https://doi.org/10.54141/psbd.1491268

PAMUKKALE JOURNAL OF SPORT SCIENCES
ISSN: 1309-0356
dergipark.org.tr/en/pub/psbd

Pamukkale J Sport Sci, 2024, 15(2), 328-348, 2024 Research Article

8-Week Online Fitness Intervention on Muscle Strength, Flexibility, Body Composition and Physical-Self Perception: A Randomized Controlled Trial

Günay YILDIZER[1*] Feridun Fikret ÖZER[2] Caner ÖZBÖKE[1] Burak SÖĞÜT[3] Didem ŞAFAK[3] Dilara Ebru UÇAR[4]

[1]*Department of Physical Education and Sport, Eskişehir Technical University, Eskişehir, Türkiye*
[2]*Department of Coaching Education, Eskişsehir Technical University, Eskişehir, Türkiye*
[3]*Faculty of Sport Science, Eskişsehir Technical University, Eskişehir, Türkiye*
[4]*Department of Healthcare Services, Anadolu University, Eskişehir, Türkiye*

Keywords
Fitness,
Physical-self,
Well-being

Article History
Received 28 May 2024
Revised 09 August 2024
Accepted 13 August 2024
Available Online 28 August 2024

* **Corresponding Author**:
Günay YILDIZER
E-mail Address:
gunayyildizer@eskisehir.edu.tr

ABSTRACT

This research examines the effect of an online physical fitness intervention plan on health-related components, and self-perception with randomized controlled trial. A total of 43 individuals completed the study, 21 of them were in the experimental group, and 22 were in the control group. Muscle strength was assessed using push-ups and sit-ups, while flexibility was determined through sit-and-reach tests. Fat and muscle mass in the arms, legs, trunk, android, gynoid regions, and total body were measured in grams by using Dual Energy X-Ray Absorptiometry. Health, body fat, strength, flexibility, endurance sub-dimensions of Marsh Physical Self-Description Inventory was used for self-perception. Results showed that group and time interaction had a significant effect on self-perception of body fat and push-ups, flexibility left and right, total fat, body fat mass in the arm, leg, and gynoid regions. Although the muscle mass of the experimental group increased in the 8-week period, this situation was not statistically significant. The implemented physical fitness intervention program has a significant impact, particularly in terms of fat burning. The findings obtained in strength tests can be associated with a decrease in fat mass, especially in the upper body. In conclusion, these findings underscore the potential of online fitness interventions in achieving positive health outcomes, emphasizing the multifaceted benefits of such programs on both perceived and measured physical well-being.

INTRODUCTION

Physical fitness is one of the leading concepts of health and well-being at all stages of life (Corbin et al., 2000). The components of health-related physical fitness, namely flexibility, cardiovascular endurance, body composition, muscular strength, and endurance are important components of overall health and associated with numerous health benefits (Pescatello et al., 2014). Increased physical activity level is associated with improved health-related fitness (Jaakkola et al., 2019), positive effects on blood pressure, metabolism, and body weight (Pedersen & Saltin, 2015) mental health benefits such as reduced anxiety levels and stress (Codella et al., 2017; Zou et al., 2022). Although the relationship between participating in regular exercise to increase physical fitness and health is evident, the prevalence of sedentary behavior is high among people from all age groups (Bauman et al., 2018). Sedentary lifestyle is a global issue, and a considerable amount of people inveterately engage in various sedentary activities such as playing video games, watching TV, and using computer for a long time. Sedentary behavior is defined as any waking behavior, such as sitting or leanin with an energy expenditure of 1.5 metabolic equivalent task (MET) or less (Tremblay et al., 2017). A sedentary lifestyle is utterly related to various chronic health problems such as cardiovascular diseases, diabetes, cancer, hypertension, obesity, depression, musculoskeletal diseases and premature mortality (Park et al., 2020). Sedentary behaviors are not just associated with negative health outcomes, but there is also consistent evidence that sedentary behavior is associated with lower physical fitness in various age groups (Guo et al., 2022; Mateo-Orcajada et al., 2022).

In certain contexts, individuals tend to engage in prolonged sedentary behaviors, and these contexts are considered sedentary-promoting environments (Biddle et al., 2016). Specifically, sedentary activities encompass activities that involve extended periods of sitting, such as smartphone usage, computer-based work, or long hours of study. Environments that facilitate and encourage these sedentary behaviors can be categorized as sedentary-promoting environments. These environments may have detrimental effects on individuals within them, including university students who are expected to be physically active based on their age group (Guo et al., 2022; Yoo et al., 2020). Indeed, university students and office workers who predominantly engage in sedentary behaviors, such as prolonged sitting and computer-based work have consistently shown associations with various aspects of diminished physical fitness (Li et al., 2022; Prieske et al., 2019; Prince et al., 2019; Yoo et al., 2020). Activities entailed with sitting in the classroom paradigm should be replaced with standing desk activities in the classroom to improve cardiometabolic health of university students (Butler et al., 2018). Therefore, sedentary behavior associated with study and work is a matter of public health concern, given its detrimental effects on both health and physical fitness (Dewitt et al., 2019). Although environmental factors in university campuses are generally sufficient to promote a physically active lifestyle, work demands employees and students might mitigate the physical activity participation and increase the time spent as sedentary (Castro et al., 2020; Deliens et al., 2015; Lusa et al., 2020). To illustrate, university employees spend most of their workday sitting (Faghy et al., 2022), and an individual may spend more than half the day sedentary on an ordinary workday in office settings (Wahlström et al., 2023). Similarly, university activities that students engaging are also highlighted as generally sedentary, with an average of 7.30 hours per day sitting (Castro et al., 2020). Hence, universities can be categorized as a key setting where sedentary behavior is typical, and individuals in university settings engage in high levels of sedentary time with several hours per day, which have been linked to negative health outcomes, such as obesity, type 2 diabetes, and cardiovascular disease (Vainshelboim et al., 2019).

METHODS

Research Design

The study employed a randomized controlled trial to assess the effectiveness of the developed interventions on fitness components, body composition, and perceived physical self-concept. Simple randomization was used. Time and the group variables were the independent variables, while physical fitness components (push-ups, sit-up counts and sit and reach distance, fat and muscle mass in the arms, legs, trunk, android, gynoid regions and total body), and physical self-concepts (perceived health, body fat, strength, flexibility) were the dependent variables of the study. The research was completed in 10 weeks. The pre-tests of the study were conducted in first week, and the exercise program was completed in between weeks two and nine. After the completion of the exercise program, the participants attended the post-tests in the same order as in the pre-test. The review board approved this study of the Eskişehir Technical University with Protocol No.: 63349 (06.04.2022) The study commenced in July 2022 and concluded in October 2022.

