

Effects of online functional training with different rest periods on body composition flexibility and postural control in sedentary women

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Abstract

This study investigated the effects of two different rest periods on body composition, flexibility, and postural control in sedentary women participating in online functional trainings. The sample included 64 healthy women from Hatay (Antakya), randomly assigned to three groups: Functional Training-30 (n=21), Functional Training-60 (n=20) and a Control Group (n=23). The Functional Training-30 group had a mean age of 29.48 years, height of 162.24 cm and weight of 80.70 kg, while the Functional Training-60 group had a mean age of 28.95 years, height of 163.40 cm and weight of 70.57 kg. The Control Group had a mean age of 28.44 years, height of 162.13 cm, and weight of 72.20 kg. The 8-week training program included 30 seconds of rest for one group and 60 seconds for the other and sessions lasted about an hour, three times a week. The Control Group did not participate in any training. Anthropometric parameters (body weight, body mass index, skinfold thickness, circumference measurement), posture control and flexibility were measured in the pre- and post-training evaluations. In the analysis of the data, LSD and Dunnett's C, One-Way ANOVA and t-test for Dependent Samples were applied as Post-Hoc tests. After eight weeks of functional training, a significant decrease was observed in both training groups, including body weight, BMI, circumference measurements and skinfold thickness. At the same time a significant improvement was recorded in postural control and flexibility performance ($p < 0.05$). These results show that functional training applied with different rest periods led to positive and significant changes in body composition, circumference measurements, postural control and flexibility, with the most significant change being detected in the FT-30 group.

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Introduction

Innovative approaches are needed to prevent functional decline in individuals who start under social distancing conditions. However, this is a necessity not only for pandemic conditions, but also for individuals living in urban and rural areas considering the living conditions of today's people under normal conditions. Online health exercise programs are expressed as a way to provide physical activity (Middleton et al., 2020). Thanks to highly advanced technologies the use of online exercises has expanded worldwide (Culos-Reed et al., 2021). The American College of Sports Medicine (ACSM) recommends home training or participation in virtual sports using virtual reality and augmented reality

to prevent increased obesity and complications due to the pandemic (Zheng et al., 2022). When the relevant literature is examined, it is seen that studies involving online exercises are concentrated in pregnant women (Middleton et al., 2020), obese individuals (Ozturk & Duruturk, 2022), functional exercises (Russel et al., 2011; Tousignant et al., 2011) and physical therapy (Bini & Mahajan, 2017; Bettger et al., 2020). When evaluated in this sense it is understood that the number of studies investigating the effects of functional training (FT) programs is low. Functional training aims to enhance muscular coordination through multiplanar movement patterns, integrating multiple joints and dynamic tasks. This approach systematically varies the base of support, thereby optimizing functional

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performance and improving overall movement efficiency (Sipe & Ritchie, 2012). Short rest periods between stations and exercises offer the advantage of completing a training session in a shorter time. It has been observed that sports scientists have conducted research on determining the most appropriate rest interval in order for different resistance training to achieve their goals (Freitas de Salles et al., 2009; Schoenfeld et al., 2016). It is seen that exercise applications with different rest intervals produce different results in terms of their effect on strength. Rest intervals vary depending on the intensity and purpose of the exercise (Hall & Brody, 2011; Fleck & Kraemer, 2014). For an efficient, safe and effective workout it is essential to understand the interactions between training variables, which may include intensity, number of sets, and rest interval between sets, exercise type and speed of muscle action. Research has shown that rest interval between sets is an important variable that affects both acute responses and chronic adaptations to resistance exercise programs (Freitas de Salles et al., 2009).

Online health exercise programs are shown as a way to provide physical activity. However, to our knowledge there is no other study in the literature showing the effectiveness of online functional training exercises performed with two different rest periods for healthy individuals. Therefore, creating a new exercise program for healthy individuals will be important in terms of improving functional capacity and protecting health. It is thought that a properly designed safe functional training will contribute to the development of theories and methods related to functional training design. In the light of this information in the relevant literature this study aims to investigate the effects of two different rest periods on body composition, flexibility and posture control in functional training applied online to sedentary women.

Methods

Participants and Procedure

It was planned to include 90 healthy sedentary women living in Hatay (Antakya) province as volunteers in the study. Individuals with a history of pain, surgery, injury or trauma in the lumbar area; those with neurological, systemic or degenerative diseases and those who have participated in a regular exercise program for the last 6 months were excluded from the study. The study group

consisted of three groups: Functional Training 30-second rest group (FT-30), Functional Training 60-second rest group (FT-60) and Control Group (C). Participants were randomly assigned to FT-30 (n=21), FT-60 (n=20) and C (n=23). However, due to the adverse living conditions created by the earthquake in February 2022, 9 people from the FT-30 group, 10 people from the FT-60 group, and 7 people from the C group had to leave the study halfway and the research was completed with the participation of a total of 64 people. In line with the purpose of the study, exercise sessions related to the training program to be implemented were carried out remotely online via the WhatsApp video meeting program on a tablet computer.

Functional training exercises were performed online under the supervision of a trainer (researcher) with a Level 3 Fitness Coach certificate with 8 years of experience, 3 days a week, approximately 1 hour (5 min warm-up, 5 min cool-down, 50 min exercise) for a total of 8 weeks. A functional training exercise program planned with two separate rest periods was applied to the training groups (FT-30 – FT-60). No training application was made to the participants in the C group. In order to check whether the participants in the functional training group did the exercises correctly, they were divided into small groups. The study was approved by the Hatay Mustafa Kemal University of Non-Interventional Ethical Committee (2023/26) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki. Measurements were carried out in the it was held in the sports hall of Hatay Mustafa Kemal University Faculty of Sports Sciences after obtaining the necessary permissions.

Functional Training Program

The functional training program (Table 1, Table 2) applied to the training groups (FT-30 – FT-60) with 30 seconds and 60 seconds of rest between movements was adapted by taking Aslan (2023)'s study as a reference. The functional training exercise program consisted of 8 weeks, 3 days a week, approximately 1 hour (5 min warm-up + 50 min exercise + 5 min cool-down). The FT-30 group underwent the same training program with 30 seconds of rest between movements, while the FT-60 group underwent 60 seconds of rest. The 60-second rest period between sets was applied to both training groups.

