Swiss ball exercise reduces post exercise blood pressure in healthy young adults

El ejercicio con pelota suiza reduce la presión arterial después del ejercicio en adultos jóvenes sanos

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Abstract

Introduction: Swiss ball exercise has been associated with benefits related to various conditions. However, there is little information with regard to its effects on blood pressure particularly post exercise.
Objective: To evaluate the acute effects of Swiss ball exercise on vital functions in healthy subjects.
Methodology: This was an interventional study. Participants were randomly assigned to either the control or Swiss ball exercise group. The control group was asked to lie quietly for 60 minutes, while the exercise group engaged in a 60-minute exercise session with a ball exercise. The outcomes were systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), heart rate (HR), oxygen saturation, and Borg's scale of perceived exertion score. These parameters were measured at baseline and 0, 15, 30, 45, and 60 minutes after the intervention.
Results: There were 112 participants in this study, with 56 in each group. After the 60-minute intervention, there were four factors that differed between the two groups including HR at baseline, SBP, oxygen saturation, and post-intervention Borg's scale scores. Systolic blood pressure in the ball exercise group differed significantly from baseline at 0, 15-, and 30-minutes post intervention, and from 0 minutes after intervention at 15-60 minutes post intervention.
Conclusions: Swiss ball exercise resulted in significant post exercise blood pressure reduction particularly SBP.

Keywords

Exercise; heart rate; oxygen saturation; systolic blood pressure.

Resumen

Introducción: El ejercicio con pelota suiza se ha asociado con beneficios en diversas afecciones. Sin embargo, existe poca información sobre sus efectos sobre la presión arterial, especialmente después del ejercicio.
Objetivo: Evaluar los efectos agudos del ejercicio con pelota suiza sobre las funciones vitales en sujetos sanos.
Metodología: Este fue un estudio de intervención. Los participantes fueron asignados aleatoriamente al grupo control o al grupo de ejercicio con pelota suiza. Al grupo control se le pidió que permaneciera en reposo durante 60 minutos, mientras que el grupo de ejercicio realizó una sesión de 60 minutos con pelota. Los resultados fueron la presión arterial sistólica (PAS), la presión arterial diastólica (PAD), la presión arterial media (PAM), la frecuencia cardíaca (FC), la saturación de oxígeno y la escala de Borg de percepción del esfuerzo. Estos parámetros se midieron al inicio y a los 0, 15, 30, 45 y 60 minutos después de la intervención.
Resultados: Hubo 112 participantes en este estudio, 56 en cada grupo. Tras la intervención de 60 minutos, se observaron cuatro factores que difirieron entre los dos grupos: la frecuencia cardíaca basal, la presión arterial sistólica (PAS), la saturación de oxígeno y las puntuaciones de la escala de Borg tras la intervención. La presión arterial sistólica en el grupo de ejercicio con pelota difirió significativamente con respecto a la basal a los 0, 15 y 30 minutos tras la intervención, y con respecto a los 0 minutos tras la intervención a los 15-60 minutos.
Conclusiones: El ejercicio con pelota suiza produjo una reducción significativa de la presión arterial tras el ejercicio, en particular de la PAS.

Palabras clave

Ejercicio; polígrafo; saturación de oxígeno; presión arterial sistólica.

Introduction

Exercise has shown to reduce risks of obesity which may relate to several conditions such as hypertension. Various sets of guidelines have been published that recommend regular, long-term exercise in order to prevent and treat high blood pressure (Whelton et al., 2018; Williams et al., 2018). However, studies have also found that even a single exercise session can result in post exercise hypotension and lower blood pressure (da Silva et al., 2013; van Assche et al., 2017). Persistent vasodilatation of the muscle has been postulated as a possible mechanism behind post exercise hypotension (L. R. Souza et al., 2018). A previous study showed that isometric handgrip exercise reduced systolic blood pressure by 5.4 mmHg at 7 hours after exercise (van Assche et al., 2017). Lowering of blood pressure after isometric handgrip exercise was found in various other settings: hypertension and elderly patients (Lawrence et al., 2015; Millar et al., 2013; L. R. Souza et al., 2018). This acute effect of exercise may contribute to long-term blood pressure reduction (Halliwill et al., 2013)

Swiss ball exercise is a sport recreation (Keskin et al., 2024; Ramos-Álvarez et al., 2024) and has been associated with benefits related to various conditions (Rojhani-Shirazi et al., 2017; M. C. de Souza et al., 2017; Young et al., 2015). For example, one study found that a 6-week Swiss ball exercise program improved functional reach test from 24.93 cm to 27.18 cm and reduced timed up and go test times from 21.82 sec to 20.15 sec in elderly subjects with chronic back pain (Young et al., 2015). In addition to these clinical benefits, Swiss ball exercise also improves balance/trunk stabilization and engages more muscles than exercises on hard surfaces (Kim, 2016; Lee et al., 2016; Srivastav et al., 2016; Vera-Garcia et al., 2000; Yu et al., 2017). It also has been shown to be beneficial in some diseases such as scoliosis or fibromyalgia (Arakaki et al., 2021; Song et al., 2015). However, there is little information with regard to its effects on blood pressure particularly post exercise. This study thus aimed to evaluate the acute effects of Swiss ball exercise on vital functions in healthy subjects.