Participants

A priori sample size was calculated via G*Power version 3.1.9.7 for Mixed Design ANOVA, which determined effect size 0.25, power 0.80, two groups (intervention and control) and two measurements (pre- and post-test). The basis on which values were determined were the recommendations of Cohen (1988) on statistical power and the manual of G*power software for the selected design and the appropriate analysis. The sample size was calculated to be a total of 34 participants. The inclusion criteria were determined as follows: a) working or studying at the university; b) having no health problems that would prevent participation in exercise; c) not being involved in another exercise/training program during the research process; d) voluntary participation. University employees and students were invited to participate in this study via e-mail. A total of 67 individuals replied and wanted to participate in the study. However, the results of the Physical Activity Readiness Questionnaire (PAR-Q) and the reported medical conditions indicated that only 49 participants were eligible for the intervention protocol. The eligible participants were invited to the laboratory for the implication of the data collection protocols. The study sample was randomly assigned to intervention (n = 24) and control groups (n = 25) by using randomization software. The randomization wasn't blind, as all participants work or study in the same university campus. A pretest group differences in all variables were checked by using independent sample t-tests, and there were no group differences. Three participants from the intervention group didn't complete the protocol and were excluded from the post-tests and three participants in the control group didn't attend the post-test measurements. Finally, the study sample comprised 21 participants in the intervention group 147 (M_{Age} = 30.90, SD = 8.04; M_{Weight} = 65.36, SD = 10.87; M_{Height} = 167.57, SD = 9.01, M_{BMI} = 23.25, SD = 3.26) and 22 participants in the control group (M_{Age} = 26.12, SD = 7.71; M_{Weight} = 67.54, SD = 14.34; M_{Height} = 170.24, SD = 9.95, M_{BMI} = 23.15, SD = 3.76). The group differences were rechecked for the possible covariance variables, however, there were still no differences in all dependent variables.

Procedures

Physical Fitness

All measurements were practiced in one day at Eskişehir Technical University Laboratory of Kinanthropometry. The Kinanthropometry Laboratory was includes Dual Energy X-Ray Absorptiometry (DXA), sit and reach box, stadiometer, scale, and other measurement materials. Push-up and curl-up tests were used to evaluate endurance and strength of the upper body. The sit-and-reach test were used to assess lower body flexibility.

To evaluate body composition, body mass (kg), height (cm), fat percent, muscle mass, and fat mass were measured. Before measurements, participants were informed about test procedures. Each session was administered by the same two researchers who are experienced in the field and are graduate students. After the body composition tests, participants followed in randomized order to complete physical fitness tests. Testing was preceded by a standard warm-up (five minutes of walking and five minutes of dynamic stretching). Before each session, practitioners demonstrated the test. After participants performed the tests one time for familiarization, the test was performed twice, and the best score was recorded by the practitioner. Participants allowed to rest for five minutes between all tests.

Push-Up

Participants were asked to place their hands flat on the ground under their shoulders, with a straight, slanted line on shoulders, back, and legs. While performing the test, participants were expected to lower the torso until the elbows are in line at 90 degrees angle with upper arms and shoulders were parallel to the ground, while the body was lifted up until the arms are straight at the lifting part. Participants were asked to perform push-ups every three seconds and an auditory stimulus was utilized; they were instructed to do each repetition with, their body moving rigidly in a roughly straight line. Following the familiarization, the participants were asked to complete as many push-ups as possible. The test was terminated once the individuals had completed consecutive repetitions with a restricted range of motion, and the most recent completed repetition was recorded.

Curl-Up

The participants were told to lay supine on a mat with the knees bent at a 90-degree angle, the legs spread apart, and the arms completely extended at the sides with the middle finger of, both hands contacting a piece of tape. The zero point was marked with the first piece of tape, and a second piece was placed 10 cm away. A metronome was set to 20 repetition rate per minute. In time with the metronome, the participant was directed to curl up until his middle finger reached the second piece of tape. Following the familiarization, the participants were asked to complete as many curl-ups as possible. Participants were required to keep the palms of their hands and the heels of their feet are in contact with the mat, while the shoulders and head were raised and returned to the mat, and the middle finger to the zero marker (Beck et al., 2015). The total number of repetitions that were successfully completed was noted.

Flexibility

A sit-and-reach box (Lafayette Instrument Company, USA) with a scale marked on the upper sides were placed against the wall. The participants were seated barefoot, with their legs fully extended and hip-width apart from the testing box. Participants were instructed to slowly reach forward and slide their fingers along the scale on top of the box by placing one hand over the other. The goal was for participants to maintain the position for about three seconds with their knees as straight as they could (Belkhir et al., 2021). The final position that the participant reaches were recorded to the nearest centimeter and set as the score for the test.

Body Composition

Participants' height was measured by a stadiometer (SECA, Hamburg) with an accuracy of 0.1 cm. In a standing still position, their arms at their sides, feet together, and toes touch to platform. Body mass (kg) was measured barefoot by a scale (SECA, Hamburg) with a precision of 0.1 kg. The whole-body composition (fat percentage, bone mass, muscle mass, and fat mass) was evaluated with DXA using a scanner (Lunar Prodigy Pro; GE, Healthcare, Madison, WI, USA). Prior to the measurements, the scanner's calibration was completed in accordance with the manufacturer's standard operating procedures. Before the scanning procedure, participants were requested to take off any metal from their bodies. Afterwards, participants were then instructed to lay down on the DXA mat. The participant's back was aligned with, the mat's center line, and both arms are placed to the side of the body. Height and weight pieces of information were entered into their form on the DXA software. Participants' knees and ankles were tied with a hook and pile strap to serve as a standard. Once participants were properly place, and the scanning process was started. Participants were instructed to keep still throughout the entire scanning procedure.

Physical Self-Concept

Turkish version of the Physical Self-Description Questionnaire was used to collect physical self-perception data. The 7-Likert type data collection tool was found valid and reliable among Turkish adults (Marsh et al., 2002). The inventory consists of 11 subdimensions and 70 items. However, only 27 items representing perceived body fat, flexibility, strength, and health subdimensions were used in this study. The higher scores obtained in the subdimensions represent higher physical self-perception. To illustrate, obtaining a higher score in body fat subdimension reflects perceived lower-level adipose tissue. The internal consistency values were found 0.845 for body fat, 0.790 for strength, 0.887 for flexibility, and 0.876 for the health subdimensions.