Table 1

FT-30 group 1-4 and 5-8 weeks training program.

Time (min)	1-4 Weeks	Set & Repeat	5-8 Weeks	Set & Repeat	Rest (min)	
	Movement		Movement		Between Sets	Between Movements
5	Forward Backward Run	-	Forward Backward Run	-	-	-
7	Squat	3×15	Squat (By adding weight)	3×15	60	30
7	Push-up	3×12	Push-up (Raising your feet)	3×12	60	30
7	Lunge	3×12	Lunge (By adding weight)	3×12	60	30
7	Plank	3×30 sec	Plank	3×30 sec	60	30
7	Mountain Climbers	3×30 sec	Mountain Climbers (Stretching the legs)	3×30 sec	60	30
7	Dips	3×12	Dips	3×12	60	30
7	Burpee	3×10	Burpee (Jumping)	3×10	60	30
5	Stretching, Yoga Poses	-	Stretching, Yoga Poses	-	-	-

Table 2

FT-60 group 1-4 and 5-8 weeks training program.

Time (min)	1-4 Weeks	Set & Repeat	5-8 Weeks	Set & Repeat	Rest (min)	
	Movement		Movement		Between Sets	Between Movements
5	Forward Backward Run	-	Forward Backward Run	-	-	-
7	Squat	3×15	Squat (By adding weight)	3×15	60	60
7	Push-up	3×12	Push-up (Raising your feet)	3×12	60	60
7	Lunge	3×12	Lunge (By adding weight)	3×12	60	60
7	Plank	3×30 sec	Plank	3×30 sec	60	60
7	Mountain Climbers	3×30 sec	Mountain Climbers (Stretching the legs)	3×30 sec	60	60
7	Dips	3×12	Dips	3×12	60	60
7	Burpee	3×10	Burpee (Jumping)	3×10	60	60
5	Stretching, Yoga Poses	-	Stretching, Yoga Poses	-	-	-

Body Weigh - Height Measurement and Body Mass Index

Body weight and ± 0.01 kg and height were recorded with ± 0.01 cm accuracy before the training with the participant in anatomical posture, body upright, headboard touching the vertex point of the head, soles of the feet touching the ground, arms hanging freely to the sides, in sports clothes and without shoes. Body mass index (BMI) was calculated by dividing body weight in kilograms by the square of height in meters (kg/m^2).

Circumference Measurements

Circumference measurements were taken with participants standing in anatomical posture with their weight distributed equally on both feet. Measurements were made from seven different areas such as waist, hip, upper arm, thigh, shoulder, chest and calf. Measurements were made using a tape measure. A tape measure with a precision of 0.01 cm, 2 cm wide and 150

cm long was used. Care was taken to ensure that the tape measure was parallel to the ground and that the tissue was not compressed during the measurement. The measurement values taken from seven different areas were recorded in cm.

Skinfold Measurement

Skinfold measurements were made on seven different areas of the participants: biceps, triceps, supscapula, suprailiac, chest, thigh and abdominal. Measurements were made with a device called Skinfold Caliper and were applied to each area with a pressure of $10 \text{ g}/\text{mm}^2$ with a precision of ± 0.2 mm. All measurements were taken from the right side of the body, by holding only the skin and subcutaneous fat with the thumb and index finger and by placing the caliper 1 cm away from these fingers. Each area was measured twice, waiting 2-3 seconds for each area (ACSM 2000).

V-Sit-Reach Flexibility Test

The measurement procedure for the V-Sit-Reach flexibility test was prepared as follows: A straight line of 30 cm was marked for the beginning and a 60-80 cm long line to be measured with 0.1 mm precision was placed perpendicular to this starting line. The measurement line was positioned 30-40 cm on both sides of the starting line. The point where the starting and measuring lines intersected was accepted as "0". Participants were asked to place their heels just behind the edges of the starting line without shoes. They were asked to sit with their legs open in a V shape with the soles of their feet on the measuring line. They were asked to place their hands downward with their palms overlapping on the measuring line. Then, the participant's legs were held straight by the assistant and they were asked to slowly extend by keeping their fingers on the measuring line. During the test, the participant was asked to keep their legs straight and keep their heels perpendicular to the floor. They were asked to extend slowly and in a controlled manner instead of suddenly stretching. The participant's flexibility was evaluated according to the last point they reached. Extensions beyond the baseline were recorded as plus (+), and extensions behind the baseline were recorded as minus (-) (Hui and Yuen 2000).

Y Balance (Postural Control) Test

In order to determine the dynamic balance performances of the participants, the Y Balance Test was applied in three directions, Anterior (A), Postior-medial (PM) and Posteriorlateral (PL), on the right and left feet. Before the test was applied to the participants, an explanation and demonstration of the test procedure was made. The left foot was positioned at the junction point of three 150 cm long tape measures placed at certain angles on a flat surface. The participants were asked to reach the maximum point they could reach without losing their balance, with their hands on their waists, first with their right foot, then

right back and left back, and then return to the center point after each reach. Then, the other foot was placed on the ground and the same measurement was made for the other foot (Plisky et al. 2009). All balance measurements were applied twice for both (right and left) feet with eyes open. When the balance was disturbed, the measurement was repeated and the highest score from the 2 applications was taken into account. Before starting the test, each participant was given 5 minutes of warm-up exercises. All tests were performed barefoot to eliminate any additional balance and stability that could be provided by shoes (Coughlan et al. 2012).

Data Analysis

Normality distribution was tested with the Shapiro Wilk test. According to the normal analysis results, One-Way ANOVA was applied to compare the groups LSD and Dunnett's C were used as Post-Hoc tests. Dependent Samples t-test was applied in the pre-test - post-test comparison.

Results

Analysis of pre and post functional training measurements body weight, BMI, circumference, skinfold thickness, postural control and flexibility yielded the following findings. Descriptive information of the participants is presented in Table 3.

As shown in Table 4, there were statistically significant differences between pre-test and post-test values for body weight and BMI in the FT-30, FT-60 and C groups ($p < 0.05$). In the functional training groups (both 30-second and 60-second rest), body weight and BMI decreased significantly post-intervention ($p < 0.05$). Conversely, the C group which did not participate in any training, exhibited a statistically significant increase in both body weight and BMI from pre-test to post-test ($p < 0.05$).

