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Original Article

The effect of static and dynamic core exercises on dynamic balance, spinal stability, and hip mobility in female office workers

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ABSTRACT

Objectives: This study aims to compare the effect of static and dynamic core exercises in terms of dynamic balance, spinal stability, and hip mobility in female office workers.

Patients and methods: Between May 2018 and June 2018, a total of 34 women (mean age 36.4±6.5 years; range, 28 to 54 years) who worked for a bank and exercised in the fitness center of the work place were recruited. The women were divided into two groups including 17 women in each as static and dynamic core groups and administered sessions of 20 to 30 min twice a week for six weeks. Both groups were tested for dynamic balance (Y-balance test), spinal stability (functional reach test), and hip mobility (active flexion and extension) before and after six weeks of exercise.

Results: A statistically significant improvement was found in both groups between the pre- and post-test results in terms of spinal stability, hip mobility, and dynamic balance ($p<0.05$). The only exception was the right and left leg anterior balance in the static core group. Dynamic core exercises seemed to be more effective than static core exercises in improving the right and left leg anterior balance. There were no statistically significant differences between the groups in terms of spinal stability, hip mobility, and dynamic balance according to the mean absolute change ($p>0.05$).

Conclusion: Our study results indicate that both types of exercises are effective in improving dynamic balance, spinal stability, and hip mobility in female office workers. Therefore, the expected benefits from core exercises are to enhance dynamic balance, spinal stability, and hip mobility. Female workers can perform both types of exercises safely and effectively.

Keywords: Core exercise, female office workers, hip, range of motion, spinal stability, Y balance test.

Core exercise is a popular term in athletics and the field of rehabilitation.[1-3] This popularity of core exercises may be due to the results of certain studies showing that core exercises reduce injury rate,[4] enhance performance in elite athletes,[5] and aid in the treatment of individuals with musculoskeletal problems.[6] Anatomically, the core can be described as a muscular box with the abdominals in the front, the paraspinals and glutes in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom.[7]

Although a growing body of research is focused on the effects of core exercises on the performance of elite athletes and rehabilitation outcome in individuals with musculoskeletal problems,[1] a controversy between the terms core strength and core stability still remains.[3,7] Pope and Panjabi[8] described core stability as the ability of the lumbopelvic-hip complex to prevent buckling of the vertebral column and to return it to equilibrium following perturbation. Core strength was described as muscular control required around the lumbar spine to maintain functional stability.[9] This controversy may

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be caused by differences in the field of rehabilitation or athletics.[3,7,10]

There are mixed results in terms of the effectiveness of core exercises in improving athletic performance and rehabilitation outcomes in individuals with musculoskeletal problems.[1,2,6,11,12] Escamilla et al.[13] reported that core muscle development might be important in many functional and athletic activities, since core muscle recruitment enhanced core stability and helped to provide proximal stability to facilitate distal mobility in healthy young individuals. Granacher et al.[14] reported that core strength training increased strength, flexibility, balance, coordination, and speed in healthy and young men and women. However, Jamison et al.[2] argued that trunk stabilization exercises did not improve core strength, trunk control, leg strength, and athletic performance (three-cone test, 20-yard shuttle test, and standing broad jump test) compared to resistance exercises.

These contradictory results can be explained by several methodological issues such as age (young or old), exercises status (well-trained or sedentary), types of core exercises (static, dynamic, stable, unstable, Swiss ball, etc.), duration of research (short- or long-term), and condition of individuals (those with low back pain, those with stroke, or those with multiple sclerosis).

It is known that office workers are part of a large group of workers who often work in the sitting position for most of the day. Sitting behavior in office workplaces is a known risk factor for cardiometabolic disease, type 2 diabetes, obesity, coronary artery disease, and musculoskeletal disorders.[15]

Bliven[16] reported that enhancing core stability through exercise was common for preventing musculoskeletal injury. There are two primary types of core exercises: static and dynamic. In static core exercises, such as the standard plank, side plank, and lifted leg/arm planks, the joint and muscle either work against an immovable force or is held in a static position with some resistance.[17] Dynamic core exercises such as the glute bridge, crunch, and dead bug require the ability to repeatedly or continuously exert a muscle force concentrically or eccentrically over time.[17] In the present study, we hypothesized that static core exercises would be more effective in improving spinal stability and hip mobility and that dynamic core exercises would be more effective in improving dynamic balance. We, therefore, aimed to compare static and dynamic core exercises in terms of dynamic balance, spinal stability, and hip mobility in physically moderate active female office workers.