Exercise Protocol

The physical fitness intervention lasted for eight weeks, three days a week, and 20-35 minutes a day as recommended by ACSM (Garber et al., 2011). The exercise program has been designed according to the progressive overload method (See in appendix). Therefore, the volume of the exercise program increased as the weeks progressed. Exercise videos were uploaded to YouTube on mondays, wednesdays, and fridays and send to participants via a message group to follow the program. The attendance of the participants in the program was followed up regularly through the message group. The videos have undergone some adjustments to be more entertaining and support participation. The videos featured the experts' explanations of the movements for each exercise. Also, there were images of the movements from different angles, information about the exercise time, and the music in the background. The equipment that the participants should use in the training sessions was selected from the materials available at home (eg., use of water bottles instead of weight dumbbells). The exercises have been replaced with difficult versions in the following every two weeks of the program within progressive overload exercise. The exercise sessions are divided into three parts: warm-up (2-4 min. average), main part (14-19 min. average), cool-down (3-5 min. average). The warm-up includes movements to increase the heart rate and warm-up the muscles to be worked on for that session. While the central part covered the whole-body exercises in the first weeks, and regional exercises were applied in the following weeks. The main part of the exercise program also included rest breaks when the participants were asked to move and stretch. Flexibility and stretching exercises are included in the cool-down sessions.

Data Analysis

The independent samples t-test was used to analyze the pre-test group comparison, and the results didn’t indicate any significant differences in independent variables between experimental and control groups. Data were analyzed with the 2x2 (Time x Group) Mixed Design Analyses of Variance (Mixed ANOVA) for each independent variable. The normality of the independent variables were checked by using Shapiro-Wilk’s test, and the results indicated that only muscle mass in legs distributed non-normally in the posttest for the control group, and muscle mass in arms non-normally in the pre-test for the experimental group. For those non-normal distribution, the histograms, ratios between standard errors and actual skewness and kurtosis statistics and coefficient of variation were examined (Hayran & Hayran, 2020). As the data had a fairly skewed distribution, the skewness and kurtosis data were in the normally accepted range (Kline, 2011), and the coefficient of variation was less than 30 (Hayran & Hayran, 2020), the muscle mass in the legsgs, and muscle mass in arms were accepted as normally distributed. The analyses were carried out with Mixed ANOVA. The Levene's test confirmed the assumptions of homogeneity of variances for all independent variables (p>0.05). The partial eta squared effect sizes were also reported for the magnitude of the detected effects. All analyzes were conducted with originally assigned groups.

RESULTS

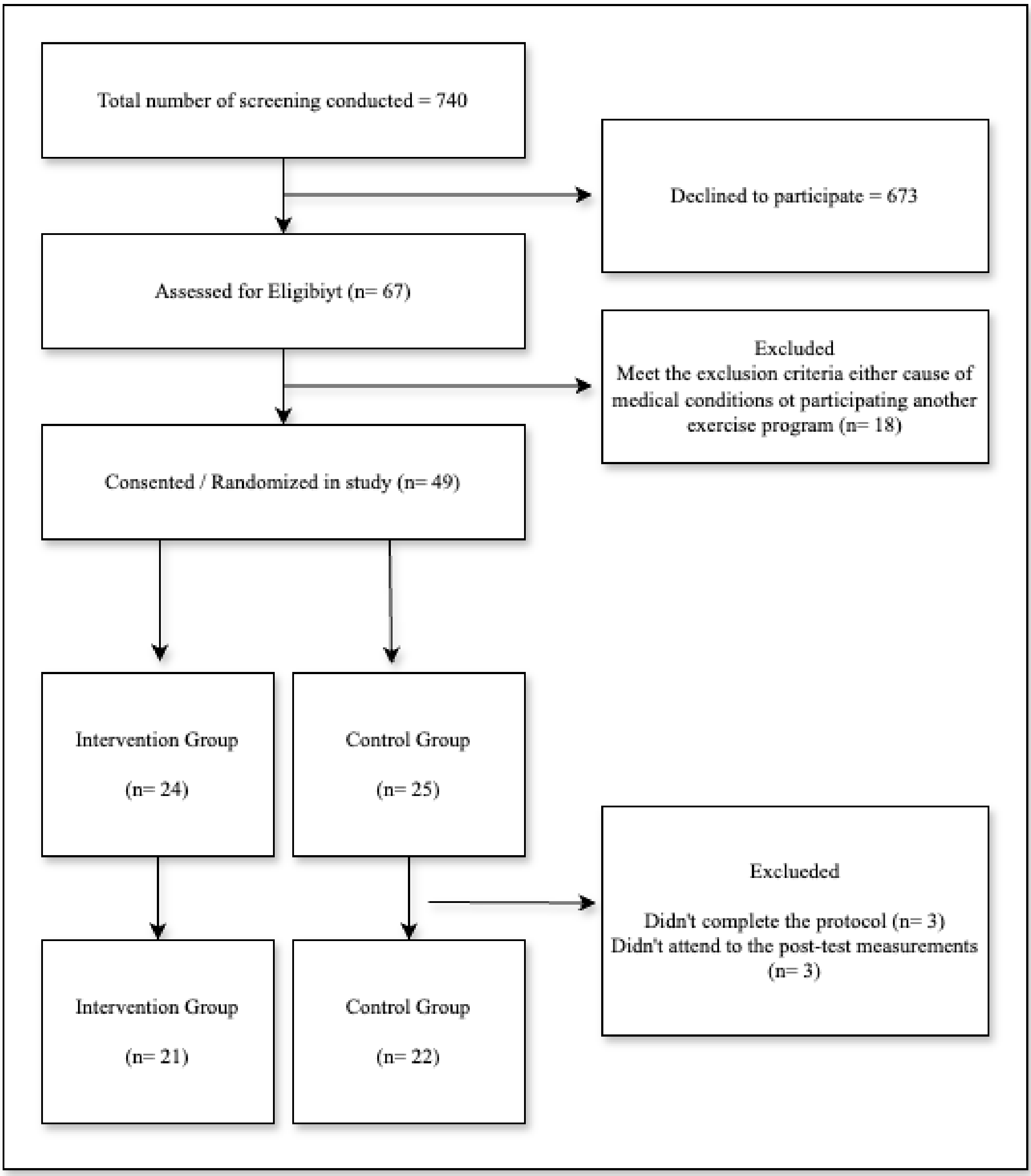
A participants' flow diagram, illustrating the number of individuals who were randomly assigned, and those who dropped out are depicted in Figure 1. The 2-way Mixed ANOVA results indicated a significant interaction between time and intervention on push-up performance [F (1,41) = 5.877, p = 0.20, η2 = 0.125], sit and reach performance with right leg [F(1,41) = 25.586, p = 0.000, η2 = 0.384], and left leg [F(1,41) = 247.679, p =0.000, η2 = 0.386] for fitness test components. The simple main effect of time on push-ups performance [F (1,41) = 15.555, p = 0.00, η2 = 0.275], sit-up performance [F(1,41) = 11.260, p = 0.02, η2 = 0.215], and sit and reach performance with a left leg [F(1,41) = 4.939, p = 0.032, η2 = 0.108] was also found and shown in Table 1.

