Effects on aerobic capacity of three 48-week community-based exercise interventions

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Abstract

A sedentary lifestyle is associated with cardiovascular disease (CVD). A substantial and compelling body of evidence demonstrates reduced CVD risk following systematic physical activity (PA). Despite this evidence, CVD continues to rise, and public health PA initiatives appear to be failing to demonstrate clinically relevant effects.

Purpose. A core component of cardiovascular health is the ability to utilise oxygen, termed 'oxygen uptake' or VO2. We investigated the effectiveness of three physical activity interventions on oxygen uptake. We did so using a Phase-IV clinical trial model, in which all treatments were administered in uncontrolled community settings, and in which all interventions and measures were delivered by, and conducted by, community health centre staff.

Methods. Participants were sedentary individuals receiving no medication to reduce CVD risk (n=238, age 43±5 years). Participants selected a PA or exercise (EX) pathway. Those who selected PA were randomised to either fitness centre based physical activity counselling delivered by an exercise professional (PAC) or a wait-list control condition (CON). Those who selected EX were randomised to either a structured exercise programme (STRUC) or unstructured fitness centre use (FREE). The dependent measure was predicted maximum oxygen uptake (VO_2max; $ml{\cdot}kg^{-1}{\cdot}min^{-1}$), measured using the COSMED Fitmate. Measures were taken at baseline and 48 weeks.

Results. Repeated measures ANOVA indicated no statistically significant difference between treatments ($F[3,215] = 1.173$, $p = .321$), and paired-sample t-tests indicated no significant pre-post effects for any treatment. When data were grouped using a quartile split by baseline VO2 max however, repeated measures ANOVA indicated significant differences between groups ($F[3,215] = 16.1$, $p < .001$), specifically that whilst in the highest two quartiles VO2 max was reduced ($M = -2.7$, $SD = 7.0$, $p = .05$ and $M = -2.6$, $SD = 6.0$, $p = .008$ respectively), and no significant change was observed in the third quartile ($M = -0.1$, $SD = 5.0$, $p = .89$), in the lowest quartile, VO2 max was significantly increased ($M = 4.1$, $SD = 6.6$, $p < .001$).

Conclusions. Data suggest that in terms of VO2, treatments in the current study were more effective with the least fit participants at baseline, and actually counter-productive for the most fit.

Introduction

The translation of laboratory findings into practice has been described as one of the greatest challenges facing health promotion and disease prevention [1, 2]. On the basis of the above it is not unreasonable to suggest that further community based physical activity intervention trials on relevant participant groups are warranted. Arguably, to inform policy and practice, such trials should replicate real world delivery, firstly in terms of how they are communicated, delivered and managed by exercise professionals, and secondly in terms of how they are accessed and experienced by patients [3]. Data to emerge from studies adopting such designs will have relevance to public health policy and practice [4].

Despite this evidence, cardiovascular disease (CVD) continues to rise, and public health PA initiatives often fail to demonstrate clinically relevant effects. In short, laboratory efficacy often fails to translate into real-world effectiveness. A core component of cardiovascular health is the ability to utilise oxygen, termed 'oxygen uptake' or VO_2. We investigated the effectiveness of three physical activity interventions on oxygen uptake. We did so using a Phase-IV clinical trial model, in which all treatments were administered in uncontrolled community settings, and in which all interventions and measures were delivered by, and conducted by, community health centre staff.

Methods

Participants were sedentary individuals receiving no medication to reduce CVD risk (n=238, age 43±5 years). Participants selected a PA or exercise (EX) pathway.

For the structured exercise programme (STRUC) participants had access to all fitness centre facilities and received an individualised exercise programme to follow which combined aerobic and resistance training. The unstructured fitness centre based exercise (FREE) allowed participants to have access to all fitness centre facilities but they received no structured programme to follow. Physical activity counselling (PAC) participants did not have access to any fitness centre facilities. Exercise professionals were instructed to meet participants once each month and deliver counselling sessions according to the 5 A's model [5]. The control group (CONT) was a wait-list group that did not have access to any fitness centre facilities, nor did they receive any PAC. The dependent measure was predicted maximum oxygen uptake (VO_2max; $ml{\cdot}kg^{-1}{\cdot}min^{-1}$), measured using the COSMED Fitmate. Measures were taken at baseline and 48 weeks.

