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ORIGINAL RESEARCH

EQUIPMENT-BASED PILATES INDUCES A CARDIOVASCULAR RESPONSE IN OLDER ADULTS; AN OBSERVATIONAL CLINICAL TRIAL.

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ABSTRACT

Introduction: Pilates improves the postural balance, strength and flexibility of older adults, but cardiovascular responses while using equipment-based Pilates is not known.

Methods: Regular Pilates participants over the age of 60 with stable blood pressure were invited to join the study, and were excluded if they took beta blocker medication. The cardiovascular effects of equipment-based Pilates classes were assessed by measuring participant's heart rates (HR) using Polar HR monitors (Polar TEAM2 Software) and rating of perceived exertion (BORG 6-20) during a regular Pilates class. After a mat based warm up, seven exercises (using reformer, trapeze, Wunda chair and core-align) were performed for five minutes each in a circuit format, and averaged HR was recorded for each epoch and the whole class. Calculations for each participant's individual workload were based on percentage of estimated maximal heart rate (training zone = 55% of MHR). After all exercises were complete, participants gave a rating of perceived exertion indicating how strenuous the session was.

Results: Eighteen healthy older adults (70.7(4.2) years; resting heart rate 63(6.0) bpm) completed the study. Average exercising heart rate was 87(8) bpm for the 35 minutes of equipment exercise. Participants spent an average 22.6 (9.9) minutes within their training zone. Exercises in standing positions produced a significantly greater cardiovascular effect with an average of 3.7(1.8) minutes per exercise in the training zone compared to supine exercises with 2.2(1.9) minutes in the training zone (P=0.0001). Overall perceived exertion was 12.7(1.7) ranging from 10 (light) to 16 (hard).

Conclusion: Exercises using the large lower body muscles and resistance from Pilates equipment elevates the heart rate into the training zone in older adults. Potential exists to design Pilates classes to meet multiple components of the exercise guidelines that apply to older adults.

Keywords: heart rate; physical activity; resistance training

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INTRODUCTION

With all of the known benefits of exercise, the lack of engagement of older adults in exercise of all types is of enormous concern to exercise professionals and other health care providers in our community. Exercise has been shown in older adults to reduce the incidence of accidental falls,[1] common chronic diseases and all-cause mortality;[2] however participation in relevant types of exercise is low. Current guidelines recommend participation in cardiovascular, resistance[3] and balance[4] or agility or flexibility training. Cardiovascular exercise participation is recommended at a minimum of 150 minutes a week and participation at this level for older adults is between 20.1% and 38.8%.[5] The percentage of older adults meeting the resistance training guidelines of 2 sessions a week for major muscle groups is reported at 12%, and balance training recommended at one hour per week; only 6% of older adults meet this guideline.[6]

Nearly 90% of older adults have at least one barrier to exercise.[7] These barriers are different from those experienced by younger adults.[8] Potential barriers to participation in relevant exercise for older adults include the time it takes to perform exercises[9] as well as knowledge of the types of exercise to perform and perceived enjoyment of exercise.[10] As well, older adults are sometimes concerned about the level of exertion that cardiovascular exercise requires, and health is cited as a common cause for not participating in physical activity.[11]

Pilates is a popular form of exercise, and includes a large repertoire of exercises that can be performed without any equipment on a mat, or using spring-based resistance equipment. Pilates is delivered in both individual tailored situations, as well as group classes, and these differences in delivery may account for the different outcome results that are reported in research trials. Current research pertaining to Pilates in the literature presents mixed findings on many outcomes of interest. Benefits to static and dynamic balance and mobility in older adults have been confirmed.[12,13] The flow on effect to reductions in fall rates is still awaiting confirmatory research.[12] The impact on cardio-metabolic health and strength has produced mixed results.[13] Other benefits include improvements in flexibility and quality of life,[14] perhaps providing some indication as to why participation in this type of exercise is growing.