Table 3

Identifying information of participants.

Variables	Age (year)			Height (cm)			Body Weight (kg)			BMI (kg/m ²)		
	FT-30	FT-60	C	FT-30	FT-60	C	FT-30	FT-60	C	FT-30	FT-60	C
n	21	20	23	21	20	23	21	20	23	21	20	23
Mean	29.48	28.95	28.44	162.24	163.40	162.13	80.70	70.57	72.20	30.61	26.30	27.41
SD	2.54	2.68	2.74	0.03	0.04	0.02	14.82	19.23	15.46	6.66	5.61	6.05

BMI: Body Mass Index; FT-30: Functional Training 30 sec Rest Group; FT-60: Functional Training 60 sec Rest Group; C: Control Group.

Table 4

Pre-test and post-test mean values of body weight and BMI of the groups and pre-test – post-test comparison of body weight (kg) and BMI (kg/m²) measurements of the groups.

Variables	Groups	Pre-Test		Post-Test		Difference Mean		t	df	p
		Mean	SD	Mean	SD	Mean	SD			
Body Weight (kg)	FT-30	80.70	14.82	76.25	11.81	4.46	4.46	4.574	20	0.000*
	FT-60	70.57	19.23	67.94	17.55	2.63	4,05	2.906	19	0.009*
	C	72.20	15.46	72.58	15.57	-.38	0.75	-2.415	22	0.024*
BMI (kg/m ²)	FT-30	30.61	5.31	28.94	4.26	1.67	1.65	4.656	20	0.001*
	FT-60	26.30	6.66	25.32	6.02	0.98	1.49	2.939	19	0.008*
	C	27.41	5.61	27.56	5.65	-.14	0.28	-2.439	22	0.023*

* $p < 0.05$

Table 5

Comparisons of age, height, body weight and BMI variables between groups.

Variables		Sum of Squares	df	Mean Square	F	p	
Age	Between groups	11.910	2	5.955	0.841	0.436	
	Within Groups	431.840	61	7.079			
	Overall	443.750	63				
Height	Between groups	0.002	2	0.001	1.225	0.301	
	Within Groups	0.051	61	0.001			
	Overall	0.053	63				
Body Weight	Pre-Test	Between groups	1238.616	2	619.308	2.265	0.113
		Within Groups	16679.410	61	273.433		
		Overall	17918.025	63			
	Post Test	Between groups	709.382	2	354.691	1.548	0.221
		Within Groups	13974.431	61	229.089		
		Overall	14683.813	63			
BKI	Pre-Test	Between groups	208.866	2	104.433	3.033	0.055
		Within Groups	2100.306	61	34.431		
		Overall	2309.173	63			
	Post-Test	Between groups	136.723	2	68.361	2.376	0.101
		Within Groups	1754.853	61	28.768		
		Overall	1891.575	63			

Table 6

Comparisons between groups in body weight and BMI.

Variable s		Sum of Squares	df	Mean Square	F	p	Difference
Body Weight	Between groups	263.291	2	131.646	11.103	0.000*	FT-30 – C
	Within Groups	723.271	61	11.857			FT-60 – C
	Overall	986.562	63				
BKI	Between groups	37.282	2	18.641	11.577	0.000*	FT-30 – C
	Within Groups	98.223	61	1.610			FT-60 – C
	Overall	135.505	63				

* $p < 0.05$

Examination of Table 5 reveals no statistically significant differences ($p > 0.05$) in age, height, body weight or BMI among the groups when comparing both pre-test and post-test values.

Analysis of Table 6, which compares pre-test and post-test difference means between groups, indicates a statistically significant difference in body weight between the C group and both the FT-30 group ($p=0.000$) and FT-60 group ($p<0.05$). The decrease in body weight for group C was significantly less than that of the FT-30 ($p=0.000$) and FT-60 groups ($p=0.006$). No significant difference was observed between the FT-30 and FT-60 groups regarding body weight changes ($p=0.095$). Similarly, for BMI significant differences were noted between the C group and both training groups with FT-30 ($p=0.000$) and FT-60 ($p<0.05$) showing greater reductions. The mean BMI change in group C was significantly lower than that of the FT-30 ($p=0.000$) and FT-60 groups ($p=0.005$). No significant difference was found between the FT-30 and FT-60 groups for BMI changes ($p=0.085$).

Table 7 reveals significant reductions in circumference measurements for the waist, hip, upper arm, thigh,

chest and calf in both FT-30 and FT-60 groups ($p<0.05$). Notably a significant decrease in shoulder circumference was observed only in the FT-60 group. In the C group no significant changes were noted in most areas except for the hip which showed a statistically significant increase ($p<0.05$).

Table 8 indicates statistically significant differences in hip, shoulder, and calf circumference measurements ($p<0.05$). The FT-30 group showed higher pre-test values than both the FT-60 ($p=0.046$) and C groups for hip ($p=0.024$) and shoulder measurements ($p=0.032$; $p=0.013$, respectively). Additionally, the FT-30 group had higher calf pre-test values compared to FT-60 ($p=0.018$). In post-test measurements, the FT-30 group also outperformed both FT-60 ($p=0.012$) and C ($p=0.013$) groups in shoulder circumference. No significant differences were found for waist, upper arm, thigh, chest and calf post-tests among the groups ($p>0.05$).

Table 7

Circumference measurements of the groups and pre-test – post-test comparisons.