Table 1
Descriptive Statistics and Mixed ANOVA Results for Fitness Components

Variables	Group	Pre-test x (SD)	Post-test x (SD)	Time		Group		Time x Group	
				F	p	F	p	F	p
Push-ups	Exp	4.61 (4.88)	9.00 (2.30)	15.555	0.000	0.076	0.784	5.877	0.020
	Con	5.77 (6.13)	6.81 (2.38)						
Sit-ups	Exp	8.09 (8.52)	12.19 (9.96)	11.260	0.002	0.000	0.990	0.094	0.761
	Con	8.40 (6.91)	11.81 (8.42)						
Flexibility-right	Exp	20.83 (9.43)	25.35 (9.28)	1.474	0.232	0.032	0.858	25.586	0.000
	Con	24.04 (6.29)	21.27 (7.92)						
Flexibility-left	Exp	21.45 (9.12)	26.33 (9.71)	4.939	0.032	0.854	0.361	25.781	0.000
	Con	22.56 (6.36)	20.65 (9.23)						

Note. Exp: Experiment, Con: Control; F: Mixed ANOVA

Figure 1
Flow Diagram



The mixed ANOVA results also indicated significant interaction between time and intervention on total fat mass [$F(1,41) = 7.349$, $p = 0.010$, $\eta^2 = 0.152$], fat mas in arms [$F(1,41) = 7.310$, $p = 0.010$, $\eta^2 = 0.151$], in legs [$F(1,41) = 7.340$, $p = 0.010$, $\eta^2 = 0.152$], in trunk [$F(1,41) = 5.199$, $p = 0.28$, $\eta^2 = 0.113$], in gynoid region [$F(1,41) = 5.560$, $p = 0.23$, $\eta^2 = 0.119$] for the body composition variables shown in Table 2.

Table 2
Descriptive Statistics and Mixed ANOVA Results for Body Composition Components

Variables	Group	Pre-test x (SD)	Post-test x (SD)	Time		Group		Time x Group	
				F	p	F	p	F	p
Total Fat Mass	Exp	21060.00 (5953.47)	20002.04 (5771.52)	2.940	0.094	0.004	0.947	7.349	0.010
	Con	20285.81 (6582.56)	20523.95 (5771.52)						
Fat Mass in Legs	Exp	7917.66 (2527.76)	7558.14 (2665.08)	2.762	0.104	0.025	0.876	7.340	0.010
	Con	7577.63 (2245.29)	7663.77 (2367.41)						
Fat Mass in Arms	Exp	4801.16 (1428.64)	4854.00 (1460.09)	0.118	0.733	0.457	0.503	0.581	0.450
	Con	5152.27 (1604.78)	5132.27 (1623.92)						
Fat Mass in Trunk	Exp	10173.47 (3330.37)	9590.04 (3215.13)	2.147	0.151	0.003	0.958	5.199	0.028
	Con	9760.13 (3908.12)	9887.09 (3949.20)						
Fat Mass in Android	Exp	1470.09 (699.14)	1400.19 (651.42)	0.212	0.648	0.003	0.956	0.397	0.532
	Con	1417.95 (770.22)	1428.81 (756.13)						
Fat Mass in Gynoid	Exp	4016.47 (1240.95)	3864.66 (1248.71)	0.682	0.414	0.076	0.784	5.560	0.023
	Con	3799.63 (1203.62)	3872.68 (1313.34)						
Total Muscle	Exp	44148.28 (8506.59)	44788.76 (8973.18)	2.005	0.164	0.622	0.435	2.265	0.140
	Con	46835.13 (10611.12)	46815.59 (10877.78)						
Muscle in Legs	Exp	14838.66 (3206.03)	15067.90 (3257.52)	2.402	0.129	1.174	0.285	0.358	0.553
	Con	16115.22 (4054.56)	16216.72 (4085.39)						
Muscle in Arms	Exp	4801.19 (1428.64)	4854.00 (1460.09)	0.118	0.733	0.457	0.503	0.581	0.450
	Con	5152.27 (1606. 78)	5132.27 (1623.92)						
Muscle in Trunk	Exp	21016.80 (4030.69)	21382.47 (4392.82)	0.353	0.556	0.303	0.585	3.467	0.070
	Con	22072.59 (4969.24)	21883.77 (5124.58)						
Muscle in Android	Exp	3080.23 (709.19)	3053.28 (729.69)	0.487	0.489	0.021	0.886	0.028	0.868
	Con	3109.36 (847.23)	3092.81 (852.11)						
Muscle in Gynoid	Exp	6923.61 (1453.20)	6993.47 (1617.95)	0.745	0.393	0.447	0.507	0.303	0.585
	Con	7321.31 (2029.34)	7336.77 (2086.23)						

Note. Grp: Group; Exp: Experiment; Con: Control; F: Mixed ANOVA

Finally, a significant interaction between time and intervention on physical self-concept was found in body fat perception [F(1,41) = 6.999, p = 0.012, η2 = 0.146], and significant main effect of time on flexibility perception [F(1,41) = 5.556, p = 0.023, η2 = 0.119]. The physical self-perception components shown in Table 3.

Table 3
Descriptive Statistics and Mixed ANOVA Results for Physical Self-perception Components

Variables	Group	Pre-test x (SD)	Post-test x (SD)	Time		Group		Time x Group	
				F	p	F	p	F	p
Body fat	Exp	21.95 (6.02)	23.95 (5.81)	1.371	0.248	0.017	0898	6.999	0.012
	Con	23.09 (7.06)	22.31 (7.12)						
Strenght	Exp	21.80 (2.35)	21.85 (2.59)	0.727	0.399	0.002	0.968	0.981	0.328
	Con	22.18 (2.55)	21.54 (3.15)						
Flexibility	Exp	18.52 (2.52)	19.33 (3.10)	0.438	0.512	1.625	0.210	5.556	0.023
	Con	20.22 (3.16)	19.77 (2.72)						
Health	Exp	37.80 (6.12)	38.61 (5.77)	0.181	0.673	0.082	0.776	0.452	0.505
	Con	37.68 (8.86	37.50 (8.66)						

Note. Exp: Experiment; Con: Control; F: Mixed ANOVA

DISCUSSION

The purpose of this research was to examine the effect of online exercise programs on the physical fitness and physical self-perception in university employees and students. The online exercise program was delivered to the participants weekly via online platform. Although the health benefits of regular exercise participation were well-established (Pedersen and Saltin 2015; Zou et al. 2022), individuals, especially those working at universities, and students sit for most of the day and exhibit sedentary behaviors (Castro et al., 2020). Online exercise programs recommended to be an option to improve physical fitness (Jaakkola et al., 2019; Pedersen & Saltin, 2015). Therefore, within the scope of the research, it was planned to promote exercise participation by providing an online exercise program for university employees and students. Online exercise program basically designed according to the progressive overload method and consists of exercises lasting an average of 25 minutes to develop physical fitness components. As a result, improvements were determined in all physical fitness components (upper-body strength, flexibility and body composition) except abdominal strength and endurance. It was also found that the perception of body fat percent, one of the sub-dimensions of physical self-perception, decreased compared to the control group. However, there was no significant difference in strength and health sub-dimensions of physical self-perception.

