

Case report

A Boxing-Oriented Exercise Intervention for Obese Adolescent Males: Findings from a Pilot Study

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Abstract

In New Zealand, obese Māori and Pasifika adolescents are at risk of numerous cardio-metabolic conditions with raising physical activity levels being proposed as a useful intervention. The present study used a mixed method design to explore the effects of a non-contact boxing-oriented training programme designed in terms of improvements to cardio-metabolic variables. Traditional recruitment strategies (media, referrals) were employed, with limited success leading to 3 adolescent boys (14-15 y) participating in the pilot intervention. Exercise sessions included 30 minutes of non-contact boxing training, followed by 30 minutes of progressive resistance training. Participants attended three 1h training sessions each week, for a total of 12 weeks. Physiological variables included anthropometric indices, visceral fat thickness, central blood pressures, central arterial stiffness (augmentation index: AIx), and carotid arterial stiffness (β). Results revealed that there was no trend for change in body weight (125.5 ± 12.1 kg vs. 126.5 ± 11.0 kg) or BMI (39.3 ± 4.1 kg·m⁻² vs. 39.0 ± 4.6 kg·m⁻²). However, there was a moderate decrease in visceral fat thickness (4.34 ± 2.51 cm vs 3.65 ± 1.11 cm, $d = 0.36$). There was no change in central pulse pressure (38.7 ± 7.3 mmHg vs. 38.3 ± 5.0 mmHg), however, there was a small improvement in β (3.01 ± 0.73 vs. 2.87 ± 0.84 , $d = 0.18$). Focus group interview data with participants and their parents were used to explore issues related to motivation to participation. Results revealed participants commented on how the programme has led to new friendships, changes to their physical appearance, and increased physical fitness. Parents commented on increased self-confidence, better performance in school, and a willingness to take part in new activities. In conclusion, it appears participating in the boxing oriented training programme was motivating to participants who engaged and had some physiological benefits in obese adolescent boys of Māori and Pasifika descent. However, despite these positive attributes, poor recruitment rates suggest that future work should focus on identifying the barriers to engagement.

Key words: Physical activity; paediatric; boxing; culture; beliefs; indigenous.

Introduction

Within New Zealand, 23% of youth (15-18 y) are considered overweight or obese; Māori (28%) and Pasifika (35%) youth have a much greater risk for obesity than other ethnicities (21%) (University of Otago and Ministry of Health, 2011). The increased prevalence places these cohorts at greater risk for obesity-related cardio-metabolic conditions, which independently and additively increase cardiovascular disease (CVD) risk (Nakagami et al.,

2006; Oliver et al., 2010; Reinehr et al., 2006; Winer et al., 2006). There is consensus that a sedentary lifestyle has contributed significantly to the current obesity epidemic (Hill et al., 2003). Unlike dieting, which can lead to loss of fat-free mass, physical activity maximizes weight lost from fat mass and minimises the loss of fat-free mass (Watts et al., 2005). Previous research has not focused on the effects of physical activity interventions on Māori and Pasifika adolescents, and given the high risks of obesity-related cardio-metabolic conditions in this population, the aim of the present study was to test the effectiveness of a non-contact boxing intervention.

There is evidence that shows aerobic and resistance training independently improves abdominal obesity and cardio-metabolic health (Lee et al., 2012), yet a combination of both training modes may demonstrate even greater benefits (de Piano et al., 2012). Exercise intensity also plays an important role. Indeed, high-intensity exercise has been associated with the greatest decreases in obesity, cardio-metabolic conditions, and the progression of CVD (Montero et al., 2012; Murphy et al., 2009; Tjonna et al., 2009). In light of the previous findings, non-contact boxing was identified as appropriate for use in an exercise intervention. Boxing training is characterized by high-intensity, intermittent activities (Arseneau et al., 2011; Bellinger et al., 1997) and, in previously untrained individuals, has been shown to result in favourable changes in cardiovascular fitness (Kravitz et al., 2003) and lipid profiles (Chatterjee et al., 2007). Besides improving physical health, boxing training can also lead to increased self-confidence, self-discipline, and character development (Sokol, 2004); it also seems that Māori and Pasifika prefer sports in which strong bonds can be made with their 'team-mates' and this extends to boxing training, perhaps perceived to be a 'family away from family'. Therefore, the purpose of this pilot study was to identify physiological and psychological benefits of a non-contact boxing-oriented training programme on obese Māori and Pasifika adolescent boys.

