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Original research

A 12-week sports-based exercise programme for inactive Indigenous Australian men improved clinical risk factors associated with type 2 diabetes mellitus

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ABSTRACT

Objectives: This study assessed the effect of a 12-week sports-based exercise intervention on glucose regulation, anthropometry and inflammatory markers associated with the prevalence of type 2 diabetes mellitus (T2DM) in Indigenous Australian men.
Design: Twenty-six inactive Indigenous Australian men (48.6 ± 6.6 years) were randomized into exercise ($n = 16$) or control ($n = 10$)conditions.
Methods: Training included ∼2–3 days/week for 12 weeks of sports and gym exercises in a group environment, whilst control participants maintained normal activity and dietary patterns. Pre- and post-intervention testing included: anthropometry, peak aerobic capacity, fasting blood chemistry of inflammatory cytokines, adiponectin, leptin, cholesterol, glucose, insulin and C-peptide. An oral glucose tolerance test measured glucose, insulin and C-peptide 30, 60, 90 and 120 min post 75 g glucose ingestion.
Results: The exercise condition decreased insulin area under the curve (25 ± 22%), increased estimated insulin sensitivity (35 ± 62%) and decreased insulin resistance (9 ± 35%; $p < 0.05$), compared with control ($p > 0.05$). The exercise condition decreased in body mass index, waist circumference and waist to hip ratio ($p < 0.05$), compared to control ($p > 0.05$). Leptin decreased in the exercise group, with no changes for adiponectin ($p > 0.05$) or inflammatory markers ($p > 0.05$) in either condition. Aerobic fitness variables showed significant increases in peak oxygen consumption for the exercise condition compared to no change in control ($p > 0.05$).
Conclusions: Findings indicate positive clinical outcomes in metabolic, anthropometric and aerobic fitness variables. This study provides evidence for sport and group-based activities leading to improved clinical risk factors associated with T2DM development in clinically obese Indigenous Australian men.

1. Introduction

An estimated 75% of Indigenous people living in non-remote areas report sedentary behaviour and low levels of physical activity.[1] In turn, physical inactivity is reported to promote the development of obesity and is strongly associated with preventable chronic diseases such as type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD). Of note, both disease states are disproportionately high in the Indigenous Australian population.[1–3] Increasing the levels of physical activity within high-risk Indigenous communities may assist in preventing the development of chronic diseases. Accordingly, given the prevalence for lifestyle-related chronic diseases in Indigenous populations, the need for evidence-based strategies to reduce physical inactivity and associated risk of non-communicable disease is essential.[4] However, to date there are very few published reports on exercise training as a primary prevention strategy for metabolic and cardiovascular disease within Indigenous people.

Of particular focus, glucose regulatory,[5] chronic systemic inflammatory[6,7] and anthropometric[8] indices are important risk-factors for metabolic disease and their interrelated effects on insulin resistance and atherosclerosis.[7] Specifically, training studies implemented within a range of Indigenous peoples report ameliorating metabolic disease through reductions in glycosylated haemoglobin (HbA1c), insulin action, body composition, blood lipids and blood pressure.[9] However, minimal exercise

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interventions are specific to the Indigenous Australian population,[10,11] with none previously reported in Indigenous Australian men relating to glucose regulatory, inflammatory and anthropometric variables.

Regardless of ancestry, sports-specific exercise training[12] or gym-based cardiovascular and resistance exercises[11] have been successful in improving glucose regulation, inflammatory and anthropometric outcomes.[11,12] Evidence-based training programmes may provide effective and sustainable opportunities to improve risk-factors associated with disease development in Indigenous Australian men. Moreover, based on the community and family-orientated culture embedded within Indigenous Australian communities,[13] group and sports-specific exercise training sessions, particularly inclusive of small-sided games (SSG) and boxing, may be an effective approach for increasing physical activity and improving clinical risk-factors associated with T2DM.[11,14] The current study aimed to assess changes in clinical risk-factors following a 12-week exercise programme. These include the assessment of primary glucose regulatory measures from oral glucose tolerance tests (OGTT) and secondary measures of inflammatory, anthropometric and aerobic capacity variables. It was hypothesized that a sports-specific exercise intervention will assist in improving these clinical risk-factors associated with the development of T2DM within Indigenous Australian men.

2. Methods

Over a 4 month period in 2012 participants volunteered from a regional New South Wales community through the support and guidance of the local Aboriginal Medical Centre and Men's group. Thirty-three men of Australian Indigenous ancestry were recruited and randomly (block randomization in groups of 4) assigned by the chief investigator to an exercise ($n = 17$) or control ($n = 16$) condition for pre-intervention testing. The extra participant was assigned to the exercise intervention based on anticipated drop-out and compliance rates.[11] Participant recruitment ensured a sample population representative of an inactive lifestyle (no regular planned or incidental activity of >60 min per week) and not diagnosed with pre-existing CVD or metabolic disorders. A 75 g oral glucose tolerance test (OGTT) at pre-intervention showed results indicative of diabetes for 6 participants who were then excluded from the study. Final sample size at post-intervention was 11 in exercise and 10 in control conditions (schematic overview of participant numbers shown in Fig. 1). Prior to participation, Institutional Human Ethics clearance was obtained and participants provided verbal and written consent for all testing procedures.