Results

Table 1. Paired samples T-test comparing absolute changes in VO_2max for each treatment group

Treatment group	Change over baseline		95% CI		t	df	Sig
	M	SD	Lower	Upper			
CONT	-1.25	5.59	-3.01	0.52	-1.43	40	0.161
FREE	0.08	5.72	-1.30	1.47	0.12	67	0.904
PAC	0.16	7.78	-2.17	2.50	0.14	44	0.888
STRUC	0.91	6.91	-0.79	2.61	1.07	65	0.287

Figure 1. Pre and post VO_2max for each treatment group

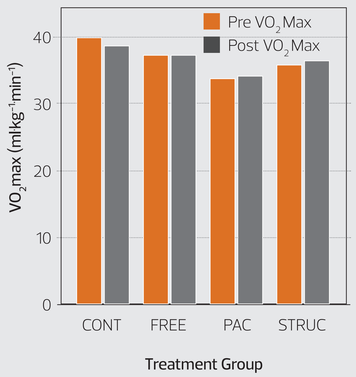

Figure 2. Pre and post VO_2max for each baseline fitness group

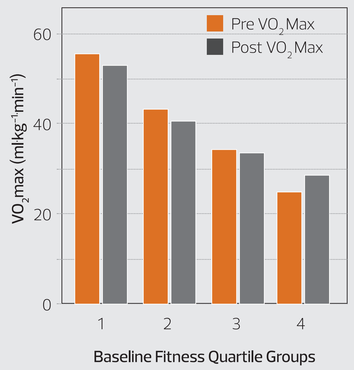

Table 2. Paired samples T-test comparing absolute changes in VO_2max for each baseline fitness group

Baseline fitness group	Change over baseline		95% CI		t	df	Sig
	M	SD	Lower	Upper			
CONT	-2.67	7.04	-5.35	0.01	-2.04	28	0.051
FREE	-2.65	6.38	-4.57	-0.74	-2.79	44	0.008
PAC	-0.11	5.09	-1.18	0.96	-0.20	88	0.840
STRUC	4.02	6.59	2.27	5.76	4.61	56	0.00

Repeated measures ANOVA indicated no statistically significant difference between treatments ($F[3,215] = 1.173$, $p = .321$), and paired-sample t-tests indicated no significant pre-post effects for any treatment.

Further analysis grouped the baseline VO_2max using a quartile split. A repeated measures ANOVA indicated significant differences between groups ($F[3,215] = 16.1$, $p < .001$). A paired sample t-test indicated that whilst in the highest two quartiles VOmax was reduced ($M = -2.7$, $SD = 7.0$, $p = .05$ and $M = -2.6$, $SD = 6.0$, $p = .008$ respectively). No significant change was observed in the third quartile ($M = -0.1$, $SD = 5.0$, $p = .89$), and in the lowest quartile, VO_2max was significantly increased ($M = 4.1$, $SD = 6.6$, $p < .001$).

Summary and Conclusion

Data suggest that over the 48 weeks, that in terms of VO_2max, the treatments in the current study were more effective with the least fit participants at baseline. Whereas the present treatments were counter-productive for the most fit participants measured at baseline.

Although there were no statistically significant differences in VO_2max for the four different treatment groups the structured exercise programme saw the largest mean increase, with the control actually decreasing over the 12 weeks. These results suggest that a structured exercise programme would be the best treatment to increase VO_2max, however further research is warranted before firm conclusions can be drawn with this population.

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The ukactive Research Institute holds a unique partnership between academia and industry to turn the tide of physical inactivity. It co-ordinates and delivers research designed to improve the use of physical activity in everyday life. Established in 2010, the ukactive Research Institute seeks to answer 'how can we get more people, more active, more often'?

The Research Institute aims to bridge the evidence gap between traditional laboratory based 'exercise is medicine' research and real world interventions. This is achieved by conducting research assessing the effectiveness of interventions on directly measured physical activity levels, clinically relevant markers of cardiovascular and metabolic health, and other core variables in real world interventions.

These questions will in time relate as much too economic, social and political factors as to scientific and health factors. Each project undertaken will, when completed, be publishable in a peer-reviewed journal article, constitute the basis of a major policy report/insight document, or produce otherwise strategically relevant data.

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