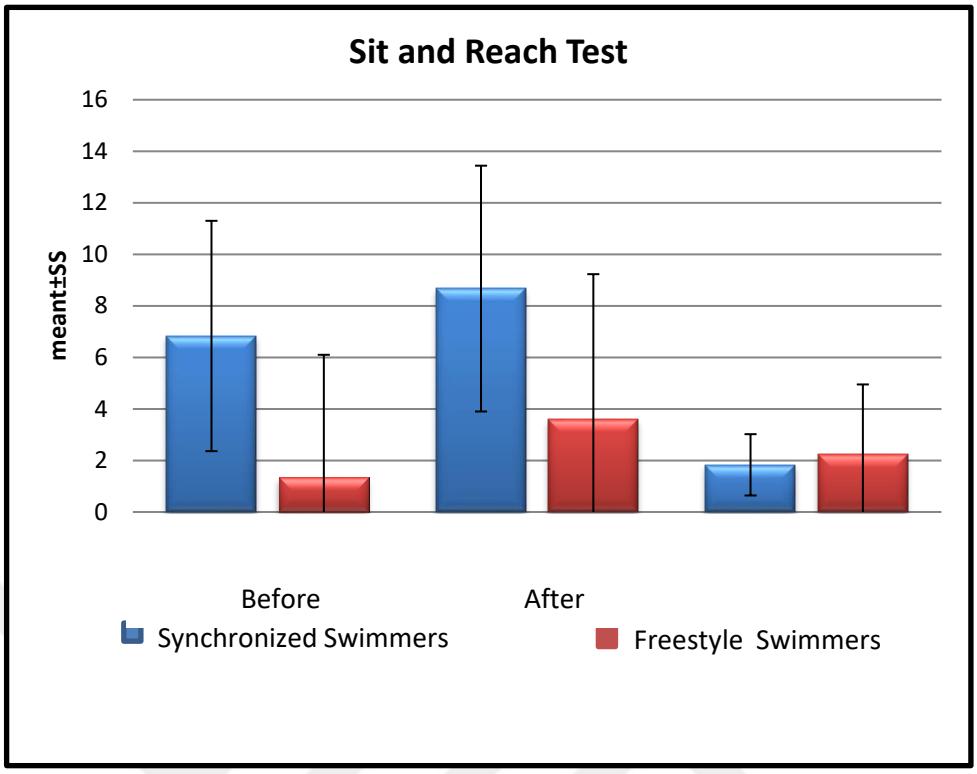
Sit andReach	Synchronized Swimmers meant±SS (median)	Freestyle Swimmers meant±SS (median)	[1]p
Before(cm)	6,83±4,47 (8,5)	1,33±4,77 (0,5)	0,011*
After(cm)	8,67±4,77 (9,5)	3,58±5,65 (2)	0,026*
Difference	1,83±1,19 (2)	2,25±2,70 (2,5)	0,517
2p	0,004*	0,028*	

[1]Mann Whitney U test *[2]Wilcoxon Sign Test* **p<0.05*

The previous flexibility levels of synchronized swimmers were statistically significantly higher than those of freestyle swimmers (p: 0.011; p <0.05).

Subsequent flexibility levels of synchronized swimmers were statistically significantly higher than those of freestyle swimmers (p: 0.026; p <0.05)

Table 3.5: Flexibility Evaluation Results



There was no statistically meaningfull difference between the groups in terms of the amount of increase seen in the last flexibility levels compared to the first flexibility levels ($p > 0.05$).

In synchronized swimmers; the increase in the last flexibility compared to the first flexibility levels was statistically significant ($p: 0.004$; $p < 0.05$).

Free style is sad; the increase in the last flexibility compared to the first flexibility levels was statistically significant ($p: 0.028$; $p < 0.05$).

4. DISCUSSION

Sable M.et al. (2012) examined the effect of sport performed on swimming and running in lung function. The runners and swimmers selected for this study who have been practicing for the last 3 years period,have been examined. It was found that those who were interested in swimming had a significant increase in lung function compared to runners [77].