The findings of the study indicated that there was a significant improvement in upper body strength of both groups, but the differences were insignificant. However, the flexibility on both sides were significantly different in favor of the experimental group. The research findings show some similarities with the studies in the literature. In a study conducted a home-based online resistance exercise program was used for middle-aged individuals for eight weeks, two days a week, 60 minutes a day. It was determined that the participants improved in the upper body strength and endurance tests after the resistance exercise program, including nine movements but did not show improvement in terms of flexibility (Kikuchi et al., 2023). A possible explanation for this situation is that the exercise program in the research consists of resistance training (Kikuchi et al. 2023). In this study, especially the use of pilates exercises may have contributed to improving flexibility. The effect of an online exercise program performed one day a week for 60 minutes on physical fitness components such as upper body strength and flexibility were examined in the elderly individuals. The findings of the research showed that improvement was found in upper body strength and flexibility of the participants, similar to this study (Aksay, 2021). The effects of home-based online resistance exercises and walking intervention performed two days a week for 24 weeks on physical fitness components such as strength, power, and aerobic function in individuals with severe obesity were investigated. According to the results of the study, home-based online resistance exercises improved strength in severely obese individuals (Orange et al., 2020). Research findings similarly show that online exercise done at home or in a different environment significantly affects physical fitness.

While variations exist among the exercise programs featured in the studies; it is noteworthy that there is a consistent improvement in upper body strength and flexibility following the interventions. Considering the key factors (time, cost, transportation, and lack of facilities) affecting participation in regular physical activity, it is important an online exercise intervention can apply at home, easily accessible and less costly. Also, online exercise programs have started to be used more intensively especially after COVID-19 restrictions. Therefore, online exercise program has an important place for the development of physical fitness components. Body composition is another essential component of physical fitness. Body composition plays a crucial role in assessing obesity, which stands as one of the foremost health challenges in both Turkey and globally today (Lopez-Jimenez et al., 2022; Turkish Ministry of Health 2019). This study also assessed the impact of an online exercise program on body composition. While the 8-week online exercise program resulted in only a modest increase in fat-free mass demonstrated a notable reduction in total fat mass. According to the results total fat mass of the intervention group decreased in legs, trunk, and gynoid region and total fat mass, but not in arms and android region. Moreover, these decreases were significantly different from the control group. Similar to our findings, a study in which pilates exercises were performed for eight weeks, three days a week and 60 minutes a day for participants consisting of students and staff at the university, found that the body fat of the participants decreased (Rogers & Gibson, 2009). As the protocol implemented in our study was including the variety of Pilates exercises, it may be concluded that consistent pilates participation might be effective in decreasing fat mass over an eight-week period. There were also resistance-type exercises in this study. According to the results of another study using resistance exercises, the body fat of the participants decreased, but no significant difference was found in body mass and BMI values (Zavanela et al., 2012). Also, Colakoglu was found that 12 weeks of calisthenic exercises had no effect on the body fat of sedentary women (Colakoglu, 2008). Main reasons for the differences between studies may be that aerobic exercises were not included in the studies (Colakoglu, 2008; Zavanela et al. 2012). In this research, the exercises were designed to include some aerobic exercises with progressive overload intensity. Both aerobic exercises and strength exercises were included in the study may have been effective on the decrease of the total fat mass results. Although the time, group, and interaction differences were insignificant, muscle mass in all measured regions was increased in the intervention group. Similarly, an increase in the muscle mass of overweight/obese individuals were determined after an eight-week Pilates program (Rayes et al., 2019). In Colakoglu's (2008) study, no increase in muscle mass was found after a 12-week program of callisthenic exercises. The reason participants did not gain significant muscle mass can be associated with the fact that no exercise materials were provided to the participants. Therefore, the participants completed the exercises with their body weights and home equipment. Another possible explanation may be the weights used by the participants may not be optimal enough to increase muscle mass. In future studies, it can be regulated and participants can work with weights suitable for them. In addition, since the primary purpose of the online exercise program was designed within the scope of the research was not to increase the muscle mass of the participants; no structuring was made for this in the program. Overall, we may conclude that the implemented eight-week protocol was more effective in terms of decreasing the fat mass, while its effect on the muscle mass increase was limited. Moreover, the insignificant differences between groups in fat and muscle mass changes in the arms and trunk can be associated with the insignificant differences in push-up and sit-up tests. As the implemented program did not significantly differ the muscle or fat mass in these regions of the body, participants performed similarly regardless of which group they were in.

CONCLUSION

In conclusion, it was determined that online exercise had positive effects on physical fitness components (upper-body strength, flexibility, and body composition) and physical self-perception. The findings of this study revealed that the pattern of change in the actual fitness and physical self-perception was similar to each other. During the eight-week intervention period, the intervention group experienced a reduction in adipose tissue across nearly all body regions, this might be leading to an improved perception of body fat. To put it more succinctly, participants reported a reduced perception of body fat after completing the eight-week exercise program, aligning with the findings from DXA measurements. Similar to many research results, the eight-week exercise program did not contribute positively to the physical self- perception of the participants (Aşçı, 2003; Kim & Ahn, 2021; Zhang et al., 2022). However, the findings of these previous studies and the current research show differences between the sub- dimensions of self-perception. The main reason for this situation is the differences in exercise programs. For example, in the exercise program design applied in this study, the inclusion of activities that will train the cardiovascular system more actively may have resulted in a more developed body fat perception. Secondly, perceiving less fat might be attributed to their heightened awareness and vigilance about the exercise program. In progressive overload exercises, the volume of the exercise is gradually increased by making some changes on the frequency, duration or intensity of the exercise program. Thus, it can be said that the participants had difficulties during the program in the last period of the research, and this could have fostered the positive evolution of their physical self-perceptions as they coped with the increased level of difficulty.

