Author’s response to reviews

Title: The effect of home-based low-volume high-intensity, low-volume interval training on cardiiorespiratory fitness, body composition and cardiometabolic health in women of normal body mass and those with overweight or obesity: protocol for a randomized controlled trial.

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Author’s response to reviews:

Thank you to both reviewers for their thorough review of this manuscript. We have made the recommended suggestions which we believe improve the clarity of the protocol. The abstract has also been modified according to reflect the changes made in the manuscript. The line numbers that are indicated in the responses below refer to the line numbers of the manuscript containing the tracked changes.

Emma Cockcroft (Reviewer 1): This manuscript address an important area of research. The need of this intervention is well constructed and the protocol presents a number of important outcomes which are not often reported in physical activity interventions, but are key health outcomes. I have a number of comments and suggestions which need addressing prior to publication.

Background

*Although the study is well situated in the national health context, detail is also needed on how this fits globally

The patterns of obesity between men and women are the same in South Africa as those globally therefore we have added the line on page 5 lines 76-77: “These data are in line with global trends of obesity whereby more women than men are obese” with reference to the following pooled analysis:

*Page 5, Lines 78-80 : It is not clear why this is included - either more detail need as to why this is not sufficient, or remove from section

Thank you for this suggestion. We have removed the reference to fiscal tax from the section as we agree it is not relevant to the context of the study. Removed from page 5 lines 90-93.

*In general this section needs restructuring, sub titles may be helpful.

Thank you for this suggestion. We agree that this section requires improved clarity. In addition to adding sub-titles, we have focused this part of the background (pages 6-7) more around the perceived barriers to engagement in exercise and physical activity and made reference to some of those barriers specific to women. By doing so we have placed the need for public health strategies in the context of the current research specifically that more research is needed on feasible strategies to improve uptake and engagement in exercise and physical activity (clarified this statement on page 5 line 96).

We have expanded on the reasons that explain the poor engagement in physical activity on page 6 line 112-128. The section therefore provides the context for the justification that different exercise modalities that take into account barriers to physical activity engagement, should be investigated further for the promotion of better engagement in good health behaviours.

We believe the improved section provides more justification for including feasibility as a secondary outcome measure, as in the next section we suggest that HIIT may be one of these more feasible public health strategies.

*Page 5, lines 89-92: "and the literature is sparse on the levels...." This section needs re-writing to improve clarity.

In addition to adding sub-titles, we have modified the paragraphs on pages 6 and 7 to iterate that certain barriers exist to participation in exercise. We have also focused this section more on women and the different barriers to PA engagement that exist for women. We have removed the line “the literature is sparse....”.

*Could you further justify the potential of home-based HIIT - link to the barriers of PA e.g lack of time, cost etc.

Please see our response to the comment above in which we have made additions to the recommended sections and therefore strengthen the link between home-based HIIT and barriers to exercise. In the added paragraph on page 6 entitled “Engagement in exercise and PA and barriers to participation in PA” we make reference to low levels of exercise engagement not only in the healthy population but also in those with chronic disease who are referred for exercise rehabilitation, barriers which include lack of transport and social influence. Additional barriers to
exercise are perceived in people who are overweight or obese as well as those diagnosed with chronic disease and therefore more pragmatic solutions (i.e. a home-based HIIT programme) for engagement in activity would serve well not only the healthy population but also those who may have obesity related diseases of lifestyle.

Methods/Design

*Page 10- Outcome measures

- You later state the vo2 max will be recorded but it is not clear that this is one of your outcome measures. If not why is it not to be included as an outcome.

Thank you for raising this concern. We did not expect VO2 peak to change substantially over the trial period therefore initially we only anticipated using the maximal exertion test to prescribe the correct individualised intensity of the HIIT programme. However, the second reviewer has also queried the use of only body composition (BMI) as the primary outcome measure. Other measures of cardiorespiratory fitness that will be measured during the maximal exertion test, may however change following the intervention. In addition our main question is to determine what the effect of the intervention is on cardiometabolic health. Therefore, to address the reviewers’ concerns and because we do not expect BMI or body composition to change, we have adjusted the primary outcomes (page 12) to be measures of body composition, a change in cardiorespiratory fitness (as measured by measuring change in VO2peak, and HR at submaximal and maximal exercise), and measures of cardiometabolic health. Secondary outcomes will therefore be feasibility (measured using exercise diaries) and physical activity and sedentary behaviour levels (measured using accelerometers).

- What was the rationale for having BMI as the primary outcome measure and not other measures of body composition such at % body fat?

We have addressed this concern in the response above. In addition, as the second reviewer pointed out it is difficult to obtain accurate measures of % body fat in an obese population and therefore we wished to obtain some indication of body composition that may not have been as variable as % body fat, hence the use of BMI. However, to make sure our measures are as accurate as possible, the same person will be performing the skin folds thicknesses for all participants and they will be using standard procedures for the measurement of the skinfold thicknesses (clarified on page 19 lines 421-428).