Shrikrishna N Bamne (2017) compared the pulmonary functions in swimmers and badminton players of Indore city. Pulmonary functions were compared in 20 swimmers who exercised for at least 6 months, 6 days a week and 20 badminton athletes who were playing daily for 1 h since 6 months. Their ages between 20-30. FVC and FEV1 levels of swimmers were significantly different than badminton players, no significant difference was observed in PEFR values between groups. It has been shown that regular exercise affects lung function positively. Shrikrishna N Bamne added that badminton sport may be as an alternate sport to improve the lung function [78].

In our study, we looked at pulmonary function values between synchronized swimmers and freestyle swimmers. They were the beginners of freestyle and synchronized swimming. We could not achieve significant improvements in groups and between in both groups. One of the studies included regular sportsmen for 3 years, the other was engaged in daily training for 6 months. May be if the study was conducted for a long time with more intense training groups, the results would be different. At the same time in two studies the athletes are older than our participants,depending on they has completed lung development. But in our study, the ages are between 6-9.

According to the Atabek et al. (2017), 13 pre-adolescent children between 7 and 10 years of age who were swimming at least 3 times a week for 6 months in the same college team, were evaluated. The values of the studied variables were compared with those of the untrained group, matched for age and gender. Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and maximum voluntary ventilation (MVV) were evaluated to determine the respiratory function. The respiratory function values were not significant different between groups [1]. Weekly antreman period was like ours, but the evaluation period is a bit longer from our study.

In Sprateek K. Mehrotra et al. (1996) study, 20 swimmers with swimming experience between 2 and 5 years, were selected. 15 people, who were not engaged in any sport in the same age group, were selected as the control group. The results were compared to each other and the control group. As a result of the study, a significant improvement was observed in the lung capacity of swimmers [7].

Gabrilo G.et al(2011) made a study to evaluate the synchronized swimmers pulmonar function values 1- year period. In this study, there are 24 participant swimmers (all women, between 14 and 16ages). FVC and FEV1 values increased significantly within the study period.Measurements are taken before and after a 1-year period [79].

In our study, 24 trained 6 to 9 years-old swimmers who were the synchronized and freestyle swimmers that trained for 3 months, 2 days a week. We expected a significant increase in both groups but there was no significant increase in lung functions in both groups after 3 months. In our study, these results are attributed to the fact that the age group is small, that they have just started sports and that the frequency of training is low. The fact that they are at the beginning of swimming and the frequency of the training program explains this result.

When we rewieved the literature, more shoulder flexibility was evaluated in swimmers. According to Jenna Sawdon-Bea et al(2015) study,they assess the effects of a 6-Week Dry Land Exercise Program for High School swimmers. In this study, swimmers were taken to land training 3 times in a week for 6 weeks. Shoulder flexibility, core stability and swimming performance were evaluated. There was a significant difference in shoulder flexibility and core stabilization of swimmers after 6 weeks of land training programme [80].

In our study, we wanted to look at the general body flexibility by using Sit and Reach test battery. Of course, sit and reach test is not reflecting whole body flexibility. We wanted to use the Eurofit test battery as a physical fitness test battery for my age group. Flexibility is a component of the eurofit test battery, sit and reach test is suitable to evaluate the flexibility parameter of eurofit.Both groups showed a significant increase in flexibility compared to before and after. At the same time, in our study, synchronized swimmers initially proved to be significantly flexible than the freestyle

swimming group as a result of the assessment. Synchronized swimmers are not randomly selected. They undergo a flexibility assessment before starting this sport. If you are not enough flexible as a result of the coach's evaluation you cannot begin to train.Girls must be very flexible to start synchronized swimming.

4.1. Limitations of the study

We think that this study has some limitations. Children were anxious to test because they are underage. They had also difficulty while getting the commands for the tests. .And also the sit and reach test does not reflect the whole body flexibility.arious combinations of body and limb lengths can significantly affect test performance. If there will be a longer-term study with more participants, more meaningful results can be achieved.