Method

Participants

This was an interventional study conducted at the Khon Kaen University Faculty of Associated Medical Sciences Department's research unit, Thailand. The inclusion criteria were age between 18 and 25 years and normal blood pressure. Subjects with any of the following conditions were excluded: respiratory diseases such as asthma, COPD, or pulmonary embolism; cardiac diseases such as heart failure or hypertension; neurological diseases such as stroke, epilepsy, or head trauma; psychiatric disorders; infectious diseases; metabolic/endocrine diseases such as diabetes or thyroid disorders; musculoskeletal diseases such as osteoporosis or osteoarthritis; and severe pain with a visual analog score greater than 5. Patients who were on antihypertensive medications, had ingested caffeine within 24 prior to the intervention, had slept less than 6 hours during the night prior to the intervention, smoked, or engaged in exercise more than 3 times/week were also excluded.

Procedure

Eligible participants were randomly assigned to either the control or Swiss ball exercise group. The intervention was performed between 4 and 6 pm. The control group was asked to lie quietly for 60 minutes, while the exercise group engaged in a 60-minute exercise session consisting of a 15-minute warm-up, 30 minutes of ball exercise, and 15 minutes of relaxation. Warm-up exercises consisted of nine postures: camel pose on the ball, cat stretch, seated side stretch, sphinx on the ball, ball above the head, ball circumduction, dragging of the feet with the ball, trunk rotation with the ball, and bouncing on the ball. The ball exercises consisted of two set of the following 10 postures: seated hip roll, rotating knee raise, side twist, straight-leg deadlift, kneeling rotation, knee raise, side-to-side reach, fly to pull over, around the world, and roll-out. The relaxation period consisted of 8 postures: bouncing on the ball, ball above the head, ball circumduction, camel pose on the ball, cat stretch, seated side stretch, sphinx on the ball, and breath control.

All patients' baseline body mass index and fat, water, and muscle percentages were measured prior to intervention. The outcomes of this study were systolic blood pressure (SBP), diastolic blood pressure

(DBP), mean arterial blood pressure (MAP), heart rate (HR), oxygen saturation, and Borg's scale of perceived exertion score. These parameters were measured at baseline and 0, 15, 30, 45, and 60 minutes after the intervention.

Data analysis

Descriptive statistics were used to determine means (SD) and percentages. Data were compared between the two groups using a Student's t test or chi-squared test where appropriate. A generalized estimating equation (GEE) was used to evaluate differences between the two groups at various points in time. Within-group differences were calculated using a general linear model. Statistical analyses were performed using STATA (College Station, Texas, USA).

Results

There are 112 participants in this study, with 56 in each group. The baseline characteristics of patients in each group are comparable, as shown in Table 1. After the 60-minute intervention, there are four factors that differed between the two groups including HR at baseline, SBP, oxygen saturation, and post-intervention Borg's scale scores (Table 2). The ball exercise group has higher mean SBP (115.4 vs 110.0 mmHg) and Borg's scale score (11 vs 6) but lower HR (70.4 vs 75.2 bpm) and oxygen saturation (97.0 vs 98.1%) than the control group, as shown in bold in Table 2.

In terms of same-group comparison, participants' scores in both groups differ significantly at various points, with the exception of Borg's scale scores in the control group (Table 2). Systolic blood pressure in the ball exercise group differs significantly from baseline at 0, 15, and 30 minutes post intervention, and from 0 minutes after intervention at 15-60 minutes post intervention. Similar differences are found in terms of HR and oxygen saturation, except that there is no difference in these measurements at baseline and 0- minute post intervention. In the control group, SBP, HR, and oxygen saturation differ from baseline significantly at 0-minute post intervention.

Table 1. Baseline characteristics of healthy participants in the ball exercise and no exercise groups.

Variables	No exercise group (n=56)	Ball exercise group (n=56)	P-value
Male sex, n (%)	24 (42.8)	24 (42.8)	0.99
Age (years)	20.2 ± 1.4	20.3 ± 1.5	0.77
Height (centrimetre)	164.6 ± 7.9	163.9 ± 7.1	0.51
Weight (kilogram)	58.0 ± 8.5	57.4 ± 9.4	0.66
Body Mass Index (kilogram/metre^2)	21.3 ± 2.3	21.3 ± 2.6	0.88
Fat (%)	15.6 ± 2.3	14.4 ± 4.6	0.18
Water (%)	59.1 ± 5.4	60.3 ± 4.8	0.11
Muscle (%)	62.4 ± 6.0	63.7 ± 5.3	0.18

Note. Data presented as mean ± SD, unless indicated otherwise.

