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A systematic review on research into the effectiveness of group-based sport and exercise programs designed for Indigenous adults

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Figures One
Abstract

Objectives: To evaluate research into the effectiveness of group-based sport and exercise programs targeting Indigenous adults on anthropometric, physiological and quality of life outcomes.

Design: A systematic review with quality assessment of study design.

Methods: A computer-based literature search of EBSCO, SPORTDiscus, CINAHL, Informit, Scopus, Web of Science, Medline, PubMed, Global Health, ProQuest and Discover databases was conducted. Methodological quality of individual articles was assessed using McMasters University Guidelines and Appraisal Forms for Critical Review for Quantitative Research. Results of the effectiveness of programs are then summarised.

Results: Six articles were identified with critical appraisal scores ranging from 6 – 12 (from a possible 15 points), with a mean score of 9.6. Five articles were of moderate to good quality. Significant improvements were observed in anthropometric, physiological and quality of life outcomes across all studies. Elements of successful group-based exercise and sport programs corresponded to global recommendations on physical activity for health for 18 to 64 year olds, and were implemented over a period of time ranging from 12 – 24 weeks to exhibit results, plus community consultation in developing programs and nutrition education.

Conclusions: Group-based programs that include nutrition, exercise and/or sport components are effective in producing short to intermediate term health outcomes among Indigenous adults. Further high quality research, specifically on group-based modified sport programs for Indigenous adults that are culturally appropriate and aim to improve quality of life are needed.

Keywords: Population groups, sports, physical fitness, program evaluation, health promotion
1. Introduction

Physical activity provides significant health benefits across the lifespan.\textsuperscript{1, 2} Competitive activity such as sport has been shown to contribute to general health,\textsuperscript{3, 4} mobility and wellbeing as people age.\textsuperscript{5} In particular, team sports played in a community-based environment have added benefits including social support, comradeship and skill development through the interactions and skills required in teamwork and when modified to cater for the specific needs and safety of people can be successful in promoting and sustaining physical activity.\textsuperscript{6, 7} Furthermore, modified sports may offer a more diverse range of physical activity opportunities for people, including Indigenous people.

Sport, through the facilitation of social networks and cultural capital,\textsuperscript{8} is of particular importance for Indigenous people, where it is suggested that sport creates a vehicle to connect across generations.\textsuperscript{9} This activity can engage Indigenous adults as role models, encouraging the abilities of men to lead, motivate and challenge those younger than themselves\textsuperscript{9} and for women to take control and seize opportunities.\textsuperscript{10} The sharing of knowledge and wisdom to younger generations is important to the Indigenous culture\textsuperscript{9, 10} where historically the younger generation were prepared for a life as hunters and gatherers by playing games.\textsuperscript{11} Furthermore, sport teaches life skills including self-reliance, discipline and cooperation\textsuperscript{11} that contribute to developing a socially cohesive environment which is the foundation of Indigenous communities. Sport, through these connections can provide a healthy path to adulthood, bridge the health divide and have an impact on the health\textsuperscript{9, 10} and longevity\textsuperscript{12} of all Indigenous adults. Furthermore, bridging the health divide is also of importance to governments as evidenced in a committed effort to risk factor prevention and chronic disease management by the Australian government.\textsuperscript{12} With the national estimated life expectancy at birth for Indigenous males being 69.1 years and females 73.7 years, 10.6 years and 9.5 years lower than for non-Indigenous males and females respectively\textsuperscript{13} being contributed largely to chronic diseases.\textsuperscript{12} Providing opportunities for Indigenous people to participate in sport is a way to increase physical activity, where in Australia, physical inactivity rates are substantially higher at an average of 70\%\textsuperscript{14} for Indigenous Australian adults compared to less than 50\% for their non-Indigenous counterparts. Furthermore, studies have
shown physical activity to be beneficial in improving general health\textsuperscript{1, 2} and obesity, diabetes and heart disease outcomes,\textsuperscript{9} as well as longevity.\textsuperscript{12} As such maintaining the health of adults as they age through physical activity is a priority.