5. CONCLUSION

Our study show that the three-months swimming training did not affect the respiratory function in 6- 9 year old children. Furthermore, we found that 3 months is very short especially for pulmonary functions, in line with the previous studies. On the other hand, it is suggested that possible results could be obtained if the duration of study was longer. It is of importance to note that sit and reach results shows significiant results in two groups. In the beginning, synchronized swimmers had higher flexibility than free style swimmers had. This stems from the fact that synchronized swimmers are subject to pre-evaluation before they become eligible for this sports.

6. REFERENCES

1. Atabek, H. Ç. (2017). The effects of swimming training on selected strength and respiratory function variables in pre-pubertal children. Journal of Athletic Performance and Nutrition, 4(1).

2. Alpay, B., Altuğ, K., & Hazar, S. (2007). Assessment of some respiratory and circulation parameters of 11-13 age group students in primary school teams by comparing them with untrained students. Mehmet Akif Ersoy University Journal of Education Faculty, 8, 22-29.

3. Mazic, S., Lazovic, B., Djelic, M., Suzic-Lazic, J., Djordjevic-Saranovic, S., Durmic, T.& Zugic, V. (2015). Respiratory parameters in elite athletes–does sport have an influence?. Revista Portuguesa de Pneumologia (English Edition), 21(4), 192-197.

4. Shephard, R. J. (1978). Human physiological work capacity (Vol. 15). Cambridge University Press.

5. Newman, F., THOMSON, M., & SMALLEY, B. (1961, January). A comparison between body size and lung function of swimmers and normal school children. In JOURNAL OF PHYSIOLOGY-LONDON (Vol. 156, No. 1, p. P9). 40 WEST 20TH STREET, NEW YORK, NY 10011-4211: CAMBRIDGE UNIV PRESS.

6. Doherty, M., & Dimitriou, L. (1997). Comparison of lung volume in Greek swimmers, land based athletes, and sedentary controls using allometric scaling. British journal of sports medicine, 31(4), 337-341.

7. Mehrotra, P. K., Verma, N., Yadav, R., Tewari, S., & Shukla, N. (1997). Study of Pulmonary Functions in Swimmers of Luckmow City. Indian journal of physiology and pharmacology, 41, 83-86.

8. Ingvar, H.(1992). Swimming physiology. Ann Anthrop.11(3):269-276.

9. Vishnu Priya, M (2015) Comparative Study on Pulmonary Function Tests in Children Swimmers Versus Non Swimmers. Masters thesis, Madurai Medical College, Madurai.

10. Jorgic B, Aleksandrovic M, Okicic T, Madic D(2009). The influence of flexibility onto the swimmingresults in students of sport and physical education.Sport Science 2 (1):91-94...

11. FINA (2009–2013) Synchronized swimming Rules. Available: http://www.fina. o r g / H 2 O / i n d e x.

12. Mountjoy, M. (2009). Injuries and medical issues in synchronized Olympic sports. rCurrent sports medicine reports, 8(5), 255-261.

13. Schaal, K., Le Meur, Y., Bieuzen, F., Petit, O., Hellard, P., Toussaint, J. F., & Hausswirth, C. (2012). Effect of recovery mode on postexercise vagal reactivation in elite synchronized swimmers. Applied physiology, nutrition, and metabolism, 38(2), 126-133.

14. Homma, M. (1994). The components and the time of'face in'of the routines in synchronized swimming. Medicine and Sport Science, 39, 149-154.

15. Jamnik V (1987) An evaluation of the physiological response to competitivesynchronized swimming and the physiological characteristics of elite synchronizedswimmers. Toronto (CA)

16.Iglesias X, Rodríguez-Zamora L, Clapés P, et al. (2014)Multidimensional analysis of the structure of competitiveroutines in synchronized swimming. Revista DE PsicologiaDel Deporte 23: 173-180.

