

## Abstract

**PURPOSE:** Aerobic exercise is recommended for blood pressure control rather than resistance exercise. However, resistance exercise is gaining prominence, particularly isometric exercise. The purpose was to compare the cardiorespiratory responses to whole body isotonic (IT) and isometric (IM) resistance exercises. **METHODS:** 8 normotensive males (21 ± 2 years) completed one familiarisation session, then an IM and IT session in a counter-balanced order, each separated by at least 72 hours. 10-repetition maximum (10-RM) for each exercise was determined in the familiarisation session. IM were held in the mid-range for 40 seconds and IT were performed for 10 repetitions with 2 seconds concentric and 2 seconds eccentric. Single sets of dumbbell lunge, barbell bench press, barbell squat, bent-over barbell row, and dumbbell shoulder press were performed, with 150 seconds rest between exercises. Oxygen uptake ( $\dot{V}O_2$ ) was collected continuously. Blood pressure (BP) and heart rate (HR) were recorded post-exercise. Rate-pressure product (RPP) was calculated from HR and BP. Energy expenditure (EE) was calculated from  $\dot{V}O_2$ . Repeated measures analyses were applied to the data. **RESULTS:** Mean EE was significantly greater during IT (6.14 ± 0.65 kcal) than IM (4.52 ± 0.73; p=0.024), with EE greater during IT compared to IM for lunge (6.86 ± 1.55 v 4.98 ± 0.92 kcal; p=0.033), squat (8.32 ± 1.80 v 4.54 ± 1.14 kcal; p=0.002), and row (6.66 ± 0.82 v 5.36 ± 0.77 kcal; p=0.001). Mean systolic BP (137 ± 12 v 134 ± 11 mmHg; p=0.609) and diastolic BP (73 ± 13 v 73 ± 4 mmHg; p=0.923) were not significantly different between IT and IM for the five exercises. Mean RPP was not significantly different between IT (18086 ± 2764) and IM (16879 ± 2386; p=0.300), but was significantly greater during squat in IM (18668 ± 2217) and IT (20080 ± 4017) compared to bench press in IM (15023 ± 2324; p=0.025) and IT (15858 ± 2379; p=0.003). Systolic BP was not significantly reduced 60 minutes following IT (-8 ± 9 mmHg; p=0.053) and IM (-10 ± 15 mmHg; p=0.105) or diastolic BP (-0 ± 9 mmHg; p=1.000) following IT, however diastolic BP significantly reduced following IM (-10 ± 11 mmHg; p=0.028). **CONCLUSION:** An IT resistance exercise session induced significantly greater energy expenditure while an IM resistance exercise session induced significantly greater post-exercise diastolic hypotension.

## Introduction

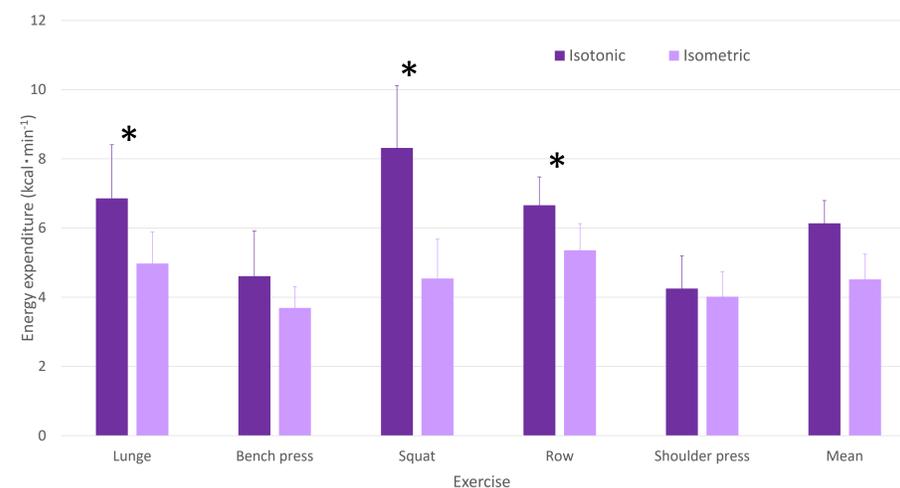
- Aerobic exercise is generally recommended for blood pressure control rather than resistance exercise as a stand alone exercise approach<sup>1</sup>.
- However, resistance exercise is gaining prominence as a non-pharmaceutical anti-hypertensive agent, particularly isometric exercise (IM)<sup>2</sup>.
- The majority of resistance training intervention studies utilise whole body isotonic (IT) resistance training methods to promote healthful adaptations<sup>3</sup> whereas the majority of isometric exercise interventions utilise handgrip or knee extensor exercises<sup>4</sup>.
- Therefore the purpose of this study was to compare the cardiovascular and respiratory responses to whole body IM versus IT resistance exercise sessions.

## Methods

- 8 normotensive males (21 ± 2 years) completed one familiarisation session, then an IM and IT session in a counter-balanced order, each separated by at least 72 hours. 10-repetition maximum (10-RM) for each exercise was determined in the familiarisation session.
- IM were held in the mid-range for 40 seconds and IT were performed for 10 repetitions with 2 seconds concentric and 2 seconds eccentric.
- Single sets of dumbbell lunge, barbell bench press, barbell squat, bent-over barbell row, and dumbbell shoulder press were performed, with 150 seconds rest between exercises.
- Oxygen uptake ( $\dot{V}O_2$ ) was collected continuously. Blood pressure (BP) and heart rate (HR) were recorded immediately after each exercise and during post-exercise. Rate-pressure product (RPP) was calculated from HR and BP. Energy expenditure (EE) was calculated from  $\dot{V}O_2$ .
- Repeated measures analyses were applied to the data.