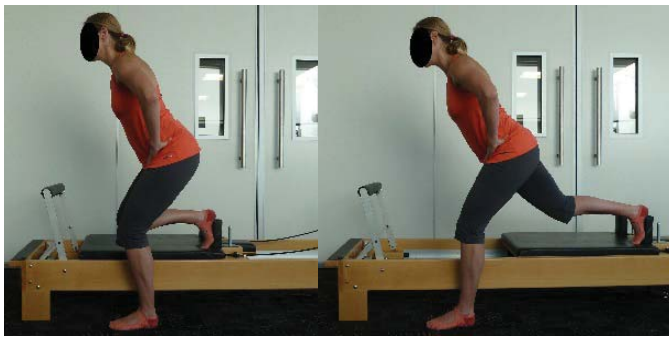
Evidence of the impact of Pilates on cardiovascular health in older adults is limited to one study that was performed using mat exercises without any resistive equipment. Cardiovascular health can be positively impacted on by working at a level of intensity that induces an increase in heart rate, with cardiovascular training zones for older adults defined as increasing heart rate to greater than 55% of age-predicted maximal heart rate. [3] Reductions in systolic blood pressure were seen after an 8-week Pilates mat training program, however other parameters that would indicate improved cardiovascular function (like resting heart rate) did not improve.[15]

The aim of this study was to determine if Pilates exercises that are performed on equipment, in a class that is designed to improve fall risk factors (such as balance and lower limb strength), would also have a cardiovascular training effect. The hypothesis that these exercises would not elevate heart rate to a sufficient level for a cardiovascular training benefit was tested.

METHODS

Participants were recruited from the University Exercise Clinic, which runs seven 60-minute classes of mat and equipment based Pilates for older adults each week. Participants were experienced in this class format. All participants had previously completed health screening using a general medical questionnaire, identification health conditions, medications and functional limitations. Participants over the age of 60 with stable blood pressure were invited to join the study, and were excluded if they took beta blocker medication. Demographic data (age, gender) and a brief history of cardiac health and medication use was recorded. Heart rate data was collected from between two to six participants per class over two weeks of classes. Staffing and class format were consistent across this time period. The cardiovascular effects of equipment-based Pilates classes were assessed by measuring participant's heart

Figure 1. Description of exercises in the intervention

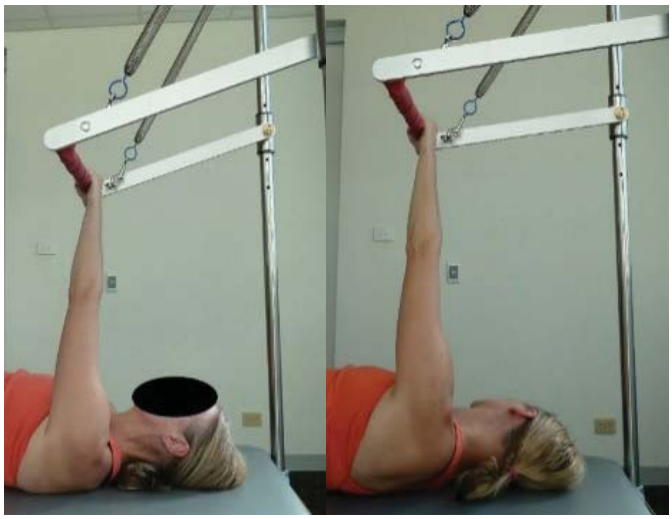


a) Scooter: Standing resisted hip extension performed on the Reformer. Variations included hands on footbar, standing upright hip extension only, hands off footbar. Aims are to improve hip extensor strength and hip disassociation.

b) Ladder Barrel: Standing supported thoracic extension and lateral flexion performed on the Ladder Barrel. Variations included Regressed Swan, Lateral Flexion Stretch and Regressed Side Sit Up. Aims are to improve mobility and strength in thoracic spine.

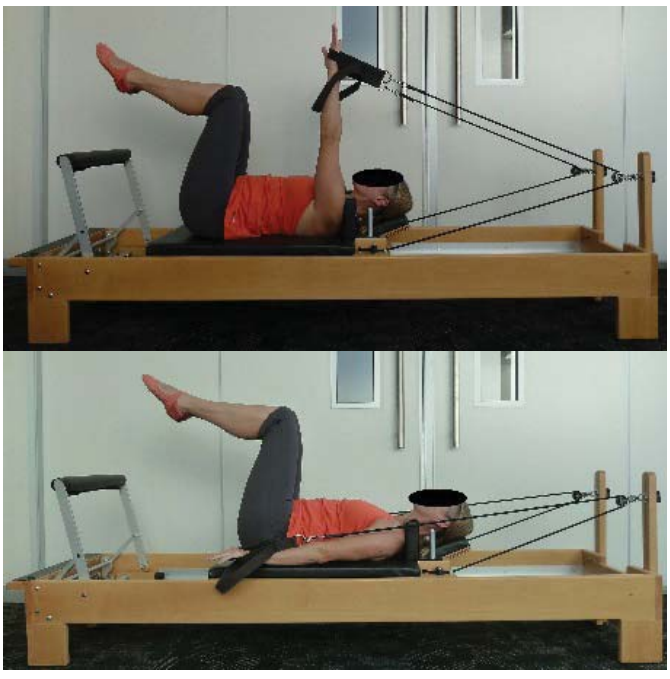
c) Standing Leg Pump: Standing resisted hip and knee extension and resisted hip and knee flexion performed on Wunda Chair. Variations included facing front, facing side ER & facing side crossover. Aims are to teach hip disassociation and improve lower extremity strength and balance.