17. Tinto, A., Campanella, M., & Fasano, M. (2017). Core strengthening and synchronized swimming: TRX® suspension training in young female athletes. The Journal of sports medicine and physical fitness, 57(6), 744-751.

18. Taylor, K.L., Sheppard, J.M., Lee, H. and Plummer, N. (2008) Negative effect of static stretching restored when combined with a sport specific warm-up component. Journal of Science and Medicinein Sport 12, 657-661.

19.Wanivenhaus, F., Fox, A. J., Chaudhury, S., & Rodeo, S. A. (2012). Epidemiology of injuries and prevention strategies in competitive swimmers. Sports health, 4(3), 246-251.

20. Croxon S. Long term athlete development matrix. Synchro. Can. 2006

21. Li, Y. McClure, P. W., & Pratt, N. (1996). The effect of hamstring muscle stretching onstanding posture and on lumbar and hip motions during forward bending. Physical Therapy, 76, 836–845 28.kaynak da aynı yerden

22. Sands, W. A., McNeal, J. R., Stone, M. H., Kimmel, W. L., Gregory Haff, G., & Jemni,M. (2008). The effect of vibration on active and passive range of motion in elite female synchronized swimmers. European Journal of Sport Science, 8, 217–223.

23. Council, O. E. (1983). Testing physical fitness Euroit experimental battery: provisional handbook.

24. Mesa, J. L., Ruiz, J. R., Ortega, F. B., Wärnberg, J., González-Lamuno, D., Moreno, L. A.& Castillo, M. J. (2006). Aerobic physical fitness in relation to blood lipids and fasting glycaemia in adolescents: influence of weight status. Nutrition, metabolism and cardiovascular diseases, 16(4), 285-293.

25.Catley M. J., Tomkinson G. R. (2013). Normative health-related fitness values for children: analysis of 85347 test results on 9-17-year-old Australians since 1985. Br. J. Sports Med. 47 98–108. 10.1136/bjsports-2011-090218.

26. Erikssen, G. (2001). Physical fitness and changes in mortality. Sports medicine, 31(8), 571-576.

27. Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. International journal of obesity, 32(1), 1.

28.Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public health reports, 100(2), 126.

29. Artero, E. G., Espana-Romero, V., Castro-Pinero, J., Ortega, F. B., Suni, J., Castillo-Garzon, M. J., & Ruiz, J. R. (2011). Reliability of field-based fitness tests in youth. International journal of sports medicine, 32(03), 159-169.

30. Artero, E. G., España-Romero, V., Castro-Piñero, J., Ruiz, J., Jiménez-Pavón, D., Aparicio, V., ... & Ortega, F. B. (2012). Criterion-related validity of field-based muscular fitness tests in youth. The Journal of sports medicine and physical fitness, 52(3), 263-272.

31. Kolimechkov, S. (2017). Physical Fitness Assessment in Children and Adolescents: A Systematic Review.European Journal of Physical Education and Sport Science.

32. Cvejić, D., Pejović, T., & Ostojić, S. (2013). Assessment of physical fitness in children and adolescents. Facta universitatis-series: Physical Education and Sport, 11(2), 135-145.

33. Knudson et al., (2000) Current Issues in Flexibility Fitness, President's Council on Physical Fitness and Sports- Research Digest, series 3, no. 10, June.

34.Bandy W.D, J.M Irion, Michelle Briggler (1994) The effect of time and frequency of static stretching on the flexibility of the hamstring muscles: Journal Of Physical Therapy; 74(9): 845-850.

35.Wilson,G.J.Elliott,B.C.and Wood,G.A.(1992),Stretch horten cycle performance enchancement through flexibility training,Medicine and Science in Sports and Exercise,24(1),116-123.

36.Bracko, M. R., & Fellingham, G. W. (2001). Comparison of physical performance characteristics of female and male ice hockey players. Pediatric Exercise Science, 13(1), 26-34.