PATIENTS AND METHODS

This prospective, randomized study was conducted at the fitness center of the Ing Bank (Directorate General, Istanbul, Turkey) between May 2018 and June 2018. A total of 34 women (mean age 36.4±6.5 years; range, 28 to 54 years) who worked for a bank and exercised in the fitness center of the work place were recruited. *Inclusion criteria were as follows*: no experience with core exercises and no history of musculoskeletal complaints within the past six months. Before the enrollment, the participants were already actively exercising irregularly twice a week, or once or twice in every two weeks. The participants were asked not to make any changes in their daily routines and activities throughout the study. All participants were randomly assigned to either the static core group (SCG, n=17) or dynamic core group (DCG, n=17). Randomization was conducted according to a completely randomized design (Figure 1). During the study, each group followed a standardized core exercise program under the supervision of a certificated fitness trainer (Tables 1 and 2). Training programs and research protocol were designed by a training and movement expert who has a PhD in sport sciences. Pre- to post-tests were performed by a fitness trainer who is a certificated Functional Movement Screen (FMS®) specialist with a Master of Science degree in Exercise Physiology.

A written informed consent was obtained from each participant. The study protocol was approved by the Human Subjects Ethics Committee of Okan University, Health Sciences Institute. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Exercise protocol

Warm-up session: Each session, including pre- and post-test sessions, started with a warm-up exercise involving three min of running on a motor-driven treadmill (Technogym-Jog700, Italy) at 6 km/h and 1% slope, followed immediately by a series of dynamic stretching exercises, including jumping jacks (2×20 reps with 15-sec rest), squats with body weight (2×15 reps with 15-sec rest), and spinal trunk rotation (2×20 reps with 15-sec rest).

Training program: The participants trained for 20 to 30 min twice a week for six consecutive weeks using the protocol for core stability exercises developed for this