From the review of literature no assessment on the effectiveness of a modified sport program on improving the quality of life (QoL) of Indigenous adults was found. However, studies have reported positive results on the use of an exercise rehabilitation program in Indigenous populations to improve chronic disease outcomes including blood pressure (BP), body mass index (BMI) and waist circumference (WC).\textsuperscript{15, 16} Participation in a cardiac rehabilitation program improved cardiovascular risk factors and health management\textsuperscript{16} and, similarly participation in a cardiopulmonary rehabilitation program led to positive changes in health behaviours, functional exercise capacity and health related QoL.\textsuperscript{15} Both rehabilitation programs consisted of one education and one\textsuperscript{16} to two\textsuperscript{15} supervised exercise sessions per week for a duration of one hour\textsuperscript{15} or within a flexible four hour timeframe,\textsuperscript{16} as well as home-based physical activity\textsuperscript{16} for a period of eight weeks.\textsuperscript{15, 16} The deficit in research is also evident for the general adult population with studies reporting mixed results, on the use of modified sport programs to improve indicators of health and QoL of non-Indigenous population sub-groups.\textsuperscript{4, 7, 17} Most research to date has focused on exercise programs of varying types that address chronic disease prevention or management.

The seldom explored association between sport and the health of Indigenous people, plus the portrayal of sport being a leisure time activity\textsuperscript{9} may be reasons for the research deficit on modified sport programs for Indigenous adults. Therefore, research that explores these associations and supports Indigenous people, their values and culture may enhance the QoL of Indigenous adults. Given the limited evidence and life expectancy of Indigenous people, this study will evaluate research into the effectiveness of group-based sport and exercise programs targeting Indigenous adults on anthropometric, physiological and QoL outcomes in order to assist in guiding further research into such programs.
2. Methods

A systematic literature search was conducted with the aim to identify and evaluate research into the effectiveness of group-based sport and exercise programs targeting Indigenous adults on anthropometric, physiological and QoL outcomes. Due to similarities in health and socio-economic disadvantage in Indigenous peoples around the world, a range of terms was selected to provide a representation of articles reporting on Indigenous peoples where Indigenous was defined according to the United Nations by the criterion of self-identification as underlined in a number of human rights documents, and a definition further endorsed by the World Health Organisation. The target population was adults aged 18 years or older and described as Australian Aboriginal, Torres Strait Islander, Murri, Koori, First Australian, Maori, Hawaiian Indigenous, Canadian Indigenous, Inuit, Aleutian, and First People and satisfy the definition of Indigenous. These Indigenous peoples were selected due to having similarities more likely of relevance to Australian Indigenous peoples, and represent geographical locations of the Pacific and circumpolar regions and characterize a proportion of the diversity within the 370 million Indigenous people spread across 70 countries worldwide.

Included programs were interventions described as, or include a group-based sport program or exercise program, where exercise and sport are defined as subcategories of physical activity that are planned, structured, repetitive, and purposeful wherein the improvement or maintenance of one or more components of physical fitness is the main objective or one of the objectives. Program evaluation outcomes also needed to include health and QoL measures. Additional inclusion criteria included articles in English, full text, peer reviewed, and scholarly journals.

The systematic search was undertaken from August 2014 – June 2015 using eleven electronic databases (EBSCO, SPORTDiscus, CINAHL, Informit, Scopus, Web of Science, Medline, PubMed, Global Health, ProQuest and Discover) selected for their focus on exercise, sport, health and Indigenous studies. After numerous searches, entering a diverse range of criteria, yielded a paucity of results, three separate searches were undertaken using the terms sport, exercise, and physical activity, where the key criterion of Indigenous remained constant throughout the three searches. To ensure a
thorough search these criteria were entered both separately and in Boolean combination into each
database, as well as a review of relevant article reference lists and key author searches. Article
identification and screening was performed by the first author with eligibility and inclusion decided by
the first three authors. Six articles were identified as meeting all the inclusion criteria and were
reviewed for critical appraisal. The article selection process is represented in Figure 1.