37.American Alliance for Health, Physical Education, Recreation and Dance. (1984). Technical Manual: Health Related Physical Fitness.

38. Hoeger, W. W., & Hopkins, D. R. (1992). A comparison of the sit and reach and the modified sit and reach in the measurement of flexibility in women. Research Quarterly for Exercise and Sport, 63(2), 191-195.

39. Holt, L., Pelham, T., Burke, D. Modifications to the standard Sit-and-Reach flexibility protocol. J Athlet Train. 1999, 34(l): 43-47.

40. .Davis, D.S., Quinn, R.O., Whiteman, C.T., Williams, J.D. and Young,C.R. (2008) Concurrent validity of four clinical tests used tomeasure hamstring flexibility. Journal of Strength and ConditioningResearch 22, 583-588.

41. Patterson, P., Wiksten, D.L., Ray, L., Flanders, C. and Sanphy, D.(1996) The validity and reliability of the back saver sit-andreachtest in middle school girls and boys. Research Quarterlyfor Exercise and Sport 67, 448-451.Rodríguez-García, P.L., López-Miñarro, P.A.

42. Jones, C. J., Rikli, R. E., Max, J., & Noffal, G. (1998). The reliability and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. Research quarterly for exercise and sport, 69(4), 338-343.

43. Jackson, A. W., Morrow Jr, J. R., Brill, P. A., Kohl III, H. W., Gordon, N. F., & Blair, S. N. (1998). Relations of sit-up and sit-and-reach tests to low back pain in adults. Journal of Orthopaedic & Sports Physical Therapy, 27(1), 22-26.

44. Vandorpe, B., Vandendriessche, J., Vaeyens, R., Pion, J., Lefevre, J., Philippaerts, R., & Lenoir, M. (2011). Factors discriminating gymnasts by competitive level. International journal of sports medicine, 32(08), 591-597.

45. Roach, S., San Juan, J. G., Suprak, D. N., & Lyda, M. (2013). Concurrent validity of digital inclinometer and universal goniometer in assessing passive hip mobility in healthy subjects. International journal of sports physical therapy, 8(5), 680

46. Vagas, E., & Akgül, A. G. (2009). Solunum sistemi fizyolojisi ve çocuklardaki farklar. Toraks Dergisi.

47. Ratnovsky, A., Elad, D., & Halpern, P. (2008). Mechanics of respiratory muscles. Respiratory physiology & neurobiology, 163(1-3), 82-89.

48. Amonette, W., & Dupler, T. (2002). The effects of respiratory muscle training on VO2 max, the vantilatory thresold and pulmonary function. Journal of Exercise Physiology, 5 (2), 29-35.

49. Neumann,D.A.(2002).Kinesiology of musculoskeletal system-e-book:foundations for Physical rehabilitation,Mosby.

50. John, E., & Guyton, A. C. (2011). Guyton and Hall Textbook of Medical Physiology. Saunders/Elsevier

51. Costanzo L.S. Physiology. Respiratory Physiology, 5th ed.Lippincott Wiliams&Wilkins, 2011;4:113-33.

52. Hirano, H., Enamido, K., Suzuki, N.(1995).Examination of the peak flow level in the Shinjuku-ku asthma child swimming classroom participation child", Information & Knowledge Database of Tokyo Women's Medical University, 65 (9). 792-793.

53.http://www.hopkinsmedicine.org/healthlibrary/test_procedures/pulmonary/pulmonary_function_tests_92,P07759/

54. Udwadia, F. E., Sunavala, J. D., & Shetye, V. M. (1987). Lung function studies in healthy Indian subjects. The Journal of the Association of Physicians of India, 35(7), 491-496.

55. MacAuley, D., McCrum, E., Evans, A., Stott, G., Boreham, C., & Trinick, T. (1999). Physical activity, physical fitness and respiratory function—Exercise and respiratory function. Irish journal of medical science, 168(2), 119.