Participants attended two pre-intervention and two post-intervention testing sessions (Fig. 1). The first testing session comprised of a PAR-Q, anthropometric measurements, blood pressure and an OGTT. The second testing session comprised of a graded exercise test (GXT). Anthropometric measures included stature, body mass, waist circumference (WC) and hip circumference using standard techniques.[15] Manual blood pressure was obtained with an aneroid sphygmomanometer and cuff (Welch-Alyn, Arden, NC, USA) expressed as the mean of 3 measurements after the participant had been seated for 5 min.

Participants presented to the laboratory between 0600 and 0900 h following an overnight fast (10–12 h) and remained rested for a 2 h OGTT. Participants were cannulated for the collection of venous blood samples at fasting, 30, 60, 90 and 120 min post-glucose ingestion that was standardized for all participants at 75 g of glucose diluted in 300 mL of water, ingested within a 5 min period (Fronine Lomb's Scientific, Sydney, Australia).

A GXT determined peak oxygen consumption (VO_{2peak}) and maximal aerobic workload (W_{max}) and was performed on an

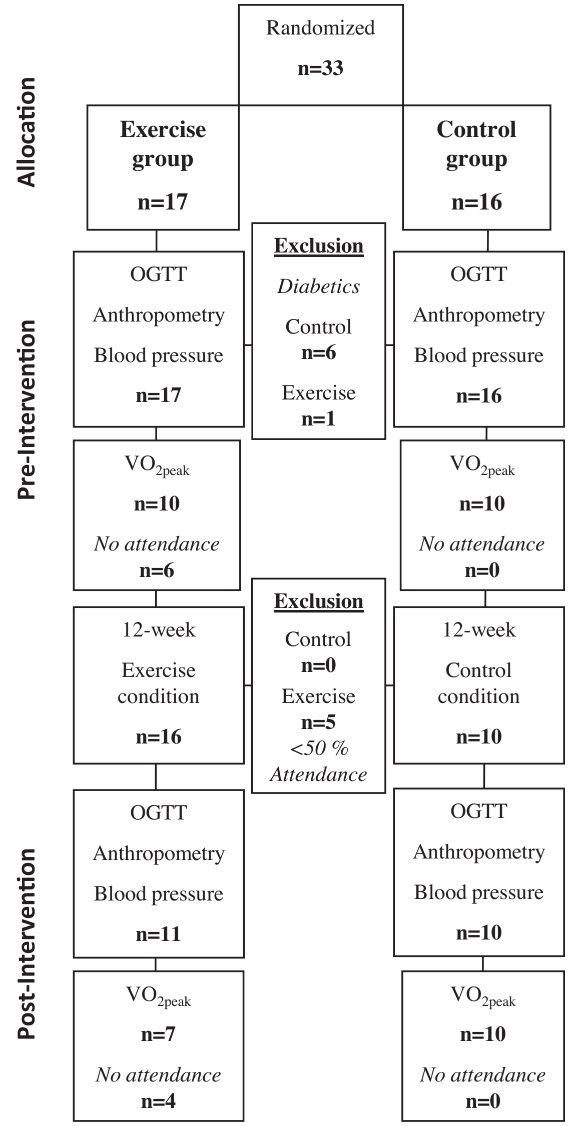

Fig. 1. Schematic overview of participant numbers, allocation, pre-intervention and post-intervention testing.

electronically braked cycle ergometer (LODE Excalibur Sport, LODE BV, Groningen, The Netherlands). Prior to each test the metabolic gas analysis system (Parvo Medics, True2400, East Sandy, UT, USA) was calibrated. The test commenced at 25 W and increased by 25 W every min. Heart rate (HR) (Vantage NV, Polar, Kempele, Finland) was recorded each min with participants exercising until maximum heart rate (HR_{max}; calculated as 220 − age) or volitional exhaustion prior to attainment of HR_{max}. Technicians were not blinded to group allocation and did not provide encouragement to the participants during pre and post-intervention testing.

Total exercise duration over the 12-weeks of training was maintained at 45 and 60 min sessions (including 5–10 min of dynamic warm-up), with exercise intensity prescribed to maintain 70–85% HR_{max}. Training frequency progressed from an allocated 2 sessions (weeks 1–6) to 3 sessions per week (weeks 7–12). Heart rate (Vantage NV, Polar, Kempele, Finland) was recorded during all sessions at 5 min intervals for the calculation of mean HR, and a session-RPE (Borg's 6–20 scale) was obtained at the conclusion to calculate training load.[16] All participants were provided with positive reinforcement and transportation (if required) to all data collection and training sessions.