Variables	Groups	Pre-Test		Post-Test		Difference Mean		t	df	p
		Mean	SD	Mean	SD	Mean	SD			
Waist (cm)	FT-30	100.36	11.06	96.52	9.48	3.84	2.75	6.397	20	0.000*
	FT-60	92.47	14.84	90.30	13.86	2.17	2.51	3.859	19	0,001*
	C	93.66	12.01	93.75	12.18	-.09	1.13	-.387	22	0.702
Hip (cm)	FT-30	112.34	11.51	107.99	8.46	4.36	5.13	3.894	20	0.001*
	FT-60	103.93	11.85	101.52	10.20	2.41	2.95	3.652	19	0.002*
	C	105.16	11.66	105.53	11.85	-.38	0.75	-2.424	22	0,024*
Upper Arm (cm)	FT-30	30.81	5.29	28.30	4.23	2.51	1.82	6.342	20	0.000*
	FT-60	27.89	7.77	25.54	6.93	2.34	2.62	4.000	19	0,001*
	C	27.59	5.26	27.70	5.43	-.11	0.43	-1.199	22	0.243
Shoulder (cm)	FT-30	106.01	8.54	105.70	8.17	0.30	0.93	1.484	20	0.153
	FT-60	100.07	10.10	99.10	9.07	0.97	2.04	2.115	19	0.048*
	C	99.36	7.32	99.37	7.43	-.01	0.25	-.247	22	0.807
Thigh (cm)	FT-30	59.37	7.82	56.11	6.81	3.26	2.05	7.281	20	0.000*
	FT-60	53.17	12.28	51.40	10.90	1.77	2.38	3.326	19	0.004*
	C	52.98	9.68	53.08	9.59	-.10	0.34	-1.406	22	0.174
Chest (cm)	FT-30	101.52	6.15	99.50	5.13	2.02	2.06	4.490	20	0.000*
	FT-60	96.97	7.00	96.11	6.49	0.86	1.18	3.252	19	0.004*
	C	97.86	5.92	97.81	5.70	0.05	0.55	0.453	22	0.655
Calf (cm)	FT-30	38.61	5.47	35.99	4.57	2.62	1.46	8.248	20	0.000*
	FT-60	33.54	8.23	32.13	7.87	1.41	1.75	3.602	19	0.002*
	C	34.80	6.12	34.87	6.10	-.08	0.23	-1.608	22	0.122

* $p<0.05$

Table 8
Comparison of circumference measurements between groups.

Variables			Sum of Squares	df	Mean Square	F	p	Difference
Waist	Pre-Test	Between groups	757.433	2	378.716	2.357	0.103	
		Within Groups	9799.672	61	160.650			
		Overall	10557.104	63				
	Post Test	Between groups	397.248	2	198.624	1.391	0.257	
		Within Groups	8712.930	61	142.835			
		Overall	9110.177	63				
Hip	Pre-Test	Between groups	865.028	2	432.514	3.177	0.049*	FT-30 – FT-60 FT-30 – C
		Within Groups	8305.690	61	136.159			
		Overall	9170.718	63				
	Post Test	Between groups	435.534	2	217.767	2.043	0.138	
		Within Groups	6500.650	61	106.568			
		Overall	6936.184	63				
Upper Arm	Pre-Test	Between groups	135.325	2	67.662	1.782	0.177	
		Within Groups	2315.649	61	37.961			
		Overall	2450.974	63				
	Post Test	Between groups	85.905	2	42.953	1.366	0.263	
		Within Groups	1917.769	61	31.439			
		Overall	2003.675	63				
Shoulder	Pre-Test	Between groups	569,552	2	284.776	3.796	0.028*	FT-30 – FT-60 FT-30 – C
		Within Groups	4576,520	61	75.025			
		Overall	5146,072	63				
	Post Test	Between groups	590.558	2	295.279	4.380	0.017*	
		Within Groups	4112.527	61	67.418			
		Overall	4703.084	63				
Thigh	Pre-Test	Between groups	561.066	2	280.533	2.783	0.070	
		Within Groups	6148.021	61	100.787			
		Overall	6709.087	63				
	Post Test	Between groups	235.992	2	117.996	1.382	0.259	
		Within Groups	5208.268	61	85.381			
		Overall	5444.260	63				
Chest	Pre-Test	Between groups	243.049	2	121.525	3.013	0.056	
		Within Groups	2459.995	61	40.328			
		Overall	2703.044	63				
	Post Test	Between groups	118.079	2	59.039	1.765	0.180	
		Within Groups	2041.006	61	33.459			
		Overall	2159.084	63				
Calf	Pre-Test	Between groups	289.763	2	144.881	3.263	0.045*	FT-30 – FT-60
		Within Groups	2708.536	61	44.402			
		Overall	2998.299	63				
	Post Test	Between groups	161.327	2	80.663	2.039	0.139	
		Within Groups	2413.424	61	39.564			
		Overall	2574.751	63				

* $p < 0.05$

Table 9
Comparisons between groups in circumference measurements.

Variables		Sum of Squares	df	Mean Square	F	p	Difference
Waist	Between groups	171.486	2	85.743	17.495	0.000*	FT-30 – FT-60
	Within Groups	298.953	61	4.901			FT-30 – C
	Overall	470.439	63				FT-60 – C
Hip	Between groups	249.991	2	124.995	10.837	0.000*	FT-30 – C
	Within Groups	703.569	61	11.534			FT-60 – C
	Overall	953.559	63				
Upper Arm	Between groups	95.219	2	47.610	14.507	0.000*	FT-30 – C
	Within Groups	200.192	61	3.282			FT-60 – C
	Overall	295.411	63				
Shoulder	Between groups	10.517	2	5.259	3.284	0.044*	FT-60 – C
	Within Groups	97.672	61	1.601			
	Overall	108.189	63				
Thigh	Between groups	124.704	2	62.352	19.584	0.000*	FT-30 – FT-60
	Within Groups	194.213	61	3.184			FT-30 – C
	Overall	318.917	63				FT-60 – C
Chest	Between groups	42.702	2	21.351	11.017	0.000*	FT-30 – FT-60
	Within Groups	118.218	61	1.938			FT-30 – C
	Overall	160.920	63				
Calf	Between groups	80.420	2	40.210	24.097	0.000*	FT-30 – FT-60
	Within Groups	101.790	61	1.669			FT-30 – C
	Overall	182.209	63				FT-60 – C