56. Durmic T, Lazovic B, Djelic M, Lazic JS, Zikic D, Zugic V, Dekleva M, et al. Sport-specific influences on respiratory patterns in elite athletes. J Bras Pneumol 2015; 41: 516–522.

57. Ranu, H., Wilde, M., & Madden, B. (2011). Pulmonary function tests. The Ulster medical journal, 80(2), 84.

58. Kendig, E. L., Wilmott, R. W., & Chernick, V. (2012). Kendig and Chernick's disorders of the respiratory tract in children. Elsevier Health Sciences

59. Lebowitz, M. D. (1991). The use of peak expiratory flow rate measurements in respiratory disease. Pediatric pulmonology, 11(2), 166-174.

60. Enright, P. L. (2003). How to make sure your spirometry tests are of good quality. Respiratory care, 48(8), 773-776.

61. Chhabra, S., Et Al., Prediction Equations For Spirometry In Adults From Northern India. Indian J Chest Dis Allied Sci, 2014. 56: P. 221-30.

62. Miller, M. R., Hankinson, J. A. T. S., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., ... & Jensen, R. (2005). Standardisation of spirometry. European respiratory journal, 26(2), 319-338.

63. Enright, P.L., M.D. Lebowitz, And D.W. Cockroft, Physiologic Measures: Pulmonary Function Tests: Asthma Outcome. American Journal Of Respiratory And Critical Care Medicine, 1994. 149(2_Pt_2): P. S9-S18.

64. Kıyan, E. (2006). Solunum Fonksiyon testleri. Türk Toraks derneği V Kış Okulu Notları.

65.Myrianthefs, P., Grammatopoulou, I., Katsoulas, T., & Baltopoulos, G. (2014). Spirometry may underestimate airway obstruction in professional G reek athletes. The clinical respiratory journal, 8(2), 240-247.

66. Nève, V., Edmé, J. L., Devos, P., Deschildre, A., Thumerelle, C., Santos, C., ... & Matran, R. (2006). Spirometry in 3–5-year-old children with asthma. Pediatric pulmonology, 41(8), 735-743.

67. Vilozni, D., Barak, A., Efrati, O., Augarten, A., Springer, C., Yahav, Y., & Bentur, L. (2005). The role of computer games in measuring spirometry in healthy and "asthmatic" preschool children. Chest, 128(3), 1146-1155.

68. 53. Merkus, P. J. F. M., De Jongste, J. C., & Stocks, J. (2005). Respiratory function measurements in infants and children. European Respiratory Monograph, 31, 166.

69. Vogt, B., Falkenberg, C., Weiler, N., & Frerichs, I. (2014). Pulmonary function testing in children and infants. Physiological measurement, 35(3), R59.

70. Bennett, J. C. (1996). Plum F. Cecil textbook of medicine.

71. Eurofit. (1993) Handbook for the Eurofit tests of Physical Fitness. Strasbourg: Council of Europe, Commitee for the Development of Sport. 75 p..

72. Hui, S.S. and Yuen, P.Y. (2000) Validity of the modified back-saver sit and-reach test: a comparison with other protocols. Medicine andScience in Sports and Exercise 32, 1655-1659.

73. Baltaci, G., Un, N., Tunay, V., Besler, A. and Gerceker, S. (2003)Comparison of three different sit and reach tests for measurementof hamstring flexibility in female university students. British Journal of Sports Medicine 37, 59-61.

74. Docherty, D. (1996). Measurement in pediatric exercise science (pp. 285-334). Champaign, IL: Human Kinetics.

75. Liemohn, W., Martin, S. B., & Pariser, G. L. (1997). The effect of ankle posture on sit-and-reach test performance. The Journal of Strength & Conditioning Research, 11(4), 239-241.

76. Hui, S. C., Yuen, P. Y., Morrow Jr, J. R., & Jackson, A. W. (1999). Comparison of the criterion-related validity of sit-and-reach tests with and without limb length adjustment in Asian adults. Research Quarterly for Exercise and Sport, 70(4), 401-406.