Methods

Recruitment

The objective of the pilot study was to recruit twenty obese adolescent males, who would be randomly assigned to a control or intervention group. Recruitment of participants for the pilot intervention included contacting local schools and physicians to help with referrals, and utilising

print and television media to promote the study within the local community. One participant was recruited through print media, while two participants were recruited through physician referrals. An additional four males were also approached through physician referral and word of mouth, but did not participate in the exercise intervention because of scheduling conflicts. School referrals proved ineffective.

Participants

Three adolescent males (14.4 ± 0.2 y) were recruited. Participants were categorized as obese (body mass index [BMI]: 39.3 ± 4.1 kg·m⁻²) based on international cut-off points (Cole et al., 2000). Two participants identified with Pacific Island ethnicity, while one participant was identified as Māori. Prior to participating, a health history questionnaire was completed; participants were excluded if there was a recent history (< 4 weeks) of orthopaedic injury or surgery, a diagnosis of neuromuscular disease or a cardiovascular condition. Exclusion criteria were established to ensure that all participants could fully function during high-intensity exercise. Participants and their parents/guardians gave written informed assent and consent, respectively, prior to beginning the study. All protocols were approved by the University Ethics Research Committee.

Intervention

Participants completed one-hour training sessions on three non-consecutive days each week, for a total of 12 weeks. The exercise intervention was divided into thirty minutes of high-intensity aerobic activity (i.e. boxing) and thirty minutes of resistance training, as a mixed modality has shown to be more effective than aerobic exercise alone in obese adolescents (Damaso et al., 2014). The boxing training was sub-divided equally into shadow boxing, bag work, and one-on-one focus-pad work. Intensity was monitored in real time, using heart monitors (Polar Team²; Polar Electro Inc., New York). Maximal heart rate was calculated using age-specific equations (Mahon et al., 2010), and exercise intensity was maintained at 90% of predicted maximal heart rate during the standard boxing training. Although 90% of predicted maximal heart rate may be deemed to be of a strenuous nature for this cohort, the basic upper body movements involved in the boxing elicited sharp elevations in cardiorespiratory responses, despite only a moderate perception of exertion being reported, mostly likely due to the large body mass and poor underlying level of fitness of the adolescents.

The progressive, closed kinetic, resistance training immediately followed the boxing training. Each resistance training session included at least six exercises, with each exercise targeting a specific area of the body: shoulders, arms, back, chest, legs, and abdomen. Initial intensity was maintained at 70% of maximal heart rate and progressed fortnightly in 5% increments, until a maximal exercise intensity of 90% was reached.

Physiological assessments

Health assessments were completed before and after the 3-month intervention. All assessments have been described previously (Stoner et al., 2013b). Briefly, body

composition variables included height, weight, abdominal circumference, BMI, and abdominal-to-height ratio. Visceral fat thickness was measured using a B-mode ultrasound device (t3200; Terason, Burlington, MA), defined as the distance between the anterior wall of the aorta and the posterior surface of the rectus abdominis muscle, measured 1–5 cm above the umbilicus at the xiphoid-umbilical line (Iacobellis, 2005). Central arterial stiffness (augmentation index, AIx) and central blood pressure were assessed using pulse wave analysis (PulseCor R7, Auckland, New Zealand) (Stoner et al., 2013a). Carotid arterial stiffness was estimated using the stiffness index (β), where arterial distension was measured using B-mode ultrasound and central blood pressures were derived from pulse wave analysis.

Psychological assessments

During week 10 of the intervention, all participants and two parents completed semi-structured interviews. The semi-structured interview schedule included open-ended questions to explore perceptions of i) participants' previous experience in playing sport and ii) participants' experiences of the programme, including what they perceived to have been difficult, enjoyable and challenging. An additional area of questioning was asked to the parents only, and explored issues of recruitment. Prior to the interviews, all questions were developed and discussed with a cultural advisor from the Māori community, and deemed culturally appropriate. Consistent with previous qualitative investigations, an inductive-deductive approach to data analysis was used in the current study (Esterberg, 2002) with the three main areas of questioning being used to guide data analysis. Interviews were completed in a private and quiet room by a single researcher and lasted approximately 10–20 minutes. Interviews were taped and transcribed at a later time.

Statistical analyses

SPSS version 20.0 (SPSS, Inc., Chicago, Illinois) was used for data analysis. Effect sizes for the physiological variables are reported using Cohen's *d*; in general, $d \leq 0.20$ is considered to be a small effect, $0.20 < d \leq 0.50$ a moderate effect, and $d > 0.50$ a large effect.

Results

Physiological

Table 1 summarizes the anthropometric and physiological variables for both pre and post-exercise intervention. There was no trend for change in body weight, waist circumferences or BMI. However, there was a moderate decrease in visceral fat thickness ($d = 0.36$). While there was no change in central pulse pressure, there was a small improvement in carotid β ($d = 0.18$). Conversely, there was a trend for increased AIx ($d = 0.65$).