PRACTICAL IMPLICATIONS

The study's findings underscore the significance of online exercise methods as valuable alternatives for enhancing various fitness aspects and fostering positive self-perceptions of physical fitness. Notably, exercise approaches tailored to participants' proficiency levels, incorporating progressive overload, prove effective in enhancing physical fitness. Consequently, implementing online exercise programs in settings characterized by prevalent sedentary lifestyles, such as universities and similar environments, hold the potential to promote the adoption of healthier lifestyle habits. Another notable advantage is that the exercise program utilizes a minimal set of readily available household items (e.g., substituting a water bottle for dumbbells or using a sofa for elevation). Overall, the online program eliminates the necessity for access to a gym or an extra trainer, offering participants the benefits of convenience, time efficiency, and cost savings.

Limitations

This study has certain limitations. Notably, a portion of the participants discontinued the exercise program, potentially influenced by the initial lack of motivation, especially considering their sedentary background. Therefore, future studies could benefit from incorporating motivational support to enhance participant engagement and further improve physical self-perception. Additionally, it is essential to note that the online video-based exercise programs lacked individualized prescriptions. Last but not least, the blinding protocols were as a suggestion for future research, the conditions under which this study was conducted were not conducive to the implementation of any blinding protocol, and one of the possible consequences of this situation is that the group of exercise participants may have been extra motivated by the needs of the group they were in. Incorporating personalized exercise prescriptions within online home-based programs could should be considered to address this limitation.

Acknowledgements

This research was supported by Eskişehir Technical University Research Project Commission under grant number 21GAP074.

Declaration of conflict interest

The authors have no relevant financial or non-financial interests to disclose.

Authors' contributions

Günay Yıldızer was responsible for the research design, data collection, data analysis and interpretation, writing the manuscript and approval of the final version; Feridun Fikret Özer and Caner Özböke were responsible for data collection, data analysis and interpretation, writing the manuscript and approval of the final version; Burak Söğüt and Didem Şafak were responsible for data collection and writing the manuscript; Dilara Ebru Uçar was responsible for research design, data analysis and interpretation, writing the manuscript and approval of the final version.

Ethics Statement

This study was approved by the review board of Eskişehir Technical University with Protocol No. 63349 at 06.04.202

REFERENCES

Aksay, E. (2021). Live online exercise programs during the Covid-19 pandemic –are they useful for elderly adults? *Journal of Physical Education and Sport, 21*(4), 1650–1658. https://doi.org/10.7752/jpes.2021.04209

Aşçı, F. H. (2003). The effects of physical fitness training on trait anxiety and physical self-concept of female university students. *Psychology of Sport and Exercise, 4*(3), 255–264. https://doi.org/10.1016/S1469-0292(02)00009-2

Bauman, A. E., Petersen, C. B., Blond, K., Rangul, V., & Hardy, L. L. (2018). The descriptive epidemiology of sedentary behaviour. *In Sedentary Behaviour Epidemiology (pp. 73–106)*. Springer, Cham. https://doi.org/10.1007/978-3-319-61552-3_4

Beck, A. Q., Clasey, J. L., Yates, J. W., Koebke, N. C., Palmer, T. G., & Abel, M. G. (2015). Relationship of physical fitness measures vs. occupational physical ability in campus law enforcement officers. *Journal of Strength and Conditioning Research, 29*(8), 2340–2350. https://doi.org/10.1519/JSC.0000000000000863

Belkhir, Y., Rekik, G., Chtourou, H., & Souissi, N. (2021). Does warming up with different music tempos affect physical and psychological responses? The evidence from a chronobiological study. *The Journal of Sports Medicine and Physical Fitness, 62*(1), 149–156. https://doi.org/10.23736/S0022-4707.21.12093-6

Biddle, S. J. H., Bennie, J. A., Bauman, A. E., Chau, J. Y., Dunstan, D., & Owen, N. (2016). Too much sitting and all-cause mortality: Is there a causal link? *BMC Public Health, 16*(1), 1–10. https://doi.org/10.1186/S12889-016-3307-3

Butler, K. M., Ramos, J. S., Buchanan, C. A., & Dalleck, L. C. (2018). Can reducing sitting time in the university setting improve the cardiometabolic health of college students*? Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, Volume 11*, 603–610. https://doi.org/10.2147/DMSO.S179590

Castro, O., Bennie, J., Vergeer, I., Bosselut, G., & Biddle, S. J. H. (2020). How sedentary are university students? A systematic review and meta-analysis. *Prevention Science, 21*(3), 332–343. https://doi.org/10.1007/s11121-020-01093-8

Cohen J. (1988).Statistical Power Analysis for the Behavioral Sciences. 2nd ed. NJ: Lawrence Earlbaum Associates;

Colakoglu, F. F. (2008). The effect of callisthenic exercise on physical fitness values of sedentary women. *Science & Sports, 23*(6), 306–309. https://doi.org/10.1016/j.scispo.2008.06.002

Corbin, C. B., Robert, P. P., & Franks, B. D. (2000). Definitions: Health, fitness, and physical activity. *The President's Council on Physical Fitness and Sports Research Digest*.

Deliens, T., Deforche, B., De Bourdeaudhuij, I., & Clarys, P. (2015). Determinants of physical activity and sedentary behaviour in university students: A qualitative study using focus group discussions. *BMC Public Health, 15*(1), 1–9. https://doi.org/10.1186/s12889-015-1553-4

Dewitt, S., Hall, J., Smith, L., Buckley, J. P., Biddle, S. J. H., Mansfield, L., & Gardner, B. (2019). Office workers' experiences of attempts to reduce sitting-time: An exploratory, mixed-methods uncontrolled intervention pilot study. *BMC Public Health, 19*(1). https://doi.org/10.1186/S12889-019-7196-0

Faghy, M. A., Duncan, M. J., Pringle, A., Meharry, J. B., & Roscoe, C. M. P. (2022). UK university staff experience high levels of sedentary behaviour during work and leisure time. *International Journal of Occupational Safety and Ergonomics, 28*(2), 1104–1111. https://doi.org/10.1080/10803548.2021.1874704

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., & Lee, I., M.(2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine and Science in Sports and Exercise, 43*(7), 1334–1359. https://doi.org/10.1249/MSS.0B013E318213FEFB

Guo, M. M., Wang, X. Z., & Koh, K. T. (2022). Association between physical activity, sedentary time, and physical fitness of female college students in China. *BMC Women's Health, 22*(1), 1–10. https://doi.org/10.1186/s12905-022-02108-y

Hayran, M., & Hayran, M. (2020). *Sağlık araştırmaları için temel istatistik* (1st ed.). Ankara: Hipokrat Yayınevi

Jaakkola, T., Huhtiniemi, M., Salin, K., Seppälä, S., Lahti, J., Hakonen, H., & Stodden, D. F. (2019). Motor competence, perceived physical competence, physical fitness, and physical activity within finnish children. *Scandinavian Journal of Medicine & Science in Sports, 29*(7), sms.13412. https://doi.org/10.1111/sms.13412

Kikuchi, N., Ohta, T., Hashimoto, Y., Mochizuki, Y., Saito, M., & Kozuma, A.(2023). Effect of online home-based resistance exercise training on physical fitness, depression, stress, and well-being in middle-aged persons: A pilot study. *International Journal of Environmental Research and Public Health, 20*(3). https://doi.org/10.3390/IJERPH20031769

Kim, I., & Ahn, J. (2021). The effect of changes in physical self-concept through participation in exercise on changes in self-esteem and mental well-being. *International Journal of Environmental Research and Public Health, 18*(10). https://doi.org/10.3390/IJERPH18105224

Kline, R. B. (2011). *Principles and Practices of Structural Equation Modelling*. The Guilford Press.