Critical appraisal of selected articles for quality was conducted using the McMasters University
Guidelines and Appraisal Forms for Critical Review for Quantitative Research. This critical
appraisal tool was selected as each article utilised quantitative methods and for its previous application
in sport and exercise science systematic literature reviews. The form uses a questionnaire format
and provides grading options that include ‘yes’, ‘no’, ‘not applicable’ and ‘not addressed’ depending
on the question. A numerical scoring system, devised in previous reviews was used to facilitate
comparison across articles. The criteria and scoring system are illustrated in Table 1. Scores between 7
and 10 were defined as moderate quality (50 – 66%) and scores ≥10 out of 15 (>66%) were defined as
good quality based on previous reviews. A moderate to good score for five articles was considered
by the authors to be sufficient to guide future research; however, the authors also consider that it
would be prudent to address the limitations of the six included articles. The scoring criteria included
relevance of the literature that informed the overall study, practicality of the design, analysis and
results based on outcome measures and sample, measurement, and performance biases. All included
articles were critically appraised and scored by the first author then independently by the second and
third authors. Scores were then collated and compared. Agreement on scores and quality was reached
by discussion between reviewers by seeking a common understanding of the criterion definitions and
decision-making applied to the scoring system. This process ensured that critical appraisal methods
were applied consistently.

3. Results
The results of the critical appraisal for the six included articles in this review are presented in Table 1. The critical appraisal scores ranged from 6 – 12, with a mean score of 9.6, of a possible 15 points indicating a moderate to good quality for five articles\textsuperscript{29-33} (Table 1). There was a lack of studies providing a high level of evidence therefore the quality of evidence needs to be considered when interpreting the findings. The authors also considered that direct comparisons of findings were not appropriate given the diversity of intervention program types and methods of evaluation used across studies thus recommending caution in the use of the overall findings.

A summary of the six included articles are described in Table 2. All six articles evaluated participants living in Australia,\textsuperscript{29, 32, 34} Canada\textsuperscript{30} and New Zealand.\textsuperscript{31, 33} One article\textsuperscript{32} included only men with one further article\textsuperscript{29} including only women, while the remaining four articles included men and women. The most commonly used study design was before and after used in five articles.\textsuperscript{30, 31, 33-35} One article\textsuperscript{29} described the study design as pragmatic randomised control trial (P-RCT) where the design was justified in a preceding paper.\textsuperscript{35} However, the authors suggested it aligned more to being a before and after design given the critique criterion used due to the control group receiving treatment while awaiting the intervention. The remaining study\textsuperscript{32} was RCT in design.

Outcomes measured across studies included anthropometric, physiological and QoL using standardised and validated measures of BMI, WC, waist to hip ratio (WHR), body weight (BW), BP, physical fitness and QoL using the Short Form-36 Health Survey (SF-36).\textsuperscript{36, 37} These measures collectively are markers of risk factors associated with chronic diseases including cardiovascular disease\textsuperscript{15, 16} and type 2 diabetes mellitus,\textsuperscript{34} and mental illness including depression and anxiety,\textsuperscript{38-40} all of which are major health concerns that impact on QoL for Australian Indigenous adults.\textsuperscript{15, 16, 34, 39, 40}

Anthropometric outcome measures included BMI and BW in all six reviewed articles,\textsuperscript{30-35} WC in five articles\textsuperscript{29-33} and WHR in one article.\textsuperscript{32} Significant improvements were found from baseline to immediately post-assessment for BMI in men\textsuperscript{30-32, 34} and in women,\textsuperscript{29-31, 34} for BW in men\textsuperscript{30-32} and in women,\textsuperscript{29-31} for WC in men\textsuperscript{30-32} and in women,\textsuperscript{30, 31} and finally for WHR in men.\textsuperscript{32} Further significant
improvements in BMI and BW were found at three months follow-up.\textsuperscript{29} One article\textsuperscript{34} found initial significant improvements in BMI at six months that increased back to baseline by 12 months accompanied by no sustained BW loss.