* $p < 0.05$

A statistically significant difference was observed in the pre-test-post-test changes of waist, hip, upper arm, shoulder, thigh, chest and calf circumference measurements among the groups ($p < 0.05$) (Table 9). The FT-30 group exhibited a greater decrease in waist circumference compared to both the FT-60 group ($p = 0.019$) and the C group ($p = 0.000$), while the FT-60 group also decreased more than the C group ($p = 0.001$). The C group had a smaller reduction in hip circumference than the FT-30 ($p = 0.000$) and FT-60 groups ($p = 0.009$). Additionally, the C group showed a greater decrease in upper arm circumference compared to both FT-30 ($p = 0.000$) and FT-60 groups ($p = 0.000$). No significant differences were noted between the hip ($p = 0.071$) and upper arm ($p = 0.759$) pre-test-post-test changes of the FT-30 and FT-60 groups ($p > 0.05$). The FT-60 group demonstrated a significantly greater reduction in shoulder circumference compared to the C group ($p = 0.014$), but no significant difference was found between the FT-60 and C groups for shoulder

values in the FT-30 group ($p > 0.05$). The FT-30 group showed a greater decrease in thigh circumference compared to both FT-60 ($p = 0.010$) and C groups ($p = 0.000$), with the FT-60 group also decreasing more than the C group ($p = 0.001$). The pre-test-post-test differences in chest circumference for the FT-30 group were significantly greater than those of both the FT-60 group ($p = 0.010$) and C group ($p = 0.000$), while no significant difference was found between the FT-60 and C groups ($p = 0.062$). Finally, the calf circumference of the FT-30 group was higher than both the FT-60 ($p = 0.004$) and C groups ($p = 0.000$), with the FT-60 group also exceeding the C group ($p = 0.000$).

Table 10 indicates a statistically significant decrease in skinfold thickness measurements in the biceps, triceps, subscapular, suprailiac, chest, thigh and abdominal areas for both the FT-30 and FT-60 groups following the 8-week functional training program ($p < 0.05$). In contrast, the C group showed no significant changes in skinfold thickness across all measured areas ($p > 0.05$).

Table 10
Skinfold thickness measurements and pre-test – post-test comparisons.

Variables	Groups	Pre-Test		Post-Test		Difference Mean		t	df	p
		Mean	SD	Mean	SD	Mean	SD			
Biceps (mm)	FT-30	22.44	6.93	20.45	5.76	1.99	1.63	5.584	20	0.000*
	FT-60	18.36	8.71	17.34	7.94	1.02	1.47	3.095	19	0.006*
	C	19.35	6.01	19.40	6.05	-.04	0.12	-1.738	22	0.096
Triceps (mm)	FT-30	23.45	6.80	21.25	5.88	2.20	2.74	3.682	20	0.001*
	FT-60	18.89	8.94	17.83	8.13	1.06	1.49	3.158	19	0.005*
	C	19.96	5.81	20.00	5.80	-.03	0.10	-1.699	22	0.103
Supscapula (mm)	FT-30	26.27	6.55	24.27	5.84	2.00	1.34	6.822	20	0.000*
	FT-60	21.50	9.10	20.47	8.38	1.03	1.46	3.141	19	0.005*
	C	23.10	6.09	23.13	6.07	-.03	0.11	-1.500	22	0.148
Suprailiac (mm)	FT-30	27.38	6.69	25.23	6.18	2.15	1.43	6.885	20	0.000*
	FT-60	22.29	9.12	21.04	8.27	1.25	1.79	3.127	19	0.006*
	C	24.25	5.40	24.26	5.41	-.01	0.10	-.419	22	0.680
Chest (mm)	FT-30	23.40	6.80	21.86	6.26	1.54	1.35	5.207	20	0.000*
	FT-60	18.10	9.94	17.18	9.31	0.92	1.42	2.907	19	0.009*
	C	19.44	7.57	19.40	7.58	2.19	1.92	1.910	22	0.069
Thigh (mm)	FT-30	27.33	8.06	25.14	7.25	0.87	1.20	5.218	20	0.000*
	FT-60	21.98	9.62	21.11	9.25	-.06	0.25	3.241	19	0.004*
	C	22.43	7.18	22.50	7.19	2.93	1.89	-1.168	22	0.255
Abdominal (mm)	FT-30	30.20	8.98	27.27	7.83	1.69	1.71	7.110	20	0.000*
	FT-60	24.76	11.25	23.08	10.44	2.19	1.92	4.395	19	0.000*
	C	25.51	7.92	25.49	8.06	0.87	1.20	0.220	22	0.828

* $p < 0.05$

Table 11 shows no statistically significant differences in pre-test and post-test skinfold thickness values for the biceps, triceps, subscapular, suprailiac, chest, thigh and abdominal areas among the FT-30, FT-60 and C groups before training ($p > 0.05$).

A statistically significant difference was observed in the pre-test-post-test changes in skinfold thickness for the biceps, triceps, subscapular, chest, thigh and abdominal areas among the groups ($p < 0.05$) (Table 12). The FT-30 group showed a greater reduction in biceps thickness compared to both the FT-60 group ($p = 0.016$) and the C group ($p = 0.000$), while the FT-60 group also decreased more than the C group ($p = 0.007$). For the triceps, the FT-30 group had significantly higher reductions than both the FT-60 ($p = 0.043$) and C groups ($p = 0.000$), with no significant difference between FT-60 and C ($p = 0.050$). The subscapular thickness decreased

significantly more in the FT-30 group compared to both FT-60 ($p = 0.007$) and C ($p = 0.000$), while the C group had less reduction than FT-60 ($p = 0.003$). The FT-30 group also showed greater reductions in suprailiac thickness than FT-60 ($p = 0.029$) and C ($p = 0.000$), with the FT-60 group also reducing more than C ($p = 0.002$). Both FT-30 ($p = 0.000$) and FT-60 groups ($p = 0.013$) had significantly lower chest values than C, with no significant difference between the two training groups ($p = 0.079$). Similarly, thigh reductions were greater in both FT-30 ($p = 0.000$) and FT-60 groups ($p = 0.022$) compared to C, with FT-30 decreasing more than FT-60 ($p = 0.002$). Finally, the FT-30 group reduced abdominal skinfold thickness more than both FT-60 ($p = 0.009$) and C groups ($p = 0.000$), while the FT-60 group also showed greater reductions than C ($p = 0.000$).

Table 11
Comparison of skinfold thickness between groups.