d) Arm Series Facing Out: Standing resisted upper extremity exercises performed at the end of the Trapeze Table. Variations included Punching, Punching with Lunge (contralateral & ipsilateral) & Hug-a-Tree. Aims are to improve upper extremity strength, shoulder girdle control and coordination.



e) Supine Scapular Series: Supine lying assisted scapular protraction and elevation, resisted scapular retraction and depression and assisted/ resisted thoracic rotation exercise performed on the Trapeze Table with Tower Bar. Variations included protraction/retraction only, elevation/ depression only, p/r & e/d combination & rotation. Aims are to improve scapular control and mobility of thoracic spine.

f) Side Split Series: Standing resisted hip abduction with assisted hip adduction (heavy band tension) and assisted hip abduction with resisted hip adduction (light band tension), performed on the Core Align. Variations included straight legs, quarter squat, single leg quarter squat. Aims are to improve hip abductor and adductor strength and hip disassociation.



g) Supine Arm Series: Supine lying resisted upper extremity strength exercises performed on the Reformer. Variations included arcs, T, circles both directions, triceps press. Aims are to improve upper extremity strength, improve mobility and challenge core control.

rates (HR) using Polar HR monitors (Polar TEAM2 Software) and rating of perceived exertion (RPE) (BORG 6-20) during a regular Pilates class at the University Exercise Clinic. Informed written consent was gained before participation. This project was approved by the Tasmanian Health and Medical Research Ethics Committee (H0015313).

INTERVENTION

Each class consisted of both mat and equipment based exercises, with heart rate data for this study recorded and analysed for the equipment section only. After a mat based warm up, seven exercises (using reformer, trapeze, wunda chair and core-align) were performed for five minutes each in a circuit format (Figure 1) in a continuous manner. The order of exercises was the same in each class. Participants were not instructed to change their intensity over their usual exercise performance in class. The classes were supervised by an exercise scientist who is a certified practitioner of mat and studio Pilates (Certificate IV with Polestar™ International) and four years of teaching equipment based Pilates. Heart rate was recorded at rest before the class and then averaged for each minute of exercise. As well, heart rate averages for each different exercise epoch of five minutes and the whole class were calculated. The sampling rate of data collection from the monitors was every 15 seconds. After all exercises were complete, participants used a Borg scale of perceived exertion, to indicate how strenuous the session was.

DATA ANALYSIS

Each participant's training zone was calculated as 55%-70% of age predicted maximal heart rate. This was used to determine the amount of time that participants were in their training zone during each exercise and for the whole class. Researchers recorded the timing of use of equipment during the class to identify any changes in heart rate with particular types of exercise. Paired t-tests compared the exercises performed in standing to those performed in supine (see Figure 1).

RESULTS

Eighteen healthy older adults with controlled blood pressure (four male) with a mean age of 70.7(4.2) years participated in the study. Five people self-reported high blood pressure and two low blood pressure, with the rest documenting blood pressure within normal ranges. One participant recorded a history of palpitations, with no other cardiac history identified. Medication use was recorded, however ten participants were currently not taking prescription medication, two took one prescription daily, three took two medications and two took three

Table 1. Average heart rate, time spent in training zone and % maximum heart rate averaged for each exercise.