Li, W., Cui, Y., Gong, Q., Huang, C., & Guo, F. (2022). The association of smartphone usage duration with physical fitness among Chinese university students. *International journal of environmental research and public health*, *19*(1). https://doi.org/10.3390/IJERPH19010572

Lopez-Jimenez, F., Almahmeed, W., Bays, H., Cuevas, A., Di Angelantonio, E., le & Roux, C. W. (2022). Obesity and cardiovascular disease: mechanistic insights and management strategies. A joint position paper by the world heart federation and world obesity federation. *European Journal of Preventive Cardiology*, *29*(17), 2218–2237. https://doi.org/10.1093/EURJPC/ZWAC187

Lusa, S., Punakallio, A., Mänttäri, S., Korkiakangas, E., Oksa, J., Oksanen, T., & Laitinen, J. (2020). Interventions to promote work ability by increasing sedentary workers' physical activity at workplaces – A scoping review. *Applied Ergonomics*, *82*, 102962. https://doi.org/10.1016/J.APERGO.2019.102962

Marsh, H. W., Marco, I. T., & Apçý, F. H. (2002). Cross-cultural validity of the physical self-description questionnaire: comparison of factor structures in Australia, Spain, and Turkey. *Research Quarterly for Exercise and Sport*, *73*(3), 257–270. https://doi.org/10.1080/02701367.2002.10609019

Mateo-Orcajada, A., González-Gálvez, N., Lucía Abenza-Cano, & Vaquero-Cristóbal, R. (2022). Differences in physical fitness and body composition between active and sedentary adolescents: A systematic review and meta-analysis. *Journal of Youth and Adolescence*, *51*, 177–192. https://doi.org/10.1007/s10964-021-01552-7

Orange, S. T., Marshall, P., Madden, L. A., & Vince, R. V. (2020). Effect of home-based resistance training performed with or without a high-speed component in adults with severe obesity. *Translational Sports Medicine*, *3*(1), 34–45. https://doi.org/10.1002/TSM2.115

Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary lifestyle: overview of updated evidence of potential health risks. *Korean Journal of Family Medicine*, *41*(6), 365–373. https://doi.org/10.4082/kjfm.20.0165

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine-Evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medicine and Science in Sports, 25*, 1–72. https://doi.org/10.1111/SMS.12581

Pescatello, L. S., Arena, R., Riebe, D., & Thompson, P. D. (2014). *ACSM's Guidelines for exercise testing and prescription* (9th ed.).

Prieske, O., Dalager, T., Herz, M., Hortobagyi, T., Sjøgaard, G., Søgaard, K., & Granacher, U. (2019). Effects of physical exercise training in the workplace on physical Fitness: A systematic review and meta-analysis. *Sports Medicine*, *49*(12), 1903–1921. https://doi.org/10.1007/s40279-019-01179-6

Prince, S. A., Elliott, C. G., Scott, K., Visintini, S., & Reed, J. L. (2019). Device-measured physical activity, sedentary behaviour and cardiometabolic health and fitness across occupational groups: a systematic review and meta-analysis. *International*

Journal of Behavioral Nutrition and Physical Activity, *16*(1), 1–15. https://doi.org/10.1186/S12966-019-0790-9

Rayes, A. B. R., De Lira, C. A. B., Viana, R. B., Benedito-Silva, A. A., Vancini, R. L., Mascarin, N., & Andrade, M. S. (2019). The effects of pilates vs. aerobic training on cardiorespiratory fitness, isokinetic muscular strength, body composition, and functional tasks outcomes for individuals who are overweight/obese: A clinical trial. *PeerJ*, *2019*(2), 2–15. https://doi.org/10.7717/PEERJ.6022/SUPP-4

Rogers, K., & Gibson, A. L. (2009). Eight-week traditional mat pilates training-program effects on adult fitness characteristics. *Research Quarterly for Exercise and Sport*, *80*(3), 569–574. https://doi.org/10.1080/02701367.2009.10599595

Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., & Latimer-Cheung, A. E. (2017). Sedentary behavior research network (SBRN) – Terminology consensus project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 75. https://doi.org/10.1186/s12966-017-0525-8

Turkish Ministry of Health. (2019). *Türkiye beslenme ve sağlık araştırması*. Ankara.

Vainshelboim, B., Brennan, G. M., LoRusso, S., Fitzgerald, P., & Wisniewski, K. S. (2019). Sedentary behavior and physiological health determinants in male and female college students. *Physiology & Behavior*, *204*, 277–282. https://doi.org/10.1016/j.physbeh.2019.02.041

Wahlström, V., Januario, L. B., Mathiassen, S. E., Heiden, M., & Hallman, D. M. (2023). Hybrid office work in women and men: do directly measured physical behaviors differ between days working from home and days working at the office? *Annals of Work Exposures and Health, 67*(9), 1043-1055.

Yoo, J.-I., Cho, J., Baek, K.-W., Kim, M.-H., & Kim, J.-S. (2020). Relationship between smartphone use time, sitting time, and fitness level in university students. *Exercise Science*, *29*(2), 170–177. https://doi.org/10.15857/ksep.2020.29.2.170

Zavanela, P. M., Crewther, B. T., Lodo, L., Florindo, A. A., Miyabara, E. H., & Aoki, M. S. (2012). Health and fitness benefits of a resistance training intervention performed in the workplace. *Journal of Strength and Conditioning Research*, *26*(3), 811–817. https://doi.org/10.1519/JSC.0B013E318225FF4D

Zhang, Q., Miao, L., He, L., & Wang, H. (2022). The Relationship between self-concept and negative emotion: A moderated mediation model. *International Journal of Environmental Research and Public Health*, *19*(16), 2–10. https://doi.org/10.3390/IJERPH191610377