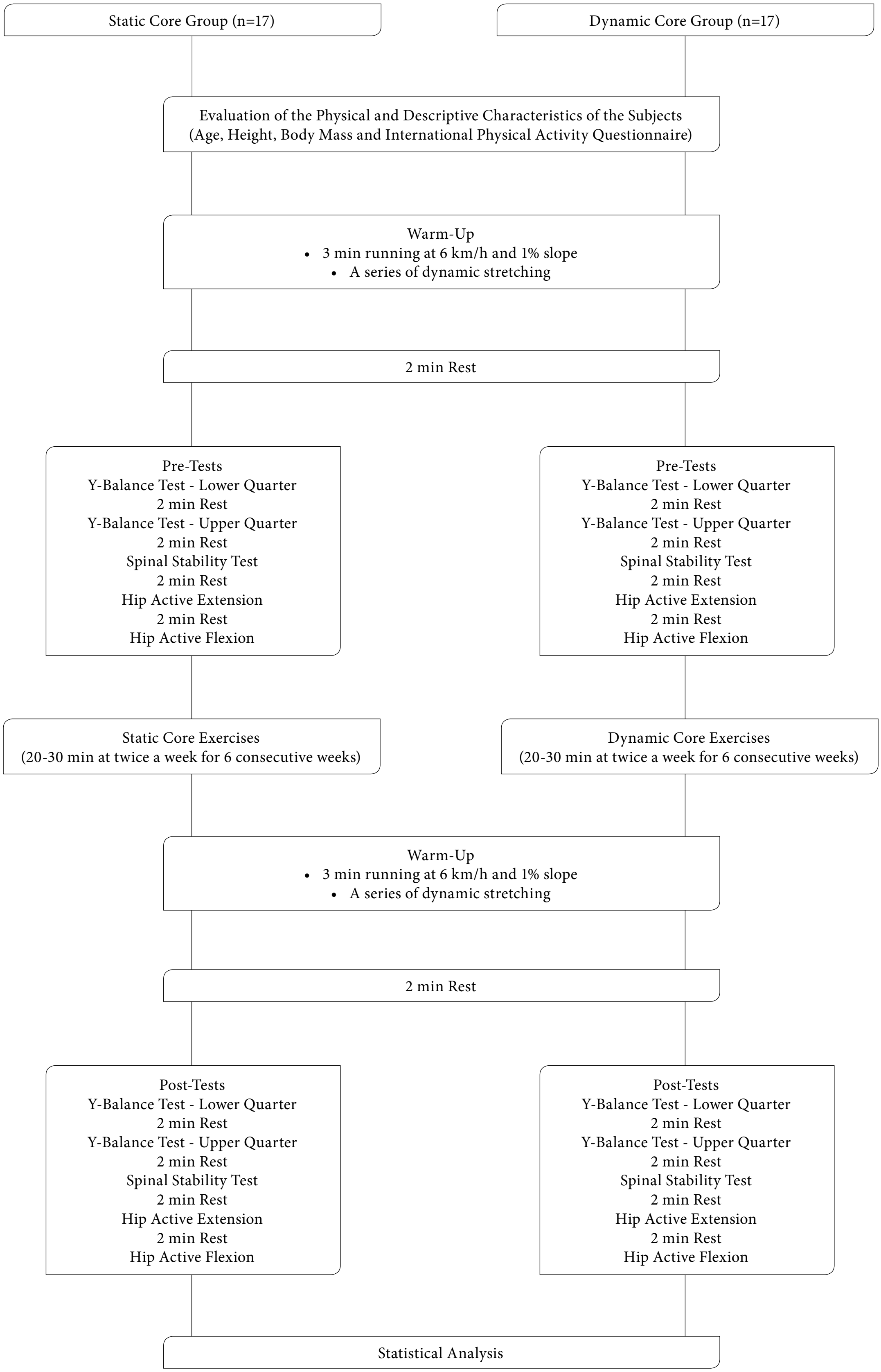

Figure 1. Study flowchart.

TABLE 1
Dynamic core exercises used in the study

Exercise	Week-1 (set/sec)	Week-2 (set/sec)	Week-3 (set/sec)	Week-4 (set/sec)	Week-5 (set/sec)	Week-6 (set/sec)
Crunch	2×25	2×25	2×30	2×30	2×40	2×40
Lying leg raise	2×20	2×20	2×25	2×25	2×30	2×30
Reverse hyperextension	2×25	2×25	2×30	2×30	2×40	2×40
Lying knee raise	2×25	2×25	2×30	2×30	2×40	2×40
Dynamic double leg stretch	2×15	2×15	2×20	2×20	2×25	2×25
High plank with hip extension	2×30	2×30	2×35	2×35	2×45	2×45
Glute bridge	2×30	2×30	2×35	2×35	2×45	2×45

study (Tables 1 and 2). Core exercises were performed on a Pilates mat; they also included the current exercise programs of the participants. We attempted to equalize total training duration throughout the study. The training time increased progressively from 20 to 30 min during the study.

Physical activity: Physical activity of the participants was assessed using the self-administered short (seven-item) form of the International Physical Activity Questionnaire (IPAQ). The IPAQ was used to report activities performed for at least 10 min during the last seven days. The IPAQ scoring protocol assigns the following metabolic equivalent (MET) values to walking, moderate, and vigorous intensity activities: 3.3, 4.0, and 8 METs, respectively.[18] The total weekly physical activity of the participants was determined as energy expenditure. The MET-min per week (MET·min·wk^{-1}) were calculated as duration × frequency per week × MET intensity.[19] The participants can be classified according to the MET·min·wk^{-1} obtained from the IPAQ as follows: inactive, <600 MET/min/week; moderately active, 600-1,499 MET/min/week; and active, ≥1,500 MET/min/week.[20]

The IPAQ has been shown to be reliable and valid for the assessment of total physical activity in Turkish men and women.[21]

Dynamic balance: Dynamic balance of the participants was evaluated by the Y-balance test (YBT) via Functional Movement Systems (Lynchburg, VA, USA).

Y-balance test -lower quarter (YBT-LQ)

All participants performed the test with their shoes off. They were allowed two practice trials before recording the actual measurements of their dominant leg. Leg length was measured from the inferior tip of the anterior superior iliac spine to the distal end of the medial malleolus.[22] The YBT-LQ examined the maximum reach of the lower extremity of the dominant leg in the anterior, posteromedial (PM), and posterolateral (PL) directions while the participant maintained a unilateral stance with the