Physiological outcome measures included BP in four articles\textsuperscript{29-33} and various measures of physical fitness in two articles.\textsuperscript{31, 32} Physical fitness measures used predicted maximal oxygen uptake (VO$_2$ max), modified Bruce Protocol stage and heart rate (HR)\textsuperscript{31} and VO$_2$ peak, maximum aerobic workload and graded exercise test duration.\textsuperscript{32} Two articles found significant improvements from baseline to immediately post-assessment for BP in men and women\textsuperscript{30, 31} and in physical fitness measures also in men\textsuperscript{32} and women.\textsuperscript{31}

Quality of life outcome measures using SF-36 were reported in one article\textsuperscript{33} where QoL using two category summaries for physical (PCS) and mental health, and eight specific sub-domains (Physical Functioning, Role-Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional, Mental Health) were reported. Significant improvements from baseline to immediately post-assessment in QoL were found in PCS. Furthermore, the specific sub-domains where significant improvements were found included Physical Functioning, General Health and Vitality in both training groups, Role-Physical, Social Functioning and Role-Emotional in the resistance training group and Bodily Pain in the aerobic training group. Additionally, when separated by gender, the specific sub-domains where significant improvements were found included Social Functioning and Role-Emotional more marked in men than women.

The program elements across studies varied with one commonality in that the sport and/or exercise session design components of type, duration, frequency and intensity corresponded to global recommendations on physical activity for health for 18 to 64 year olds\textsuperscript{20} and were implemented over a period of time to exhibit results. The type of sport and exercise programs included combinations of structured exercise, resistance training, aerobic training, walking, running and sport as well as diet modification and nutrition education. The implementation period ranged from 12 to 24 weeks and
included 12 weeks with a three month follow-up plus further follow up at 24 and 52 weeks, weeks, four months with follow-up in a maintenance program for a further 8 months, 12 weeks, 24 months of participant tracking in a continuing program and 16 weeks. Excluding the diet modification and nutrition education components, the duration ranged from 30 – 60 minutes and included 60 minutes, ≥30 minutes, and 45 – 60 minutes. The frequency ranged from two to four times per week and included four times per week two of which were group sessions, one group and two individual sessions per week, four group sessions per week, two sessions per week for the first 6 weeks then three sessions per week for the remaining five weeks, three group sessions per week and 2 – 4 times per week. The intensity included moderate to high intensity, 80 – 90% of maximum HR, self-selected high and lower intensity where distance covered rather than session duration was emphasised, 75 – 80% maximum HR for cardiovascular training, 65 – 85% of HR reserve for the aerobic training group and 6 – 8 repetitions to neural fatigue for the resistance training group. Other supporting elements of programs included the provision of transport to and from venues if required, and in all six studies the social interaction of the group-based program was reported as a key aspect.

The consultation process was acknowledged as an important element in the majority of programs that may have positively influenced the success of these interventions, particularly on program compliance and QoL. All six articles reported that community consultation during various stages of the program was an important factor in ensuring the cultural appropriateness and community acceptance of the program. Often, consultation was undertaken by receiving advice from Indigenous advisory groups and/or gaining approval from Indigenous Ethics Committees that guided the research design, development and implementation of the program. Having a community focus and group social interaction were also viewed as critical program elements.

4. Discussion
The aim of this systematic review was to evaluate research into the effectiveness of group-based sport and exercise programs targeting Indigenous adults on anthropometric, physiological and QoL outcomes. The current review found that there is limited research specifically pertaining to group-based sport and exercise programs for Indigenous adults that focuses on QoL outcomes. Many more programs have focused on chronic disease risk factor measures. Researchers to date have attempted to address the gap between Indigenous and non-Indigenous health with a focus on chronic disease prevention and management through lifestyle management programs and, exercise and nutrition programs. However, the program choice may have influenced compliance issues of commitment, motivation, participant circumstances and program experience in Indigenous adults. A gym and sports-based program reported one of the highest compliance rates which is consistent with contemporary research in Pacific adults suggesting that sports may be preferred over traditional forms of exercise with lower compliance.

This review revealed that the most widely used study design was before and after used in five articles, which is consistent with contemporary research into Indigenous populations as this design is considered to be culturally and ethically appropriate with a protocol acceptable to participants. Before and after designs also have a practical element in that they apply in real-life community contexts and, while RCTs provide methodological rigour, they are considered unethical and compromise an inclusive philosophy by restricting access to effective programs.