Psychological

Interview data revealed 7,489 words of comments. As Table 2 shows, results revealed data could be classified under three themes: 1) "barriers to exercising"; 2) "benefits of exercising", which sub-divided into i) confidence

Table 1. Anthropometric and physiological characteristics pre- and post-exercise intervention

Variable	Pre		Post		d
	X	(SD)	X	(SD)	
Weight (kg)	125.5	(12.1)	126.5	(11.0)	.09
Waist (cm)	123.6	(9.5)	124.0	(10.0)	.04
BMI (kg·m ²)	39.3	(4.1)	39.0	(4.6)	.08
Waist:Height Ratio	0.69	(.10)	.69	(.07)	.06
Visceral Fat (cm)	4.34	(2.51)	3.65	(1.11)	.36
VO _{2max} (ml·kg ⁻¹ ·min ⁻¹)	28.4	(10.5)	32.2	(7.0)	.43
HR (b·min ⁻¹)	69.8	(22.8)	67.2	(18.5)	.13
cPP (mmHg)	38.7	(7.3)	38.3	(5.0)	.06
AIx (%)	27.0	(6.9)	30.3	(2.4)	.65
β	3.01	(.73)	2.87	(.84)	.18

BMI, body mass index; VO_{2max}, maximal oxygen uptake; cSBP, central systolic blood pressure cPP, central pulse pressure; AIx, augmentation index; β, beta stiffness index; d = Cohen's d effect size

to exercise in future; ii) physical fitness benefits; iii) psychological well-being in other areas of life; 3) "recruitment", describing how the exercise programme could be marketed more effectively. Direct quotations that represent these themes are presented.

External barriers to exercise were present. For example, one parent noted "During it, it's been a little bit tough for me, because I've got younger children, they've got sport, I've got my own business, I've got work. It was a huge big juggling act some days and I think financially it's been taking a little bit of its toll on us."

Barriers included negative experiences from previous participation in team sport. One participant's mother indicated:

"We tried him a few weeks ago with rugby league, but, the team that he got in with rugby league, was, there was a whole lot of other boys his age and they already are in clubs, they play rugby league, and he felt a bit intimidated, so he just went "I don't wanna do that, I wanna stick to boxing."

One participant reported:

"The only sport from this year before was just [rugby] league and the training was minimal stuff. I did, also, rugby, and that took up my whole week every time, so I usually had Monday, Tuesday, Wednesday, Friday, rugby game on sat, [rugby] league on Thursday, then [rugby] league on Sunday, so the whole week was, just, on rugby, rugby, rugby."

Participants and parents reported that their motivation to exercise improved following involvement in the programme. For example, "I don't have to make him do the boxing, he just walks out the door. He just loves it. He loves it. I think he actually found his, I dunno, his career, maybe? As far as exercise and fitness, and wanting to do something that is totally his."

In terms of the benefits of the programme, parents reported that the benefits were multi-factorial. For example, one parent reported "He's not so aggressive as he used to be because he could be quite aggressive at times, I mean we've had a few run-ins. He's actually calmed down quite a lot" and "He's quite confident now, his schooling has actually picked up. He's come quite a long way." A participant reported "I'm not as angry as I would be ever since I've started this." One parent reported noticeable positive changes. "Got him into boxing and now that's what he does around the house. As he's walking

around the house, does all of his boxing moves, even when we are in public. It's increased his activity level and I think it's definitely increased his confidence. He's involved in everything now. At school, yeah, everything."

Although there was no overt focus on nutrition, the effects were noticeable with respect to diet. One parent reported:

"He's not eating a lot at once. He used to eat quite a lot all at once but I've actually made it span out a bit more over a few meals, rather than just eating all at once. Usually he would just [eat] all at once then not have good things. Not have this and that."

Physical benefits were observed by both participants and parents:

"Um, I definitely think his fitness has come up. And I'd like for him to carry on with it, he wants to carry on with it and, uh, go really hard however we can and boxing."

"Physically, I've got more stamina to do things longer, because before I wouldn't be able to do things for a long period of time and also stronger so I can lift heavier things, to put stuff away and it's helped me channel my anger, so I wouldn't be as angry on other days."

A feature of boxing training is that it is proposed to be physically demanding. Participants reported that they experienced feeling fatigued but interpreted such feelings in a positive way. For example, "Not sore, just really tired, and I just wanna be awake and do stuff, so, so it's not a bad thing." A further comment included "The training, yes, and when you go into the ring yes, cause it does seem like you need to be committed to doing the hard work if you wanna increase the physical stuff and all that."