TABLE 2
Static core exercises used in the study

Exercise	Week-1 (set/sec)	Week-2 (set/sec)	Week-3 (set/sec)	Week-4 (set/sec)	Week-5 (set/sec)	Week-6 (set/sec)
Static double leg stretch	2×25	2×25	2×30	2×30	2×35	2×35
One arm high plank	2×10*	2×10*	2×15*	2×15*	2×20*	2×20*
High plank with hip extension	2×15*	2×15*	2×20*	2×20*	2×25*	2×25*
Glute bridge iso hold	2×45	2×45	2×50	2×50	2×60	2×60
Reverse hyperextension hold	2×40	2×40	2×45	2×45	2×55	2×55
One leg knee raise	2×15*	2×15*	2×20*	2×20*	2×25*	2×25*
Static ab hold	2×25	2×25	2×30	2×30	2×40	2×40

* Unilateral exercise. Time to treatment for each side.

opposite leg centered on a platform. According to the standardized protocol, a trial was considered invalid, if the participant *(i)* failed to maintain unilateral stance, *(ii)* landed on the reaching foot, *(iii)* failed to return to the starting position such as removing the hands from the hips, or *(iv)* pushed or kicked the indicator to increase distance. Three trials were repeated for each direction and the examiner recorded the maximum reach score.[22]

Y-balance test -upper quarter (YBT-UQ)

The test started with length measurement of the dominant limb. During the measurement, the participant stood in the anatomical position, while the examiner identified the C7 vertebra. After the C7 vertebra was identified, the examiner instructed the participant to raise (abduct) the dominant limb to the shoulder height at a 90° angle. The examiner, then, measured the distance from the C7 spinous process to the most distal tip of the dominant limb middle finger.[23] All participants were allowed two practice trials before the actual recording of the measurements for the dominant limb.

During the test, the participants assumed the starting position with the testing hand on the stance platform and the thumb adducted while being aligned behind the red starting line. The starting position for the reach hand was defined by positioning the reach hand on top of the medial reach with the indicator placed at shoulder width from the stance plate. Performance consisted of reaching the three directions with the dominant hand, while maintaining a push-up position with the feet at shoulder width apart. The trial was discarded and repeated, if the participant *(i)* failed to maintain unilateral stance on the platform (e.g., touched down to the floor with the reach hand or fell off the stance platform), *(ii)* failed to maintain reach hand contact with the reach indicator on the target area while in motion (e.g., shoved the reach indicator), *(iii)* used the reach indicator for stance support (e.g., placed fingers or hand on top of the reach indicator), *(iv)* failed to return the reach hand to the starting position under control, or *(v)* lifted either foot off of the floor.[23] Three trials were repeated for each direction and the examiner recorded the maximum score.

As the reach distance was associated with the limb length, it was normalized to limb length using the following formula for lower and upper limbs:[24]

Lower limb= Reach distance (cm)/Leg length (cm)×100

Upper limb= Reach distance (cm)/Arm length (cm)×100

Spinal stability: The functional reach test was used to measure forward spinal stability.[25,26] The participants stood next to a wall with a comfortable stance width. They were, then, required to make a fist with their preferred arm and to reach as far as possible while keeping the arm parallel to the ground. The distance that participants could reach forward holding their arm parallel to the ground was measured in cm.[27] Three trials were performed and the average of the last two trials was recorded.

Hip mobility (active flexion and extension): Hip extension and flexion was measured with a plastic goniometer (Lafayette Instrument Europe, Richardson Products Inc., Sammons Preston J00240, 12-inch) on the dominant leg of the participants. Hip extension was performed with the participant in the prone position and the knee on the measured side extended. Hip flexion was performed in the supine position with the knee flexed on the measured side and the opposite leg extended and resting on the examining table.[28] During hip extension and flexion measurement, the greater trochanter was determined to be the pivot point.[29]

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Data were expressed in mean±standard deviation

TABLE 3
Descriptive characteristics of study population

	Static core group (n=17)	Dynamic core group (n=17)	
Variables	Mean±SD	Mean±SD	*p*
Age (year)	35.9±5.7	36.8±7.3	0.899
Height (cm)	162±6.2	165±6.1	0.234
Body mass (kg)	58.6±5.2	60.9±6.1	0.205
IPAQ score (MET-min/week)	830±22	821±19	0.795

SD: Standard deviation; IPAQ: International Physical Activity Questionnaire.