Collectively anthropometric outcomes significantly improved across all six reviewed articles in BW, BMI, WC and WHR in contrast to a significant initial improvement in BMI that was not sustained for a longer term. Results were consistent with contemporary research in Indigenous adults and non-Indigenous adult men demonstrating significant improvements in BW with further significant improvements in BMI and WC. While non-sustained results were reported in BMI at 12 months, a further non-significant modest improvement in BMI was reported at the three month follow-up which possibly suggests that a maintenance program may be appropriate in preserving BMI gains over the long term which is consistent with contemporary research and
reinforced in one intervention that has a maintenance program underway. Furthermore, preserving gains in BMI as well as potential gains that may be achieved in BW, WC and WHR supports the committed effort to risk factor prevention and chronic disease management by the Australian government.

In this review the results of physiological outcomes were consistent with contemporary research in Indigenous adults, Pacific adults and non-Indigenous adult men exhibiting significant improvements in BP and physical fitness that were demonstrated across all three population groups regardless of the physical fitness measure employed. In contrast, improvements in BP and physical fitness were also reported as non-statistically significant where sample size is likely to have been a key factor in the result. However, overall improvements are encouraging for Indigenous adults with BP and physical fitness derived from participation in sport and exercise programs, linked to better health outcomes.

Similarities were found in the evidence on the effects of various exercise types on the specific sub-domains of QoL using SF-36 in Indigenous populations. This review found significant improvements overall across seven out of the eight specific sub-domains of QoL to be consistent with contemporary research with additional improvements in PCS. Differences in findings were in sub-domains Physical Functioning and Mental Health where significant improvements were found in single studies. The evidence, although limited, demonstrates consistent and strong findings, corresponding to contemporary research in non-Indigenous populations, from comprehensive reporting of results on sub-domains of SF-36 to guide future research in Indigenous populations.

Group-based exercise and/or sport session design components of type, duration, frequency and intensity varied considerably. This variation is consistent with contemporary research that were effective in achieving the most significant results in anthropometric, physiological and QoL outcomes. Furthermore, where the session type included group-based sport, one article reported significant improvements in all anthropometric and physiological outcomes.
compared to those seen following group-based exercise\textsuperscript{29-31} which are consistent with findings in contemporary research of Indigenous\textsuperscript{48} and Pacific adults.\textsuperscript{43} These improvements may be due in part to compliance,\textsuperscript{32} suggesting that group-based sport may be the most effective option for Indigenous men and women. In contrast, group-based exercise demonstrated significant improvements in QoL in Indigenous adults\textsuperscript{33} consistent with contemporary research demonstrating encouraging results of group-based sport in Indigenous children.\textsuperscript{49} Therefore, it is difficult to draw specific conclusions to assist future research other than ensuring that global recommendations on physical activity for health for 18 to 64 year olds\textsuperscript{20} are observed, and that programs which include group-based sport are implemented over a period of time to exhibit results as demonstrated in the evaluated articles\textsuperscript{29-33} and contemporary research.\textsuperscript{15-17, 43, 47}

Uniformities emerged across articles that comprise the elements that may have contributed to the success of programs. Firstly, consultation with Indigenous groups and community involvement in programs facilitated program acceptance by the community\textsuperscript{29-33} which is consistent with contemporary research,\textsuperscript{15, 16, 50} as well as building trust and embracing Indigenous insights for non-Indigenous researchers.\textsuperscript{9} Secondly, the inclusion of a diet or nutrition education component\textsuperscript{29, 31} is consistent with contemporary research evaluating programs from a chronic disease platform.\textsuperscript{15, 16, 43} However, Indigenous programs whose components were only sport and/or exercise related were successful in achieving outcomes.\textsuperscript{30, 32, 33} Finally, including individualised exercise\textsuperscript{29, 30, 42} combined with group-based exercise and/or sport sessions\textsuperscript{29-33} may be appropriate, however group and community based programs particularly sport-based programs may be more acceptable than other group-based programs as team sports are popular within Indigenous communities through the reinforcement of group cohesion and cooperation.\textsuperscript{32, 47} This popularity is supported in a parallel RCT\textsuperscript{43} of Pacific adults where small-sided team based sports were reported to have promising results on improving health and cardiovascular fitness and reducing the risk of diabetes and cardiovascular disease.