*Page 12- Blinding

- The decision for unbinding the researcher doing most of the data collection is unclear.

The researcher doing most of the data collection will logistically not be able to be blinded as they will know what BMI group each participant belongs as well as to due to them encouraging adherence (through text messaging) to the HIIT programme.
*Page 13: This section would benefit from a re-write in places. For example "participants will also be connected to a heart rate monitor" could be heart rate will be recorded using a chest worn heart rate strap (RX8, Polar Electro). This section also jumps between using face mask to record oxygen consumption to HR and then back to breath-by-breath analysis. Re-write for more logical structure

Thank you for this suggestion. Throughout the paragraph on the maximal exertion test on pages 14-15 we have made the writing clearer and more logical. Some redundancies have also been deleted.

*Page 13- Home-based HIIT

Please include more detail of the exercises, not all readers will know what a burpee etc is - could have a diagram explaining the exercises.

Thank you we have added in our annotated sheet as Supplementary file 1 - indicated on page 17 line 369.

*Somewhere in this section it would be useful to include more detail on recruitment - how will participants be recruited, is there any strategy to recruit particularly the high BMI group?

A more detailed recruitment section has been added on page 11 line 233-241.

*Page 15/16 data collection

Include references for the methods described in these sections e.g. a reference for determining HOMA-IR and others.

Thank you. We have added the following references for the following measures:

RPE:


HOMA-IR:
Evelyn B Parr (Reviewer 2): The authors are conducting an interesting study which I look forward to seeing the results of in due course. With regards to the manuscript, there are a few areas for minor improvement.

Firstly, please use people first language to describe women with overweight/obesity rather than overweight/obesity as an adjective. Obesity in many (but not all) countries is a NCD (line 65) and should be communicated here as such.

Thank you for bringing this to our attention. We have reworded this throughout the manuscript including in the title. We have also changed our description of healthy weight women to women of normal weight.

Why are the same number of controls enrolled when the attrition rates may be higher, what is their incentive to remain in the study?

Following concerns raised by both reviewers, we have changed the primary outcomes to changes in body composition, a change in cardiorespiratory fitness (as measured by measuring change in VO2peak, and HR submaximal and maximal exercise), and measures of cardiometabolic health. Therefore the incentive would be for controls to improve those variables of health. We agree that attrition rates may be somewhat higher in the controls however the controls will also receive mobile text messages encouraging them to adhere to the intervention. We have clarified that controls will also receive the messages on page 18 line 392.

How is diet being controlled, or at least assessed, as changes to dietary intake can have a large effect on body composition irrespective of exercise?

Thank you for raising this concern. We have added that all participants are requested to maintain their normal dietary habits and that they do not start a new diet during the study period (page 12 lines 259).

The authors correctly point out the vast number of benefits of exercise that occur irrespective of weight loss. Considering the primary outcome of HIIT-type exercise is to increase CRF, why is the primary outcome change in body composition? What aspect of body comp is expected to change (Line 215)- lean mass or fat mass or body fat percentage? What aspect of body composition being studied should be specified. Further, the hypothesis (on line 161-165) does not hypothesise a change in the primary outcome of a change in body composition and instead postulates on cardiometabolic health which is extremely broad.

Thank you for drawing our attention to this. In order to make the outcomes clearer and in response to the first reviewer who raised a similar query on the rationale for BMI being the primary outcome we have modified and made it clearer so that the primary outcomes are a...
change in cardiorespiratory fitness, body composition, measures of cardiovascular health and biomarkers of metabolic health. Secondary outcomes of the study will be feasibility (completion and drop-out rates and intervention adherence) and physical activity and sedentary behaviour levels (measured using accelerometers). We have therefore also made the hypothesis clearer on page 10 lines 199-205.

The conclusion suggests that the primary outcome is feasibility? i.e. that HIIT protocols are sustainable outside of the lab. So, is the primary outcome feasibility or improvements in body composition?

We apologise for this confusion and have clarified primary and secondary outcomes on page 13 and subsequent data analysis sections. This was because of the justified concern that both reviewers mentioned that we do not expect to see a change in body composition as most literature points to this. Therefore body composition measures will be primary outcomes in addition to other physiological measures of cardiometabolic health. In addition, because the rationale behind a HIIT exercise program is that it saves time and our particular protocol may be performed at home we would like to see what the feasibility of the HIIT program is in this study. Therefore, feasibility is also a secondary outcome to the study and has been included and is reported in the methods section (page 18 line 407). We have also added more justification to the background which clarifies the rationale for having feasibility as an outcome in this study as detailed in the response to the first reviewer’s comments above.