TABLE 4
Statistical comparison of performance changes in YBT-LQ between study groups

			Test score			Absolute change				
	Group	Test time	Mean±SD	Median	IQR	Mean±SD	Median	IQR	*p*	ES
Right leg anterior	SCG	Pre-test	59.8±5.0			2.4±4.8			0.107	1.60‡
		Post-test	62.2±4.9							
	DCG	Pre-test	57.5±4.9			4.9±4.3*				
		Post-test	62.5±4.8							
Left leg anterior	SCG	Pre-test	60.5±5.8			1.7±4.1			0.162	1.05‡
		Post-test	62.2±4.9							
	DCG	Pre-test	59.4±4.3			3.50±3.2*				
		Post-test	62.9±4.8							
Right leg PM	SCG	Pre-test	76.9±7.6			5.2±9.2†			0.411	0.10**
		Post-test	82.1±7.3							
	DCG	Pre-test		70.6	62.2-93.9		8.98	-7.2/22.5*		
		Post-test		79.5	70.4-92.8					
Left leg PM	SCG	Pre-test		78.6	58.6-89.8		7.3	-5.9-21.5*	0.376	0.10**
		Post-test		85.1	74.5-96.4					
	DCG	Pre-test		74.2	63.3-96.4		8.5	-3.6-25.6*		
		Post-test		84.4	70.5-101.2					
Right leg PL	SCG	Pre-test	78.4±7.0			8.5±7.3*			0.272	1.36‡
		Post-test	86.9±6.8							
	DCG	Pre-test	73.8±9.3			11.1±6.8*				
		Post-test	84.9±10.3							
Left leg PL	SCG	Pre-test	76.5±8.6			8.8±5.03*			0.713	0.21‡
		Post-test	86.9±6.9							
	DCG	Pre-test	73.4±9.7			9.6±7.3*				
		Post-test	83.0±8.5							

YBT-LQ: Y balance test-lower quarter; SD: Standard deviation; IQR: Interquartile range (25th-75th percentiles); ES: Effect size; SCG: Static core group; DCG: Dynamic core group; PM: Posteromedial; PL: Posterolateral; * There has been a statistically significant difference between pre and post-test in related group (p<0.01); ** Mann-Whitney U Test; † There has been a statistically significant difference between pre and post-test in related group (p<0.05); ‡ Independent- samples t-test; Pre-test; Preoperative; Post-test: Postoperative.

(SD) or median and interquartile range (25th and 75th percentiles) in parametric or non-parametric tests, respectively. The mormality assumption of the related data were checked by the Shapiro-Wilk test. Independent samples t-test or Mann-Whitney U test was used to compare each variable between the groups according to the normality test result. The paired t-test or Wilcoxon signed-rank test was used in case of within-subject comparisons. The effect size of the analyses was calculated. A *p* value of <0.05 was considered statistically significant.

RESULTS

Descriptive characteristics of the participants are presented in Table 3. In this study, according to the IPAQ scoring system, the participants in both groups were moderately active. There were no statistically significant differences between the groups in terms of descriptive characteristics (p>0.05).

Statistical comparison of performance changes in the YBT-LQ and YBT-UQ between the groups are presented in Tables 4 and 5, respectively. As shown in these tables, both types of exercise were effective in improving dynamic balance (p<0.05). Static or dynamic core exercises were not superior to each other in improving dynamic balance, except for the leg anterior direction. In terms of the leg anterior direction, dynamic core exercises seemed to be more effective than static core exercises (Table 4).

Statistical comparison of performance changes in hip mobility and spinal stability between the two groups are presented in Table 6. Both exercises were

TABLE 5
Statistical comparison of performance changes in YBT-UQ between study groups