The authors acknowledge that there are limitations in the current study. Firstly, selection bias may have occurred by using the selected databases resulting in relevant studies being inadvertently missed.
However, the main databases for the topic area were included in the rigorous systematic search strategy as well as reviewing relevant article reference lists and conducting key author searches to reduce this bias. Secondly, a further selection bias was minimised in article identification and screening by all three authors agreeing on the definitions and inclusion criteria as they apply to this study. Another limitation of the present study may have been that the authors were not blinded to the publishing journal and authorship of articles. Although all articles were appraised independently and critical appraisal methods were applied consistently the process, however, was unavoidably subjective. Having a consistent scoring metrics and agreement between authors for each criteria aided in reducing this bias. Furthermore, the expansion of search terms to include Indigenous populations other than those who represent geographical locations of the Pacific and circumpolar regions may have enhanced the ability to gain further insight into the effectiveness of sport and exercise programs on improving the QoL of Indigenous adults. This was considered out of the scope of this review due to the number and diversity of Indigenous peoples worldwide. This review, however, does provide useful baseline information for the development of further research in this field.

Of the six reviewed articles three\(^\text{30, 32, 33}\) focused on either types of sport or exercise as a sole intervention strategy with one of those articles\(^\text{33}\) focusing on QoL as the primary outcome measure and two further articles with a focus solely on men\(^\text{32}\) and women.\(^\text{29}\) Also, of the six reviewed articles three\(^\text{30, 31, 33}\) were identified as good quality from the critical appraisal process with one of those studies\(^\text{33}\) achieving the highest score. The reviewed literature is applicable and useful as it highlights sound research techniques that are highlighted in the critical appraisal criteria for each study which can be applied to future research. Moreover, with sport, particularly team sport, being popular amongst Indigenous populations including Indigenous Australians, future research could focus on programs that include small-sided games and team sports as an achievable option to reduce low physical activity rates\(^\text{43}\) and improve QoL outcomes. Furthermore, because Indigenous Australian adults have reported enjoyment\(^\text{47}\) and cultural satisfaction participating in sport,\(^\text{9}\) programs including small-sided games and team sports have the potential to be sustainable,\(^\text{47}\) bridge the health divide and have an impact on the health\(^\text{9}\) and longevity\(^\text{12}\) of Indigenous Australian adults.
The knowledge gained from the results of this study can be used to inform research that will evaluate the effectiveness of a group-based modified sport program on improving the QoL of Indigenous adults. Furthermore, research findings can be used to inform local sporting clubs and government agencies in the delivery of equitable, socially inclusive, culturally appropriate, accessible and effective group-based modified sports programs for all members of the community.

5. Conclusion

This review evaluated research into the effectiveness of sport and exercise programs targeting Indigenous adults on anthropometric, physiological and QoL outcomes. In the limited research that currently exists, we found that group-based programs that include nutrition, exercise and/or sport components for Indigenous adults are effective in achieving health and QoL outcomes. Combinations of structured exercise, resistance training, aerobic training, walking, running and sport, as well as diet modification and nutrition education, were acceptable among the adult Indigenous population. However there is a need to enhance the methodological quality of research in the field. This review may be used to inform research on group-based modified sport programs for Indigenous adults that are designed and delivered in a culturally appropriate manner with the aim to improve QoL.

Practical Implications

- Sport-based programs are accepted within Indigenous communities and effective in improving health and QoL outcomes
- Structured exercise, resistance training, aerobic training, walking, running and sport as well as nutrition education may be effective in promoting physical activity among Indigenous adults
- Group and community based programs within Indigenous communities are likely to be more successful than individualised exercise
• Consultation with Indigenous groups and community involvement in programs facilitates program acceptance by the community

• Although RCTs are considered gold standard study designs in evaluating interventions in controlled settings, well conducted before and after study designs may be more appropriate for community based programs among Indigenous communities

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References


Fig. 1. Flow diagram for article selection process.
**Table 1**

Critical appraisal criteria and scoring system with final scoring and quality.

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<tr>
<td>• Dropouts</td>
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<tr>
<td>Conclusions &amp; clinical</td>
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implications

- Limitations/biases

<table>
<thead>
<tr>
<th>Quality</th>
<th>Mod/</th>
<th>Mod</th>
<th>Good</th>
<th>Good</th>
<th>Mod</th>
<th>&lt; Mod</th>
<th>Good</th>
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<tr>
<td>Mod/</td>
<td>15</td>
<td>9</td>
<td>11</td>
<td>11</td>
<td>9</td>
<td>6</td>
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<td>Good</td>
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Total | 15 | 9 | 11 | 11 | 9 | 6 | 12 |


Table 2
Description of Reviewed Articles.