Pilates Exercise	Standing	Average HR	Minutes spent within training zone	Average % MHR
Scooter	Yes	92.9 (± 11)	4.3 (± 1.4)	62.2
Ladder Barrel variations	Yes	88.9 (± 8.0)	3.6 (± 1.9)	59.5
Standing Leg Pump variations	Yes	86.4 (± 7.9)	3.1 (± 2.1)	57.9
Arm Series Facing Out variations	Yes	92.9 (± 10.1)	4.2 (± 1.4)	62.2
Supine Scapular Series	No	77.3 (± 7.4)	1.1 (± 1.3)	51.8
Side Split Series variations	Yes	86.5 (± 9.5)	3.1 (± 1.9)	57.9
Supine Arm Series variations	No	85.3 (± 8.5)	3.3 (± 1.8)	57.1

medications daily. Resting heart rate mean was 63(6) bpm and mean exercising heart rate was 87(8) bpm for the 35 minutes of equipment exercise. Participants spent a mean time of 22.6(9.9) minutes within their training zone.

Exercises in standing positions produced a significantly greater cardiovascular effect with an average of 3.7(1.8) minutes per five minute exercise block in the training zone compared to supine exercises with 2.2(1.9) minutes in the training zone (P=0.0001). Overall perceived exertion was 12.7(1.6) ranging from 10 (light) to 16 (hard).

DISCUSSION

This study determined that Pilates exercises performed on resistive equipment, particularly in standing, can sufficiently elevate heart rate into a cardiovascular training zone in older adults. This data provides an important new perspective and contrasts to a previous review, which suggests that the lack of cardiovascular training effects, previously seen with Pilates, requires people to choose to add an additional component of aerobic training to their regime.[14] With evidence that Pilates can have an aerobic training benefit, it expands the capacity of this exercise modality to meet multiple health goals of older adults.

In this study, the exercises that produced the longest duration cardiovascular response were performed in standing or using spring-based resistance. Exercise in standing and moving over the base of support are also important for balance training.[1] Consequently, the goals of improving aerobic fitness and balance control can both be met while exercising in standing using exercises similar to those used in this class, providing efficiency in exercise delivery.

Exercises were performed with either resistive spring tension or body weight against gravity, which meant that the resistance training component of the recommendations for physical fitness are also able to be met in a single workout session. The guidelines for this multi-component exercise is supported universally with guidelines from Australia aligning with those suggested by the American College of Sports Medicine[16] and World Health Organisation's global recommendations for physical activity.[17] Very few other exercise regimes designed for motor control are able to meet resistance training guidelines and also impact on cardiovascular health, although a yoga intervention found long term improvements in cardiovascular health.[18]

Over fifty percent of older adults are considered sedentary and the lack of engagement of older adults in exercise of all types is a major concern.[5] Lack of time is an important barrier to exercise participation.[19] Exercise programs that can cater to multiple aspects of physical fitness may assist in overcoming this barrier. This drives a need for health professionals to design multicomponent exercise programs that are appealing to older adults to uptake.

Pilates is a popular form of exercise; in 1991, The Pilates Method Alliance reported 1.7 million Americans were practicing Pilates on a regular basis. These numbers have surged more than sixfold and in 2005 more than 11 million Americans were practicing regularly.[20] The moderate level of exertion reported in this study may be one reason why Pilates is appealing as an exercise modality to older adults. With over 14 000 instructors registered in the United States alone, there is potential to capitalise on this and expand the specific training of these instructors to deliver Pilates to older adults.

In this study, qualified instructors supervised small classes and this produced cardiovascular training effects not reported before. These results may not be generalisable to larger classes. However, the implications for health improvements warrant further research on the longitudinal benefits of Pilates on cardiovascular health.

CONCLUSION

This study determined that Pilates exercises performed on resistive equipment, particularly in standing, can elevate the heart rate into a cardiovascular training zone. Health professionals can structure Pilates classes to meet the overall needs of clients. This study adds to literature supporting the choices of older adults to help them meet their exercise needs.

PRACTICAL APPLICATIONS

- Instructors have the capacity to tailor Pilates classes to meet all components of physical activity guidelines – balance, resistance training and moderate aerobic conditioning. Classes that address multiple components of fitness may be appealing for the 'time poor' older adult.
- Instructors can maximise aerobic conditioning within Pilates programs by increasing the amount of time performing exercises in the standing position.
- Spring based Pilates equipment can be used to progressively overload the cardiovascular system for sustained aerobic conditioning within the older population.
- Specific Pilates exercises can be selected to optimize the amount of time spent in target heart rate zones when individualizing Pilates programs.

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