Variables			Sum of Squares	df	Mean Square	F	p
Biceps	Pre-Test	Between groups	188.561	2	94.280	1.800	0.174
		Within Groups	3195.097	61	52.379		
		Overall	3383,657	63			
	Post Test	Between groups	102,370	2	51.185	1.170	0.317
		Within Groups	2668.090	61	43.739		
		Overall	2770.460	63			
Triceps	Pre-Test	Between groups	237.221	2	118.610	2.272	0.112
		Within Groups	3184.533	61	52.205		
		Overall	3421.754	63			
	Post Test	Between groups	122.190	2	61.095	1.388	0.257
		Within Groups	2685.704	61	44.028		
		Overall	2807.894	63			
Supscapula	Pre-Test	Between groups	243.614	2	121.807	2.276	0.111
		Within Groups	3264.396	61	53.515		
		Overall	3508.010	63			
	Post Test	Between groups	155.623	2	77.811	1.680	0.195
		Within Groups	2824.997	61	46.311		
		Overall	2980.620	63			
Suprailiac	Pre-Test	Between groups	271.637	2	135.818	2.658	0.078
		Within Groups	3117.248	61	51.102		
		Overall	3388.884	63			
	Post Test	Between groups	196.764	2	98.382	2.217	0.118
		Within Groups	2706.426	61	44.368		
		Overall	2903.189	63			
Chest	Pre-Test	Between groups	315.282	2	157.641	2.366	0.102
		Within Groups	4064.156	61	66.626		
		Overall	4379.437	63			
	Post Test	Between groups	225.036	2	112.518	1.858	0.165
		Within Groups	3694.338	61	60.563		
		Overall	3919.374	63			
Thigh	Pre-Test	Between groups	370.347	2	185.173	2.695	0.076
		Within Groups	4191.193	61	68.708		
		Overall	4561.539	63			
	Post Test	Between groups	173.341	2	86.670	1.387	0.258
		Within Groups	3812.949	61	62.507		
		Overall	3986.289	63			
Abdominal	Pre-Test	Between groups	363.394	2	181.697	2.054	0.137
		Within Groups	5395.604	61	88.453		
		Overall	5758,997	63			
	Post Test	Between groups	181.055	2	90.528	1.168	0.318
		Within Groups	4728.002	61	77.508		
		Overall	4909.058	63			

Table 12

Comparison of pre-test-post-test difference means between groups for skinfold thickness.

Variables		Sum of Squares	df	Mean Square	F	p	Difference
Biceps	Between groups	45.531	2	22.765	14.626	0.000*	FT-30 – FT-60
	Within Groups	94,947	61	1.557			FT-30 – C
	Overall	140.478	63				FT-60 – C
Triceps	Between groups	55.063	2	27.532	8.692	0.000*	FT-30 – FT-60
	Within Groups	193.211	61	3.167			FT-30 – C
	Overall	248.274	63				
Supscapula	Between groups	45.351	2	22.675	18.043	0.000*	FT-30 – FT-60
	Within Groups	76.659	61	1.257			FT-30 – C
	Overall	122.010	63				FT-60 – C
Suprailiac	Between groups	51.977	2	25.988	15.542	0.000*	FT-30 – FT-60
	Within Groups	102.001	61	1.672			FT-30 – C
	Overall	153,978	63				FT-60 – C
Chest	Between groups	24.735	2	12.368	10.057	0.000*	FT-30 – C
	Within Groups	75.019	61	1.230			FT-60 – C
	Overall	99.754	63				
Thigh	Between groups	55.923	2	27.961	16.596	0.000*	FT-30 – FT-60
	Within Groups	102.775	61	1.685			FT-30 – C
	Overall	158.698	63				FT-60 – C
Abdominal	Between groups	93.801	2	46.901	21.666	0.000*	FT-30 – FT-60
	Within Groups	132.047	61	2.165			FT-30 – C
	Overall	225.849	63				FT-60 – C

* $p < 0.05$

Table 13 reveals a statistically significant increase in postural control measurements for the FT-30 and FT-60 groups across six directions (Right A, Right PM, Right PL, Left A, Left PM, Left PL) after the training ($p < 0.05$). This indicates that functional training positively impacted postural control in both groups. In contrast, the C group which did not participate in the training experienced a significant decrease only in the Right A and Left PL measurements ($p < 0.05$), with no significant changes in other postural control variables ($p > 0.05$). Regarding flexibility, both the FT-30 and FT-60 groups demonstrated significant improvements in post-test scores compared to pre-test values ($p < 0.05$). Conversely, no significant changes were observed in the flexibility measurements of the C group ($p > 0.05$).

Table 14 indicates that there were no statistically significant differences in pre-test postural control and flexibility measurements among the FT-30, FT-60, and C groups prior to training ($p > 0.05$). Similarly, post-test

comparisons revealed no significant differences between the groups after the training period ($p > 0.05$).

A statistically significant difference was observed between the pre-test-post-test mean differences of postural control and flexibility variables among the groups ($p < 0.05$) (Table 15). Specifically, the postural control mean difference in the Right A direction was greater in both the FT-30 and FT-60 groups compared to group C ($p = 0.000$). Similarly, the Right PM and Right PL mean differences were also significantly lower in group C compared to both training groups ($p = 0.037$ and $p = 0.000$, respectively). For the Left A direction, group C again showed a lesser decrease compared to the FT-30 and FT-60 groups ($p = 0.000$). The FT-30 group exhibited a greater decrease in the Left PM variable compared to the FT-60 group ($p = 0.036$), and both training groups decreased more than group C ($p = 0.000$). Lastly, the flexibility mean differences for group C were significantly lower than those for both the FT-30 ($p = 0.000$) and FT-60 groups ($p = 0.000$).

Table 13

Mean values of postural control and flexibility measurements of groups and postural control and flexibility pre-test – post-test comparison of groups.