<table>
<thead>
<tr>
<th>Article</th>
<th>Cohort</th>
<th>Age in years</th>
<th>Exercise type</th>
<th>Intervention duration</th>
<th>Session duration</th>
<th>Frequency per week</th>
<th>Measures</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canuto et al.(^{29})</td>
<td>Women</td>
<td>18 – 64</td>
<td>Group CV and RT Incidental activity</td>
<td>12 weeks</td>
<td>60 min</td>
<td>2 CV and RT</td>
<td>BW 6.4%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td>BMI 5.4%</td>
<td></td>
</tr>
<tr>
<td>Foulds et al.(^{30})</td>
<td>Men/Women</td>
<td>≥18</td>
<td>Group and individual walk, walk/run or run</td>
<td>13 weeks</td>
<td>Time to complete 10 km</td>
<td>1 group</td>
<td>BW 2.2%</td>
<td>87.5%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BMI 2.3%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WC 2.4%</td>
<td></td>
</tr>
<tr>
<td>McAuley et al.(^{31})</td>
<td>Men/Women</td>
<td>24 – 60</td>
<td>Group exercise</td>
<td>4 months</td>
<td>30 min</td>
<td>4</td>
<td>BW 3.1%</td>
<td>Not reported</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>BMI 3.2%</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>WC 6.5%</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>BP systolic 4.4%</td>
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<tr>
<td>Study</td>
<td>Gender</td>
<td>Age Range</td>
<td>Intervention Type</td>
<td>Duration</td>
<td>Frequency</td>
<td>Outcome Measures</td>
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<tr>
<td>Mendha et al. 32</td>
<td>Men</td>
<td>42 – 55</td>
<td>Group gym and sports-based</td>
<td>12 weeks</td>
<td>2 (weeks 1 – 6)</td>
<td>BW 1.4% 69%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45 – 60 min</td>
<td>3 (weeks 7 – 12)</td>
<td>BMI 14.2%</td>
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<td></td>
<td></td>
<td></td>
<td>WC 3.2%</td>
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<td></td>
<td></td>
<td>WHR 2.1%</td>
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<td>GXT VO₂ peak 10.7%</td>
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<td></td>
<td>GXT duration 11.8%</td>
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<td></td>
<td></td>
<td></td>
<td>W max 14.6%</td>
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<tr>
<td>Rowley et al. 34</td>
<td>Men</td>
<td>39 – 52</td>
<td>Group sport</td>
<td>24 months</td>
<td>2 – 3 sport</td>
<td>Not reported</td>
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<tr>
<td></td>
<td>Women</td>
<td></td>
<td>Group walking</td>
<td></td>
<td>3 – 4 walking</td>
<td>Not reported</td>
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<tr>
<td>Sukala et al. 33</td>
<td>Men</td>
<td>42 – 55</td>
<td>Group RT</td>
<td>16 weeks</td>
<td>3 per week</td>
<td>Physical Functioning 22% 70%</td>
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<tr>
<td></td>
<td>Women</td>
<td></td>
<td>Group AT</td>
<td>40 – 60 min</td>
<td></td>
<td>Role-Physical 19%</td>
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<td></td>
<td></td>
<td>Bodily Pain 12%</td>
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<td></td>
<td>General Health 19%</td>
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<td></td>
<td></td>
<td>Vitality 22%</td>
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<td>Social Functioning 18%</td>
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<td>Role-Emotional 22%</td>
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<td>PCS 8%</td>
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</tbody>
</table>
CV = Cardiovascular, RT = Resistance training, GXT = Graded exercise test, W max = Maximum aerobic workload, AT = Aerobic training

Measures are reported as change in significantly improved outcomes
Identification

3,944 articles identified through database searching

3 articles identified through reference list search of key articles

Screening

3,944 articles underwent title and abstract screening and duplicate removal

66 articles were identified for full text screening

13 articles were identified for inclusion

Eligibility

13 articles were assessed for eligibility by 3 reviewers

7 individual studies were identified from the 13 articles

Included

6 articles were selected for final inclusion