In terms of the cultural specificity and age appropriateness of the programme, parents reported that "I like to specifically target things that are aimed at Polynesian children. But that's just me, I don't know why. Support the cause, you know. And support whatever anyone is trying to do for the community in that way, specifically for Polynesians." One parent reported that a way to raise the profile of the programme would be to work with church groups. For example, "My only thing would be to find an in with a pastor who knows a lot of other pastors. You know, get in to some of the community groups. But mostly its churches, well that's what I think the best way to get involved is. Most of them go to church, 80% of them go to

Table 2. Specific participant feedback

Raw data quotes	Indicative Theme	General Dimension
<p>“We signed him up with [a] boxing academy there and, they took one look at him. He’s so big. They took one look at him and says because of his age, he thought he was going to go to the junior team, with the juniors. But what happened is they took one look at him and they said ‘oh no, you’re too tall, and you’re too big. You’re too big and we’ve gotta put you onto the seniors if we get a place.’ But they had no places at the time for him to go there. And they said, ‘but we’ll put you on the waiting list.’ And that was last year.”</p>		
<p>“When he was younger, I used to make him play rugby league and softball. He had a stint with softball, he had a stint with rugby league, he used to go to kapa haka (traditional Māori performing arts) and all of that, so he’s been away on trips similar to exercise programs and stuff. Otherwise no. He hasn’t really been involved in team, really he arrived from, he got extended from Māori.”</p>	Barriers to exercise	Barriers
<p>“Rugby wasn’t ok for me because, I did get game time, but, I didn’t feel a whole lot important to the team, and when I injured my back on the second game, my mom pulled me out of the school club so I ended up doing league instead, and I enjoy that very much.”</p>		
<p>“I don’t have to make him do the boxing, he just walks out the door. He just loves it. He loves it. I think he actually found his, I dunno, his career, maybe? As far as exercise and fitness, and wanting to do something that is totally his.”</p>	Psychological benefits	Benefits
<p>“The training, yes, and when you go into the ring yes, cause it does seem like you need to be committed to doing the hard work if you wanna increase the physical stuff and all that.”</p>		
<p>“Yeah, it has actually. He’s not eating a lot at once. He used to eat quite a lot all at once but I’ve actually made it span out a bit more over a few meals, rather than just eating all at once. Usually he would just [eat] all at once then not have good things. Not have this and that. I think nutrition would be the one if you could add anything to it, would be the one to talk about, you know, when they’re doing exercise and stuff”.</p>	Fitness benefits	
<p>“Well it seems to be harder than what I used to do but I enjoy that because I think my fitness has gotten better cause of it and, with the league and this, my fitness has been bigger”.</p>		
<p>“Um, I definitely think his fitness has come up. And I’d like for him to carry on with it, he wants to carry on with it and, uh, go really hard however we can and boxing.”</p>		
<p>“He’s not so aggressive as he used to be because he could be quite aggressive at times, I mean we’ve had a few run ins. He’s actually calmed down quite a lot.”</p>		
<p>“Yes, he’s quite confident now, his schooling has actually picked up. He’s come quite a long way.”</p>	Benefits outside of sport	
<p>“I’ve met new friends, the exercise was good for me, and just enjoying it, really, just having fun.”</p>		
<p>“Yeah, I think so. I got him into league last year and that got his confidence up a little. Got him into boxing and now that’s what he does around the house. As he’s walking around the house, does all of his boxing moves, even when we are in public. Which is interesting? It’s increased his activity level and I think it’s definitely increased his confidence. He’s involved in everything now. At school, yeah, everything.”</p>		
<p>“My only thing would be to find an in with a pastor who knows a lot of other pastors. You know, get in to some of the community groups. But mostly its churches, well that’s what I think the best way to get involved is. Most of them go to church, 80% of them go to church, they’ve got a huge community: Samoans, Tongans, Cook Islanders even.</p>		
<p>“Transportation would be really good, I think. And I think that would help get a lot of other, especially Polynesian boys, involved. Because I know the Polynesian culture. If it’s easier for them, they’ll do it. Know what I mean? If they have someone picking them up, dropping them off, and they can still concentrate on whatever they want to concentrate on, church, whatever, then they will be more willing, I think. I would still do it but I am not fully traditional, one of these people. But that would definitely make a huge difference, I think. A huge difference, if transportation was involved.”</p>	Recruitment issues	Recruitment

church, they’ve got a huge community: Samoans, Tongans, Cook Islanders even.”