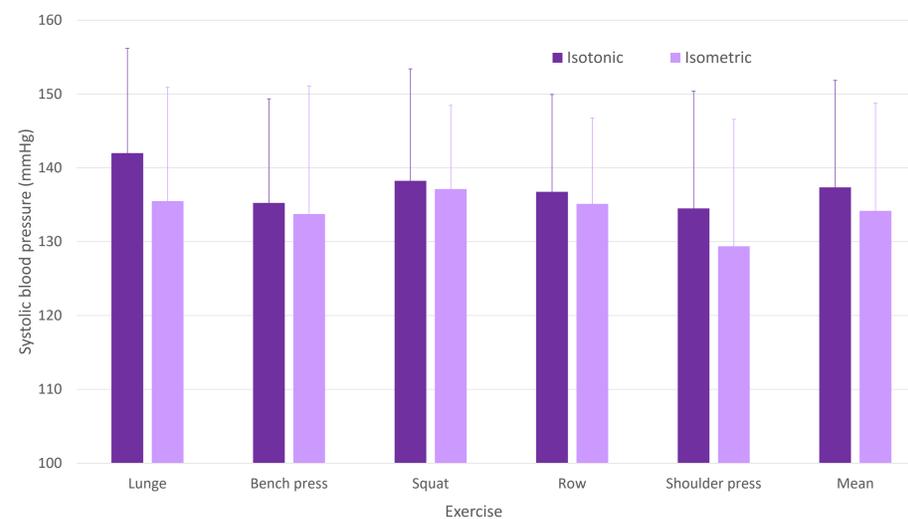
## Results

- Mean EE was significantly greater during IT (6.14 ± 0.65 kcal) than IM (4.52 ± 0.73; p=0.024), with EE greater during IT compared to IM for lunge (6.86 ± 1.55 v 4.98 ± 0.92 kcal; p=0.033), squat (8.32 ± 1.80 v 4.54 ± 1.14 kcal; p=0.002), and row (6.66 ± 0.82 v 5.36 ± 0.77 kcal; p=0.001) (Figure 1).



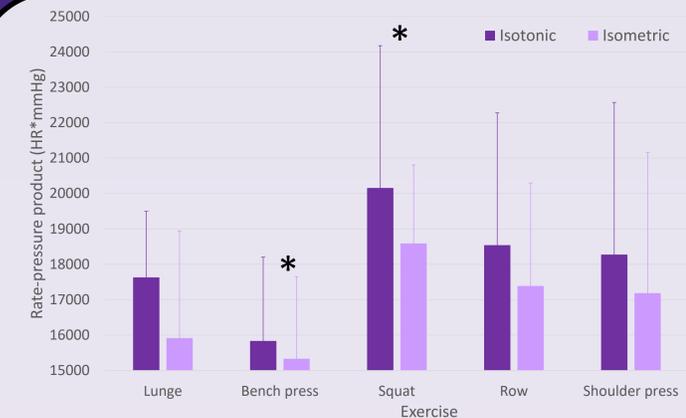
**Figure 1** Energy expenditure during isotonic versus isometric resistance exercise

- Mean systolic BP (137 ± 12 v 134 ± 11 mmHg; p=0.609) and diastolic BP (73 ± 13 v 73 ± 4 mmHg; p=0.923) were not significantly different between IT and IM for the five exercises (Figure 2).



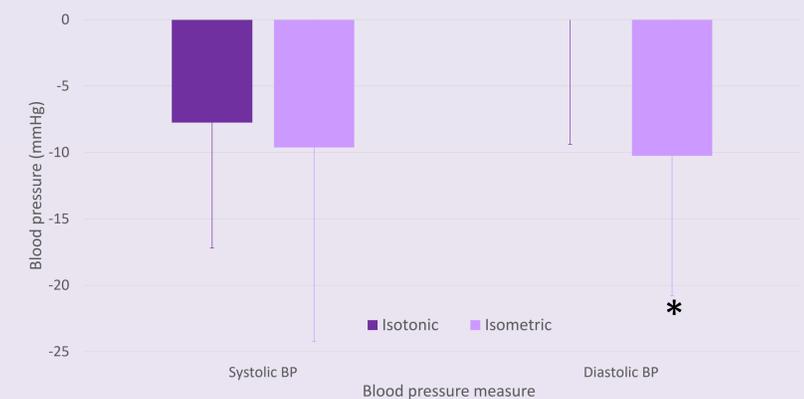
**Figure 2** Systolic blood pressure responses to isotonic versus isometric resistance exercise

- Mean RPP was not significantly different between IT (18086 ± 2764) and IM (16879 ± 2386; p=0.300), but was significantly greater during squat in IM (18668 ± 2217) and IT (20080 ± 4017) compared to bench press in IM (15023 ± 2324; p=0.025) and IT (15858 ± 2379; p=0.003) (Figure 3).



**Figure 3** Rate-pressure product during isotonic versus isometric resistance exercise

- Systolic BP was not significantly reduced 60 minutes following IT (-8 ± 9 mmHg; p=0.053) and IM (-10 ± 15 mmHg; p=0.105) nor diastolic BP (-0 ± 9 mmHg; p=1.000) following IT, however diastolic BP was significantly reduced 60 minutes following IM (-10 ± 11 mmHg; p=0.028) (Figure 4).



**Figure 4** Post-exercise hypotension 60 minutes following isotonic versus isometric resistance exercise

## Conclusion

- Isotonic resistance exercise induced significantly greater energy expenditure than isometric resistance exercise.
- Isometric resistance exercise induced significantly greater post-exercise diastolic hypotension without significantly elevating BP or RPP during exercise compared to isotonic resistance exercise.
- Future research should compare the effects of IM to IT resistance training interventions on metabolic and cardiovascular health.

## References

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