Variables	Groups	Pre-Test		Post-Test		Difference Mean		t	df	p
		Mean	SD	Mean	SD	Mean	SD			
Right A (cm)	FT-30	55.23	5.56	56.56	4.82	-1.33	1.12	-5.421	20	0.000*
	FT-60	57.79	5.72	58.77	5.50	-.98	0.67	-6.505	19	0.000*
	C	58.06	4.62	57.80	4.49	0.25	0.43	2.789	22	0.011*
Right PM (cm)	FT-30	74.26	5.50	76.71	4.78	-2.45	1.33	-8.408	20	0.000*
	FT-60	76.29	5.01	78.00	5.05	-1.71	1.30	-5.865	19	0.000*
	C	76.07	4.50	75.87	4.30	0.20	0.58	1.667	22	0.110
Right PL (cm)	FT-30	72.79	5.53	74.75	4.70	-1.97	1.22	-7.382	20	0.000*
	FT-60	74.48	6.05	76.39	5.94	-1.90	1.13	-7.560	19	0.000*
	C	75.96	4.85	75.88	4.72	0.08	0.32	1.176	22	0.252
Left A (cm)	FT-30	54.01	5.51	54.83	5.02	-.82	0.84	-4.484	20	0.000*
	FT-60	56.07	6.04	56.86	5.67	-.79	0.76	-4.652	19	0.000*
	C	57.08	4.41	57.11	4.46	-.03	0.30	-.481	22	0.636
Left PM (cm)	FT-30	72.67	5.41	74.87	4.84	-2.20	0.96	-10.514	20	0.000*
	FT-60	75.74	6.22	77.40	6.14	-1.66	0.92	-8.078	19	0.000*
	C	75.51	4.82	75.52	4.90	-.01	0.49	-.085	22	0.933
Left PL (cm)	FT-30	71.54	5.56	73.16	4.97	-1.62	2.64	-2.814	20	0.011*
	FT-60	74.39	6.20	76.04	6.11	-1.66	0.96	-7.750	19	0.000*
	C	75.53	4.46	75.06	4.52	0.47	0.72	3.116	22	0.005*
Flexibility (mm)	FT-30	18.00	3.47	19.51	3.42	-1.51	0.81	-8.561	20	0.000*
	FT-60	18.48	4.16	19.96	3.84	-1.49	0.94	-7.053	19	0.000*
	C	18.93	3.22	18.82	3.29	0.11	0.45	1.195	22	0.245

* $p < 0.05$; A: Anterior; PM: Posteriomedial; PL: Posteriorlateral; FT-30: Functional Training 30 sec Rest Group; FT-60: Functional Training 60 sec Rest Group; C: Control Group.

Discussion

This study aimed to explore the effects of an 8-week online functional training program with two different rest periods on body composition, postural control and flexibility in sedentary women. The findings indicate that functional training with varying rest intervals resulted in positive changes in the measured parameters, including body weight, BMI, circumference measurements, flexibility and postural control.

Functional training significantly improves body composition by increasing muscle mass and reducing fat mass. Combining functional strength training with aerobic exercise is often more effective than traditional resistance training alone leading to reductions in body fat percentage and waist circumference along with increases in lean body mass (Khalafi et al., 2023). In this

study, an 8-week functional training program with different rest periods resulted in decreased body weight and BMI in sedentary women. Similar research on sedentary housewives also showed significant reductions in body weight, BMI and body fat percentage after 8 weeks of Pilates and mat exercises (Kadı, 2021). Another study noted decreased BMI in sedentary women undergoing functional training (Aslan, 2023) aligning with our findings. Wang et al. (2024) reported that combining functional strength and aerobic training was more effective for fat reduction than traditional resistance methods. Khalafi et al. (2023) also highlighted increases in muscle mass and decreases in fat mass in postmenopausal women. Together, these findings suggest that functional training positively impacts metabolic health.

Table 14
Comparison between groups postural control measurements.

Variables			Sum of Squares	df	Mean Square	F	p
Right A	Pre-Test	Between groups	103.558	2	51.779	1.846	0.167
		Within Groups	1711.141	61	28.051		
		Overall	1814.699	63			
	Post Test	Between groups	50.135	2	25.067	1.032	0.363
		Within Groups	1482.285	61	24.300		
		Overall	1532.419	63			
Right PM	Pre-Test	Between groups	52.365	2	26.182	1.045	0.358
		Within Groups	1528.174	61	25.052		
		Overall	1580.539	63			
	Post Test	Between groups	48.708	2	24.354	1.104	0.338
		Within Groups	1346.014	61	22.066		
		Overall	1394.722	63			
Right PL	Pre-Test	Between groups	110.685	2	55.343	1.850	0.166
		Within Groups	1824.532	61	29.910		
		Overall	1935.218	63			
	Post Test	Between groups	28.947	2	14.473	0.551	0.579
		Within Groups	1603.511	61	26.287		
		Overall	1632.457	63			
Left A	Pre-Test	Between groups	106.503	2	53.251	1.879	0.161
		Within Groups	1728.493	61	28.336		
		Overall	1834.996	63			
	Post Test	Between groups	66.637	2	33.318	1.310	0.277
		Within Groups	1551.001	61	25.426		
		Overall	1617.637	63			
Left PM	Pre-Test	Between groups	123.103	2	61.551	2.050	0.138
		Within Groups	1831.517	61	30.025		
		Overall	1954,620	63			
	Post Test	Between groups	70.411	2	35.205	1.253	0.293
		Within Groups	1714.555	61	28.107		
		Overall	1784.966	63			
Left PL	Pre-Test	Between groups	182.109	2	91.054	3.111	0.052
		Within Groups	1785.381	61	29.269		
		Overall	1967,490	63			
	Post Test	Between groups	88.402	2	44.201	1.629	0.204
		Within Groups	1654.734	61	27.127		
		Overall	1743.136	63			
Flexibility	Pre-Test	Between groups	9.597	2	4.798	0.367	0.694
		Within Groups	796.754	61	13.062		
		Overall	806.351	63			
	Post Test	Between groups	14.214	2	7.107	0.577	0.565
		Within Groups	751.765	61	12.324		
		Overall	765.979	63			

* $p < 0.05$

Table 15

Comparison of pre-test-post-test difference means between groups for postural control and flexibility.