77. Sable, M., Vaidya, S.M. & Sable, S.S. (2012). Comparative study of lung functions in swimmers and runners. Indian Journal Physiol Pharmacol. 56(1), pp.100-4.

78. Bamne, S. N. (2017). Comparative study of pulmonary functions in swimmers and badminton players of Indore city. National Journal of Physiology, Pharmacy and Pharmacology, 7(9), 999.

79. Gabrilo, G., Peric, M., & Stipic, M. (2011). Pulmonary function in pubertal synchronized swimmers: 1-year follow-up results and its relation to competitive achievement. Medical Problems of Performing Artists, 26(1), 39.

80. Sawdon-Bea, J., & Benson, J. (2015). The effects of a 6-week dry land exercise program for high school swimmers. Journal of Physical Education and Sports Management, 2(1), 1-17.

APPENDIX 1: ETHICAL COMMITTEE APPROVAL

T.C. YEDİTEPE ÜNİVERSİTESİ

Sayı : 37068608-6100-15- 1586 **17/01/2019**
Konu: Klinik Araştırmalar
Etik kurul Başvurusu hk.

İlgili Makama (Fatma Yüksek)

Yeditepe Üniversitesi Fizik Tedavi ve Rehabilitasyon Bölümü Dr. Öğr. Üyesi Şule Badıllı Demirbaş'ın sorumlu olduğu **"6-9 Yaş Arası Senkronize Yüzme ve Serbest Stil Yüzmeye Başlayan Kız Çocukları Arasındaki Flexibilite ve Akciğer Kapasitesi Değişimlerinin İncelenmesi"** isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası (**1557** kayıt Numaralı KAEK Başvuru Dosyası), Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından **16.01.2019** tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isimi belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 939**).

Prof. Dr. Turgay ÇELİK
Yeditepe Üniversitesi
Klinik Araştırmalar Etik Kurulu Başkanı

Yeditepe Üniversitesi 26 Ağustos Yerleşimi, İnönü Mahallesi Kayışdağı Caddesi 34755 Ataşehir / İstanbul
T. 0216 578 00 00 www.yeditepe.edu.tr F. 0216 578 02 99

APPENDIX 2: INFORMED WRITTEN CONSENT

GÖNÜLLÜ ONAM FORMU

"6-9 yaş arası Senkronize yüzme ve serbest stil yüzmeye yeni başlayan kız çocuklarının esneklik ve solunum kapasitesi açısından araştırılması ve değerlendirilmesi "amaçlanmıştır.Çalışma için 3aylık bir süre hedeflenmiştir.Bu çalışmanın başında ve sonunda değerlendirmeler yapılıp 2 yüzücü grubu arasında esneklik ve solunum kapasitesi açısından anlamlı bir farklılık olup olmadığına bakılacaktır.Çalışmada esneklik için "Sit and Reach testi",solunum kapasitesi için de Spirometre ile FVC,FEV1 değerlerine bakılacaktır.Her sporcu için disposable sft ağızlıkları kullanılacaktır.Çalışmaya toplamda 24 kişi dahil edilmesi planlanmıştır.

Sayın Fizyoterapist Fatma Yüksek tarafından Yeditepe Üniversitesi Spor Fizyoterapisi anabilimdalında tıbbi bir araştırma yapılacağı belirtilerek bu araştırma ile ilgili yukarıdaki bilgiler bana aktarıldı. Bu bilgilerden sonra böyle bir araştırmaya çocuğum katılımcı olarak davet edildi.