Table 2. Outcomes of healthy participants in the ball exercise group (EG) and no exercise group (CG) at baseline and after intervention.

Outcomes	Group	Baseline	0 min	15 min	30 min	45 min	60 min
SBP	CG	114.1±9.2	110.0±8.5*	111.4±9.8	111.2±9.7	111.7±8.5	111.9±9.7
	EG	112.5±7.7	115.4±8.5*	108.9±7.9*#	108.2±7.3*#	109.9±6.7#	109.8±7.2#
DBP	CG	71.0±7.4	71.0±8.0	71.2±7.9	71.7±7.3	72.3±6.7	73.6±7.9#
	EG	70.0±6.8	72.4±6.9*	67.8±4.9#	69.4±7.5	69.7±7.7	71.0±7.8$
MAP	CG	85.3±7.2	84.0±7.6	84.6±7.8	84.9±7.6	85.4±6.6	86.3±7.9#
	EG	84.0±6.5	86.7±6.6*	81.5±5.1#	82.4±6.3#	83.1±6.1#	84.0±6.6$
HR	CG	75.2±12.3	70.0±10.0*	69.4±8.8*	67.6±8.5*	67.8±9.4*	69.5±10.0*
	EG	70.4±10.3	73.5±10.0*	66.8±9.2*#	65.7±9.6*#	64.9±9.3*#	65.4±7.9*#
O2 sat	CG	97.0±1.7	98.1±1.2*	98.1±1.1*	98.1±1.1*	98.2±1.4*	98.2±1.2*
	EG	97.4±1.5	97.0±1.6	98.2±1.0*#	98.0±1.3#	98.2±1.2*#	98.5±1.0#
Borg's scale	CG	6±0	6±0	6±0	6±0	6±0	6±0
	EG	6±0	11±1.3	6±0	6±0	6±0	6±0

Note. SBP: systolic blood pressure, mmHg; DBP: diastolic blood pressure, mmHg; MAP: mean arterial blood pressure, mmHg; HR: heart rate, bpm; O2 sat: oxygen saturation, %; CG: control group; EG: experiment group; * indicates significant difference from baseline; # indicates significant difference from 0 minutes after intervention; $ indicates significant difference from 15 minutes after intervention; bold type indicates significant difference between groups.

Discussion

This study shows 30 minutes of Swiss ball exercise to be beneficial; in that it results in persistent post exercise hypotension in SBP and HR from 15 minutes to 60 minutes (Table 2).

Although long-term engagement in a regular Swiss ball exercise regimen has been shown to result in reduction of blood pressure (da Silva et al., 2013), no previous study has evaluated its acute cardiovascular effects. This study finds that the 30 minutes of Swiss ball exercise immediately and significantly increases SBP and lowers oxygen saturation (bold, Table 2). Additionally, SBP, HR, and oxygen saturation differ significantly from baseline with the maximum of 60 minutes in HR (Table 2).

We also find an acute rise in SBP after this type of exercise (112 to 115 mmHg), but to a lesser extent than in a previous study that employs isometric handgrip exercise (134 to 144 mmHg) (van Assche et al., 2017). This difference may be explained by differences in the study populations, as the previous study enrolled pre-hypertension patients resulting in higher baseline SBP. In addition, while our study finds that SBP in the Swiss ball group is lower at 30 minutes post exercise than at baseline (112.5 vs 108.2 mmHg), SBP at 30 minutes post isometric exercise in the previous study does not differ that at baseline (133.9 vs 134.0 mmHg) (van Assche et al., 2017). This suggests that Swiss ball exercise, but not isometric exercise, results in acute SBP reduction, meaning that post exercise hypotension effects may vary by type of exercise. The post exercise hypotension findings in this study may have resulted from a reduction in post exercise HR, which was found at up to 60 minutes.

Although this study demonstrated the beneficial effects of Swiss ball exercise in terms of acute post exercise hypotension, there are some limitations. First, we do not evaluate long-term post exercise hypotension, as does in the previous study mentioned above, in which SBP is shown to be significantly lower at 7 hours post isometric exercise (van Assche et al., 2017). However, we believe that engaging in Swiss ball exercise would yield similar results. Second, this study is conducted in young, healthy subjects, rather than pre-hypertensive subjects as in the previous study, and may thus not be generalizable to other age groups or populations. Finally, it may not be able to compare to other exercise or conditions such as gender or obesity groups (Chávez et al., 2021; Franco et al., 2023; Putra et al., 2024).

Conclusions

Swiss ball exercise resulted in significant post exercise hypotension particularly SBP from 15 minutes to 60 minutes. Further studies were required to confirm the results of this study and apply in other study populations particularly those with hypertension.

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