Discussion

The present study investigated the effects of non-contact boxing intervention on cardio metabolic variables and explored factors associated with the intervention. The small sample size limits meaningful statistical analysis of changes in physiological data. Previous research has indi-

cated that high-intensity, intermittent exercise training can significantly decrease abdominal fat mass (Irving et al., 2008); the moderate decrease in visceral fat thickness in the current study tentatively supports these findings. Although there was a smaller effect size, the improvement in carotid β similarly supports previous findings that physical activity can improve early markers of atherosclerosis in children (Farpour-Lambert et al., 2009). Without changes to body weight, it could be suggested that improved cardiovascular function is more strongly related to visceral fat than overall mass (Hayashi et al., 2004; Lear et al., 2007). While objective determination of physiological benefits was limited, the improved body composition and cardiovascular function were corroborated by the subjective reports of participants and their parents during the open-ended interviews.

Interview data show support for previous research that demonstrates that regular exercise participation raises self-confidence and self-esteem (Ekeland et al., 2004), including transference from sport to life in general. Interview data reveal participants reported that they found the sessions to be physically demanding but interpreted symptoms of fatigue as a signal that goals were being achieved. Previous research has found that people experience positive psychological states coupled with fatigue after successfully completing physically demanding events (Lane and Wilson, 2011). It is proposed that the close proximity of a boxing trainer during training sessions aids in developing confidence in physically unfit participants. In running, the person can see how fast [or slow] he or she is running by using a watch. In boxing, there is no observable and objective indicator of progress, therefore, if the coach is offering encouragement the individual will re-appraise this information differently. One participant commented “everyone’s encouraging, no one criticizes you harshly, it’s just pointers here and there, and everyone’s really helpful”.

Despite these beneficial effects of the training programme, the number of participants recruited was lower than expected. Given the self-reported positive experiences, we argue that the key factor to the success of the intervention is to get people to begin the programme. Research indicates that individuals are aware of the benefits of exercise and often have good exercise intentions (Gollwitzer and Sheeran, 2006). However, it appears that translating an exercise intention into action is challenging (Gollwitzer and Sheeran, 2006). In particular, it is possible that the goal to exercise conflicted with negative perceptions of exercise from previous experiences. Attempting to overcome the ‘exercise intention-behaviour gap’ requires self-regulatory processes in order to overcome internal and external barriers toward exercise (Gollwitzer, 1999).

Although the present study attempted to secure community support, it is possible that aspects of the intervention were not seen as driven by key members of the community (Paine et al., 2013). Interview data suggested that involving key stakeholders from the local community could be important, and examining the influence of different ways to elevate intentions to exercise is a worthwhile line of enquiry (Schinke and Hanrahan, 2009).

Recruitment within the Pasifika and Māori communities most likely requires a multiple settings approach. Although physicians are an important link, it is more likely that recruitment through schools, church, and youth groups would be more appropriate. Specifically, a recruitment approach that is led by other youth could be a more effective strategy. Participants also suggested open days and community demonstrations as appropriate forms of recruitment within the community. We suggest that future research should seek to embed the intervention within the culture which the study is being conducted (Schinke and Hanrahan, 2009).

Limitations

At least three limitations are identifiable in the present study. The first is that the small sample size detracts from the generalizability of findings. Whilst findings offer insight into experiences of 3 participants, the extent to which these represent the population upon which findings infer is questionable. Second, the absence of a control group or condition makes interpretation of physiological markers difficult to interpret. Third, in the absence of a placebo condition, it is not possible to isolate the boxing intervention as an agent of change. It could be that increased interest by the researchers and positive reinforcement garnered via assessment was motivating, and thus any intervention involving personal contact could have elicited a similar effect. These limitations serve as a call for further research, with larger samples, and targeting participants who are presently inactive. Whilst the present study hints at the effectiveness of boxing as an intervention, further evidence is needed.

Conclusion

The present study developed a boxing-oriented intervention designed to encourage exercise uptake in obese Māori and Pasifika adolescents. Results revealed both adolescents and their parents reported positive experiences and importantly, the sense of raised self-confidence transferred from the exercise environment to general life. Although the sample size limits the inference of physiological data, the benefits were in the intended direction. It is suggested that future research identifies the extent to which boxing-oriented exercise might promote intentions to exercise and act on their good intentions.

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Key points

- A boxing-oriented intervention was developed for use with Māori and Pasifika adolescents to improve cardiometabolic risk factors.
- While results indicate positive benefits of participation in the 60-minute boxing-oriented programme, only three participants were recruited despite intense promotion.
- Future research should investigate the efficacy of strategies designed to raise intentions to exercise.

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