			Test score			Absolute change				
	Group	Test time	Mean±SD	Median	IQR	Mean±SD	Median	IQR	*p*	ES
Right arm medial	SCG	Pre-test		81.4	67.4-89.2		9.8	-0.68-24.0*	0.825	0.03†
		Post-test		90.8	75.0-97.4					
	DCG	Pre-test	78.4±8.6			10.3±8.2*				
		Post-test	88.7±7.8							
Left arm medial	SCG	Pre-test	80.1±6.6			11.6±6.2*			0.055	2.2‡
		Post-test	91.7±7.2							
	DCG	Pre-test	79.9±7.3			11.6±6.2*				
		Post-test	87.5±7.2							
Right arm inferior	SCG	Pre-test	66.2±10.6			15.3±6.3*			0.630	0.20‡
		Post-test	81.5±11.1							
	DCG	Pre-test	65.6±11.7			13.5±14.7*				
		Post-test	79.1±11.9							
Left arm inferior	SCG	Pre-test	63.0±7.1			15.3±7.1*			0.094	0.20†
		Post-test	78.3±9.2							
	DCG	Pre-test		61.4	53.95-82.1		8.6	-1.19-30.3*		
		Post-test		70.0	57.14-92.5					
Right arm superior	SCG	Pre-test	41.8±6.8			8. 1±6.1*			0.292	0.7‡
		Post-test	50.8±7.6							
	DCG	Pre-test	37.6±8.6			11.5±8.3*				
		Post-test	49.1±10.2							
Left arm superior	SCG	Pre-test	44.3±9.4			10.1±6.7*			0.125	0.7‡
		Post-test	54.4±7.2							
	DCG	Pre-test	40.7±9.0			14.3±9.1*				
		Post-test	55.0±10.1							

YBT-UQ: Y balance test-upper quarter; SD: Standard deviation; IQR: Interquartile range (25th-75th percentiles); ES: Effect size; SCG: Static core group; DCG: Dynamic core group; * There has been a statistically significant difference between pre and post-test in related group (p<0.01); † Mann-Whitney U test; ‡ Independent- samples t- test; Pre-test; Preoperative; Post-test: Postoperative.

TABLE 6
Statistical comparison of performance changes in hip mobility and spinal stability between study groups

			Test score			Absolute change				
	Group	Test time	Mean±SD	Median	IQR	Mean±SD	Median	IQR	*p*	ES
Hip flexion	SCG	Pre-test	116.0±9.8			7.9±5.1*			0.921	0.24‡
		Post-test	124.0±8.5							
	DCG	Pre-test	115.5±8.6			8.1±4.9*				
		Post-test	124.0±7.1							
Hip extension	SCG	Pre-test	20.2±7.1			5.3±6.8*			0.557	0.07†
		Post-test	25.4±4.7							
	DCG	Pre-test		16.0	12.0-33.0		6.5	-3.0-13.0*		
		Post-test		24.0	17.0-45.0					
Spinal stability	SCG	Pre-test	35.5±5.4			7.6±4.4*			0.565	0.25‡
		Post-test	43.0±5.4							
	DCG	Pre-test	35.6±7.4			8.9±8.9*				
		Post-test	44.6±6.0							

SD: Standard deviation; IQR: Interquartile range (25th-75th percentiles); ES: Effect size; SCG: Static core group; DCG: Dynamic core group; * There has been a statistically significant difference between pre and post-test in related group (p<0.01); † Mann-Whitney U test; ‡ Independent- samples t- test; Pre-test; Preoperative; Post-test: Postoperative.

effective in improving hip mobility and spinal stability ($p<0.05$). However, they were not superior to each other in improving hip mobility and spinal stability ($p>0.05$).

DISCUSSION

In the present study, we compared the influence of static and dynamic core exercises in terms of dynamic balance, spinal stability, and hip mobility in female office workers. The main findings of the current study are as follows: *(i)* both types of exercise improved spinal stability and hip mobility in female office workers and none was superior to the other; *(ii)* both types of exercise were effective in improving dynamic balance and none was superior to the other, except for the leg anterior directions; and *(iii)* the dynamic core exercises for the leg anterior direction may be more effective than static core exercises in improving dynamic balance.

According to these results, the first hypothesis of this study (static core exercises would be more effective in improving spinal stability and hip mobility) was not confirmed. On the other hand, the second hypothesis of the study (dynamic core exercises would be more effective in improving dynamic balance) was partially confirmed. The partial confirmation of the second hypothesis depended on dynamic core exercises being more effective than static core exercises in improving leg anterior direction reach in the YBT-LQ (Table 4). However, the reason why static core exercises did not improve the right and left leg anterior direction reach in the YBT-LQ is still unclear. This finding can be attributed to the measurement of right and left leg anterior balance prior to other directions according to the YBT protocol. The participants may have not understood how to maximally reach the anterior directions. Therefore, in future studies, the sessions are needed to be explain in detail.