Zou, L., Yao, L., Wilson Ansah, E., Bernardo-Filho, M., Codella, R., & Da Cunha De Sá Caputo, D. (2022). Influencing factors of students aged 10-20 non-participating in home physical exercise during the COVID-19 isolation policy period: A cross-sectional study from China. *Frontiers in Public Health / 591*, *10*, 1–14. https://doi.org/10.3389/fpubh.2022.787857

Appendix A
Exercise Program of Progressive Overload Method

	1. Session	2. Session	3. Session
1. Week	Total Time: 21. Warm Up: 2 Min., Leg: 2 Min., Back: 1 Min., Core Exercise: 5.5 Min., Rest: 5.5 Min., Cool Down: 5 Min.	Total Time: 20.5. Warm Up: 2.5 Min., Leg: 2.5 Min., Arm: 1.5 Min., Shoulder: 1.5 Min., Core Exercise: 2 Min., Chest: 30 Sec. Rest: 5 Min., Cool Down: 5 Min.	Total Time: 20.5. Warm Up: 1.5 Min., Leg: 4.5 Min., Core Exercise: 4 Min., Chest: 30 Sec., Rest: 5 Min., Cool Down: 5 Min.
2. Week	Total Time: 21.5. Warm Up: 2 Min., Leg: 4 Min., Arm: 1 Min., Core Exercise: 3 Min., Chest: 30 Sec., Shoulder: 1 Min., Rest: 5 Min., Cool Down: 5 Min.	Total Time: 22. Warm Up: 2 Min., Leg: 2 Min., Core Exercise: 6 Min., Chest: 1 Min., Rest: 6 Min., Cool Down: 5 Min.	Total Time: 22.5. Warm Up: 2 Min., Leg: 4 Min., Chest: 1 Min., Core Exercise: 4 Min., Rest: 5.5 Min., Cool Down: 5 Min.
3. Week	Total Time: 24. Warm Up: 2 Min., Leg: 5 Min., Core Exercise: 6 Min., Rest: 6 Min., Cool Down: 5 Min.	Total Time: 23.5 Warm Up: 2 Min., Arm: 6 Min., Back: 3 Min., Core: 1 Min., Rest: 5.5 Min., Cool Down: 5 Min.	Total Time: 21.5 Warm Up: 2 Min., Shoulder: 4.5 Min., Chest: 4 Min., Core Exercise: 30 Sec., Rest: 5.5 Min., Cool Down: 5 Min.
4. Week	Total Time: 23. Warm Up: 3.5 Min., Leg: 4.5 Min., Arm: 6 Min., Rest: 6 Min., Cool Down: 3 Min.	Total Time: 22. Warm Up: 3.5 Min., Back: 3.5 Min., Core Exercise: 6.5 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 23.5. Warm Up: 3.5 Min., Chest: 5 Min., Shoulder: 5.5 Min., Rest: 6.5 Min., Cool Down: 3 Min.
5. Week	Total Time: 25. Warm Up: 3.5 Min., Leg: 6.5 Min., Arm: 6.5 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 23. Warm Up: 3.5 Min., Back: 4.5 Min., Core Exercise: 6.5 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 21.5. Warm Up: 3.5 Min., Chest: 4 Min., Shoulder: 6 Min., Rest: 5 Min., Cool Down: 3 Min.
6. Week	Total Time: 25. Warm Up: 3.5 Min., Leg: 6 Min., Arm: 7 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 23.5. Warm Up: 3.5 Min., Back: 4 Min., Core Exercise: 7.5 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 24.5. Warm Up: 3.5 Min., Chest: 6 Min., Shoulder: 6.5 Min., Rest: 5.5 Min., Cool Down: 3 Min.
7. Week	Total Time: 24.5. Warm Up: 3.5 Min., Leg: 6 Min., Arm: 7 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 25. Warm Up: 3.5 Min., Back: 4.5 Min., Core Exercise: 8.5 Min., Rest: 5.5 Min., Cool Down: 3 Min.	Total Time: 25.5. Warm Up: 3 Min., Chest: 8 Min., Shoulder: 6 Min., Rest: 5.5 Min., Cool Down: 3 Min.
8. Week	Total Time: 25.5. Warm Up: 4 Min., Leg: 7.5 Min., Arm: 6.5 Min., Rest: 4.5 Min., Cool	Total Time: 26.5. Warm Up: 4.5 Min., Back: 4.5 Min., Core Exercise: 9 Min., Rest: 5.5 Min.,	Total Time: 25.5. Warm Up: 3 Min., Chest: 7 Min., Shoulder: 7.5 Min.,

Appendix A (Continued)

Warm Up	Leg	Arm	Core	Back	Shoulder	Chest
Twist Up/Twist	Bridge One	Single Arm Triceps	Single Straight	Double-Arm	Push-up plank	Pullover on the
Up With Jumping	Leg Hold	Kickback	Leg Stretch	Dumbbell Rows	with shoulder tap	floor
Arm	Bent-Knee Fire	Bent Over Triceps	Double	Plank with Lateral	External-Internal	Wide Hands
Circle/Jogging With Arm Circle Lunge Tap/Lunge	Hydrants Bridge One	Kickbacks Lying Overhead	Straight Leg Stretch Mountain	Arm Raise Elevated Plank Row	Rotation Inchworm hand	Push Up Spiderman Push
Tap With Jumping	Leg Raise	Triceps Extension	climbers		walkout	Up
Sumo Squat Dip	Plie Squat Calf	Isolated Single	Single Leg	Renegade Row	Raise and pull-	Diamond Push
Shoulder	Raises	Arm Curl	Stretch		apart	Up
Butt Kicks	Calf Raise	Zottman Curl	Bicycle Crunch	Kettlebell Swings	Shoulder Press	Dumbbell Press
Jog in place	Squat Hold	W Curl	Frog Crunch	Shrug	Prone Y’s and T’s	Chaturanga Hold
Twist March in place Scissors Step	Jumping Squat Lunge Side Lunge	Cross body Curl Concentration Curl Hammer Curl	Chest LiftPlank Tuck up	High Pull	Dumbbell Cardriver Lateral shoulderrise Arnold Press	Chaturanga Active Shuffle Push Up Incline Push Up
Lateral/Front Hop March in place	Glute bridge Bridge toe	Biceps Curl Triceps Extensions	Hollow Hold Hundred		Front ShoulderRise	Decline Push Up Burpee
twist Overhead Reach	touch Quad hip	Plank Triceps	Side plank			Push Up
High knee Cross body toe	extension Squat Sumo Squat	Kickback Biceps ReverseCurl Triceps Dips	Scissors Russian Twist			Dolphin Push Up Dumbbell Fly
touch Cross Jacks	Side Leg		Flutter Kick			
Squat Cross Arms	Raises Reverse Lunge		Navasana			
Jumping Jack			Superman Bird Dog Crunch			