Eğer bu araştırmaya katılırsam fizyoterapist ile aramda kalması gereken çocuğuma ait bilgilerin gizliliğine bu araştırma sırasında da büyük özen ve saygı ile yaklaşılacağına inanıyorum. Araştırma sonuçlarının eğitim ve bilimsel amaçlarla kullanımı sırasında çocuğumun kişisel bilgilerinin ihtimamla korunacağı konusunda bana yeterli güven verildi. Projenin yürütülmesi sırasında herhangi bir sebep göstermeden araştırmadan çekilebiliriz. (Ancak araştırmacıları zor durumda bırakmamak için araştırmadan çekileceğimizi önceden bildirmemin uygun olacağının bilincindeyim). Ayrıca tıbbi durumuma herhangi bir zarar verilmemesi koşuluyla araştırmacı tarafından araştırma dışı da tutulabilirim.

Araştırma için yapılacak harcamalarla ilgili herhangi bir parasal sorumluluk altına girmiyorum. Bana da bir ödeme yapılmayacaktır.

Bu araştırmaya katılmak zorunda değilim ve katılmayabilirim. Araştırmaya katılmam konusunda zorlayıcı bir davranışla karşılaşmış değilim.

Bana yapılan tüm açıklamaları ayrıntılarıyla anlamış bulunmaktayım. Kendi başıma belli bir düşünme süresi sonunda adı geçen bu araştırma projesinde çocuğumun "katılımcı" (denek) olarak yer alması kararını aldım. Bu konuda yapılan daveti büyük bir memnuniyet ve gönüllülük içerisinde kabul ediyorum.

İmzalı bu form kağıdının bir kopyası bana verilecektir

GÖNÜLLÜ ONAY FORMU

Yukarıda gönüllüye araştırmadan önce verilmesi gereken bilgileri gösteren metni okudum. Bunlar hakkında ebeveyn olarak bana yazılı ve sözlü açıklamalar yapıldı. Bu koşullarla söz konusu klinik araştırmaya kendi rızamla hiçbir baskı ve zorlama olmaksızın katılmayı kabul ediyorum.

Çocuğun Annesi veya Babası

Adı-Soyadı:

Adres:

Telefonu:

İmza:

Açıklamaları yapan araştırmacının Adı-Soyadı:

İmza:

APPENDIX 3: STRUCTURED QUESTIONNAIRE

DEMOGRAFİK BİLGİLERİ

Tarih:

Adı: Soyadı:

Doğum Tarihi /gün, ay, yıl):

Cinsiyeti:

Adres :

Telefon:

Anne Adı:

Baba Adı:

SAĞLIK BİLGİLER

Boy:

Kilo:

VKİ:

Yaptığı Spor veya sporlar:

Spora Başlama Yaşı:

Sistemik Rahatsızlık (kalp, akciğer vb.) veya ortopedik rahatsızlık var mı:

Kullandığı İlaçlar:

APPENDIX 4: Curriculum Vitae

Personal Informations

Name	Fatma	**Surname**	Yüksek
Place of Birth	Kozaklı/NEVŞEHİR	**Date of Birth**	06.05.1981
Nationality	Turkish	**TR ID Number**	18661063708
E-mail	fatmayksek@yahoo.com	**Phone number**	05559675745

Education

Degree	**Department**	**The name of the Institution Graduated From**	**Graduation year**
Doctorate			
Master			
University	Physical Therapy and Rehabilitation	**Pamukkale University**	2003
High school		**Anatolian High SchoolADANA-**	1999

Languages	**Grades (#))**
English	Upperintermediate
Germany	Beginner

All the grades must be listed if there is more than one (KPDS, ÜDS, TOEFL; EELTS vs),

Work Experience (Sort from present to past)

	Institute	**Duration (Year - Year)**
Physical Therapist	Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi	2009-
Physical Therapist	Meram Eğitim ve Araştırma Hastanesi	2005-2009-

Computer Skills

Program	**Level**
Microsoft	average

***Excellent , good, average or basic**

Scientific works

The articles published in the journals indexed by SCI, SSCI, AHCI

Articles published in other journals

Proceedings presented in international scientific meetings and published in proceedings book.

Journals in the proceedings book of the refereed conference / symposium

Others (Projects / Certificates / Rewards)