Parkhouse and Ball[17] reported that six weeks (2 $d.wk^{-1}$ and 1 session 45 min) of both static and dynamic core training improved core performance and that static core training was more effective in improving static balance than dynamic core training. According to the results of our study and those obtained by Parkhouse and Ball,[17] we concluded that if dynamic balance needed to be improved, athletes, physiotherapists, or trainers should use dynamic core exercises. After six weeks of both static and dynamic core training, core performance improvement was explained by Parkhouse and Ball[17] as reducing fatigue in the core musculature and allowing the athlete more neuromuscular control during balance.

A core stability training of six weeks (2 $d.wk^{-1}$ and 1 session 60 min) improved flexibility and dynamic postural stability, which was evaluated by the eight-direction limits of stability in healthy collegiate female students.[30] Cho et al.[11] reported that four weeks of core exercise (3 $d.wk^{-1}$ and 1 session 30 min, no information about static or dynamic core exercises) was effective in increasing active range of motion of trunk flexion in patients with chronic low back pain. In addition, Akuthota and Nadler[31] found that basic core stabilization exercises comprising curl-up, side bridge, and bird dog improved lumbar stability by recovering the ability to control muscles and movement through muscle strengthening. According to Sekendiz et al.,[27] 12 weeks (3 $d.wk^{-1}$ and 1 session 45 min) of Swiss-ball core strength training improved core muscular strength, endurance, flexibility, and dynamic balance (functional reach test) in sedentary women. Improvement in dynamic balance and lower back flexibility (sit and reach test) explained by Sekendiz et al.[27] was as follows: *(i)* the Swiss-ball core strength training protocol could not only facilitate the global muscles, but also facilitate the local muscle groups of the core; and *(ii)* the improved flexibility could be related to the dynamic exercises performed on the Swiss-ball that provided an increased range of movement. On the other hand, Cosio-Lima et al.[32] reported that a core exercise program of five weeks (5 $d.wk^{-1}$ and 1 session 15 min) using the physioball resulted in greater gains in the torso balance and electromyographic (EMG) neuronal activity in previously untrained women compared to performing exercises on the floor. Improving core stability after core exercise programs was explained by Wolfson et al.[33] as short-term exposure in which altered sensory input resulted in a significant improvement in sway control, inhibited inappropriate motor responses, and improved core stability.

Contrary to Sekendiz et al.[27] and Cosio-Lima et al.,[32] a systematic review argued that although core stability or traditional core exercise with a ball/device was commonly considered useful to increase the activity of core muscles,[34] the lumbar multifidus EMG activity was similar during ball/device exercise and core stability exercises without a ball/device.[34] Martuscello et al.[34] also suggested that free weight exercises such as squat and deadlift were optimal to produce activity of the lumbar multifidus muscle, and no specific type of exercise appeared to be more effective than another at producing activity of the transverse abdominis muscle. Therefore, strength and conditioning specialists should focus on prescribing multi-joint free weight exercises rather than core-specific exercises for athletes and fitness participants to train core muscle.[34]

Currently, another popular type of core exercise is unstable surface exercise.[10,17] Greater activation of core muscles was reported ,when similar exercises were performed while on an unstable surface, as opposed to a stable surface.[10] However, Granacher et al.[14] reported that if the goal was to enhance physical fitness, unstable surface core exercises had no advantage over stable surface exercises.

Based on these findings, there is no optimal type of core exercise accepted as feasible, safe, and effective for improving health and physical fitness. Therefore, the request from fitness participants or athletes may best determine the types or core exercises (stable or unstable surface, floor exercises or ball/device exercises, free weight exercises, etc.).

Furthermore, the results of the present study should be evaluated with its limitation. We used the functional reach test to determine spinal stability although the age of our participants was around 36 years and this test is more suitable for middle-aged or older patients. Therefore, if this study was performed with older participants and the same study design, different results could be obtained. Another limitation of the study is its sample size. This study involved 34 women in a single center. Also, a power analysis was unable to be done to determine the sample size of the study due to a lack of any reference apart from the study by Parkhouse and Ball.[17]

In conclusion, our study results show that both static and dynamic core exercises over a six-week period are able to effectively increase dynamic balance, spinal stability, and hip mobility in female office workers. Since static or dynamic core exercises have no advantage over each other, both types of exercise can be applied to improve spinal stability, hip mobility, and dynamic balance by fitness participants and physiotherapists. However, dynamic core exercises may be more effective than static core exercises in improving right and left leg anterior balance. Therefore, fitness instructors, trainers, and physiotherapists should design core exercise programs according to their fitness participants or sports-specific tasks for athletes.

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