Variables		Sum of Squares	df	Mean Square	F	p	Difference
Right A	Between groups	30.502	2	15.251	24.548	0.000*	FT-30 – C
	Within Groups	37.898	61	0.621			FT-60 – C
	Overall	68.400	63				
Right PM	Between groups	82.694	2	41.347	33.553	0.000*	FT-30 – FT-60
	Within Groups	75.170	61	1.232			FT-60 – C
	Overall	157.864	63				FT-60 – C
Right PL	Between groups	59.855	2	29.927	32.498	0.000*	FT-30 – C
	Within Groups	56.175	61	0.921			FT-60 – C
	Overall	116.030	63				
Left A	Between groups	8.905	2	4.452	9.998	0.000*	FT-30 – C
	Within Groups	27.165	61	0.445			FT-60 – C
	Overall	36.069	63				
Left PM	Between groups	57.477	2	28.739	44.272	0.000*	FT-30 – FT-60
	Within Groups	39.597	61	0.649			FT-30 – C
	Overall	97.074	63				FT-60 – C
Left PL	Between groups	65.373	2	32.687	11.876	0.000*	FT-30 – C
	Within Groups	167.891	61	2.752			FT-60 – C
	Overall	233.264	63				
Flexibility	Between groups	38.341	2	19.171	33.855	0.000*	FT-30 – C
	Within Groups	34.542	61	0.566			FT-60 – C
	Overall	72.884	63				

* $p < 0.05$

Şahin et al. (2023) reported that an 8-week functional training program for women significantly increased muscle mass while reducing subcutaneous fat mass and body fat percentage. They emphasized that sedentary women could improve their daily functionality by participating in such programs. Similarly, Yakalı (2020) found significant decreases in skinfold thickness among sedentary women aged 24-45 engaging in functional exercises. In our study, which included functional exercises applied with two different rest periods we observed significant reductions in skinfold thickness in the FT-30 and FT-60 groups. In contrast, the C group which did not participate in the training and continued their usual activities, showed no changes over the 8-week period. When these findings are evaluated together, they indicate that functional training applications can create a significant change in the body fat ratios of sedentary women.

In this study, the FT-30 group which rested for 30 seconds between exercises showed greater reductions in waist, hip, upper arm, thigh, chest, and calf measurements compared to the FT-60 group, which

rested for 60 seconds. A research Supporting this result, Aslan (2023) found significant decreases in arm and chest circumferences in sedentary women, although hip circumference did not show statistically significant changes. The researchers noted that participants were classified as obese based on their BMI and suggested that the slower progress in hip circumference might be due to higher fat levels in that area. The notable reductions in all measured circumferences in our study can be attributed to the multifaceted nature of functional training, which mimics natural movements from daily life. This approach allows for the simultaneous engagement of multiple muscle groups (Sipe & Ritchie, 2012). Weiss et al. (2010) also compared functional training to traditional resistance training and reported that functional training led to significant increases in biceps, forearm, calf and shoulder circumferences in young adults.

One of the primary objectives of functional exercises is to teach individuals to move effectively using their own body weight, improve balance and posture, address spinal issues and enhance postural alignment. These

exercises are specifically designed to achieve these benefits and this is supported by the scientific literature. The focus of functional training is to engage muscle groups effectively across different planes of movement and to strengthen supporting muscles (Orr et al., 2008). Research indicates that a circular training format, characterized by shorter rest intervals and repeated exercise sequences compared to traditional resistance training, is effective for reducing body fat, increasing muscle mass and enhancing functional capacity and strength (Romero-Arenas et al., 2011).

The postural control findings of this study indicate that post-test values in three directions significantly increased following the 8-week functional training program for both the FT-30 and FT-60 groups. This enhancement in postural control suggests that functional training with different rest intervals effectively improves the postural skills of sedentary women. Notably, the FT-30 group exhibited a greater increase in postural control compared to the FT-60 group. Various studies underscore the effectiveness of functional training in enhancing balance, posture and muscle strength in women particularly in counteracting age-related muscle loss (Resende-Neto et al., 2019; Sedaghati et al., 2022; McLaughlin et al., 2020). One study comparing functional and traditional exercises in elderly women found that functional training significantly improved dynamic balance, muscle strength and flexibility, facilitating safer daily activities (Resende-Neto et al., 2019). Another study highlighted that functional and strength training notably improved balance, reduced fall risk and enhanced postural stability, particularly among older women (McLaughlin et al., 2020). These findings support the effectiveness of functional training in enhancing both static and dynamic balance contributing to the reduction of posture-related issues.

The literature indicates that functional training, which involves exercises engaging multiple muscles and joints across various planes and axes, enhances not only strength and endurance but also flexibility, balance, coordination and proprioception (Blasco-Lafarga et al., 2012; Lohne-Seiler et al., 2012; Whitehurst et al., 2005). In our study, the post-training flexibility values for both the FT-30 and FT-60 groups significantly increased compared to pre-training values, while the C group showed no significant changes. This suggests that functional training with different rest intervals positively impacts flexibility performance. Weiss et al. (2010) reported that a 7-week functional training

program significantly enhanced flexibility and other parameters in participants aged 18-32. They highlighted notable improvements in the modified sit-and-reach flexibility test suggesting that multi-joint exercises particularly those involving the hip joint could maintain or enhance flexibility. Additionally, Murugan and Nageswaran (2014) reported statistically significant increases in flexibility due to functional movements.

Conclusion

In summary, the 8-week functional training program led to significant improvements in sedentary women including reductions in body weight, BMI, skinfold thickness and waist circumference along with enhancements in postural control and flexibility for both the FT-30 and FT-60 groups. Notably, the FT-30 group, which incorporated shorter rest periods exhibited greater changes in body composition, postural control and flexibility compared to the FT-60 group which utilized 60-second rest intervals. The results highlight that all measured variables showed more pronounced positive effects in the FT-30 group suggesting that the duration of rest periods can significantly influence training outcomes. These findings align with existing literature, indicating that varying rest periods can enhance the effectiveness of functional training programs offering tailored benefits for different fitness components in sedentary women. Overall, this study underscores the effectiveness of online functional training particularly with 30-second rest intervals, in improving key physical parameters. These insights serve as valuable guidance for the planning and implementation of functional training programs emphasizing the importance of customizing rest intervals to optimize results.

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Authors' Contribution

Study Design: YK, DB; Data Collection: DB; Statistical Analysis: YK; Manuscript Preparation: YK, DB; Funds Collection: YK, DB.

Ethical Approval

The study was approved by the Hatay Mustafa Kemal University of Non-Interventional Ethical Committee (29.08.2023/06/26) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

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Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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