The power calculations are unclear, the total number of participants needed is for two groups yet one of the study aims is to compare between "healthy" weight and women with overweight/obesity thus creating four subgroups. It is unlikely the sample size will be powered for this outcome and this should be disclosed accordingly.

We apologize for the confusion. The sample size calculation is for the total number of participants required to have 4 groups with 2 repeated measures in each group. We have clarified the four subgroups in the section. We have however redone the sample size calculation using change in VO2max as the outcome variable.

Are participants provided with HR monitors to be able to monitor their training adherence and prescription throughout the study?

Logistically and financially we are unable to provide heart rate monitors to participants throughout the study (we have added this as a limitation to the study protocol on page 24 lines 548-555). However, we will be providing the participants with an exercise diary for them to fill in when they complete their sessions along with a copy of the 6-20 Borg scale on which will be marked the intensity of the first HIIT session they will have performed in the lab. In addition, every 4 weeks during the intervention each participant will visit the lab to have an accelerometer fitted for an objective measure of physical activity over 7 days. Further the research assistant will be monitoring compliance throughout the study by sending mobile text messages to participants during the study, encouraging them to adhere to the program.
Minor comments:

Thank you for highlighting these errors which assist the legibility and clarity of the manuscript.

Title: should it read "on the body composition and cardiometabolic health of healthy…" or "on body composition and cardiometabolic health in healthy…"?

‘the’ has been removed. Title now reads: The effect of home-based low-volume high-intensity, low-volume interval training on body composition and cardiometabolic health in women of normal weight and with overweight or obesity: a protocol for a randomized controlled trial.

Lines 80, 105, 122, 442, 464, 470, etc use "this" which is ambiguous and can be clarified in each instance. Line 453 with "it" can also be clarified.

Line 80: sentence has been deleted.

Line 105: modified accordingly - now line 137.

Line 122: Sentence has been combined with the previous sentence and is now on page 8 line 153-156 which now reads: “Whether home-based HIIT activity produces similar cardiometabolic benefits to the classic running and cycling protocols needs investigation because feasible engagement in physical activity outside of research and clinic settings is important for sustained health benefits.”

Line 442 Now reads:

“HIIT may be especially beneficial for women who may experience more time-pressures with both family and work demands”. Line 525, page 23.

Line 464 now reads:

“Motivational messaging is a strategy that has been used in other remote interventional trials [58–60] that have used behavioural therapy (motivation and counselling) which is complementary to exercise prescription.” Page 24 line 546.

Line 470 now reads:

“Since HIIT is an effective exercise modality for the maintenance of cardiometabolic health, investigating the adherence to a home-based protocol is an important factor in understanding whether engagement in HIIT is in fact sustainable beyond the laboratory.” Page 24, line 560.

Line 81: change caloric to energy, as a calorie is a unit of energy

As requested by the second reviewer this phrase has been deleted as it is not relevant to the context of the study. Deletion made on page 5 line 92.
Line 194: why is it a requirement that participants are employed?

Apologies for this confusion. Employment is not a specific inclusion or exclusion criteria but rather relates to the area of recruitment which will be at the University (students) or in the surrounding CBD (employees). We have therefore removed it from this section. Correction made to Page 11 line 231.

Line 198: Type 1 or type 2 diabetes or both?

Thank you for pointing out this need for clarification. We have included that both are exclusion criteria on page 11 line 246.

Line 199: What do the authors mean by "if participants consider themselves as trained athletes" and what does a "structured exercise program" include?

Thank you for raising our attention to this. We have modified the sentence to make it clear that anyone who competes in sporting events or anyone has been prescribed exercise by a physical trainer or other health-related exercise professional will be excluded. Page 12, lines 251-254.

Line 266: Please reference this protocol.

The following reference (53) has been added on page 15 line 323:


Line 303: add "per session" to the total exercise time to clarify.

Per session added on page 17 line 370.

Line 304: does this mean participants could complete the training twice per day? What was the rationale for only allowing one "day off" from training? Is this going to be likely to be adhered to (pilot data or previous studies?)?

Thank you for this interesting comment. Yes, the fact that we require participants to complete 66 minutes per week means that participants could perform the activities once or twice per day on whatever days suit them best. We have clarified the combination of days on page 17 line 372. Current activity guidelines recommend that 150 minutes of moderate to vigorous physical activity be performed each week which works out to approximately 30 minutes per day on most days of the week. We therefore have no reason to believe that performing 11 minutes per day on 6 days of the week (i.e. having only one day off) will have reduced adherence than if current guidelines are prescribed.

Lines 344-346: Skinfolds in a population of overweight and obesity are notoriously difficult to be accurate. Please detail what methodologies are being used to keep as accurate as possible (i.e. person measuring, number of measures per site, time of day of measure) etc. Especially as body
composition is the primary outcome, skinfolds are less accurate in a population with greater amounts of body fat (as the estimations for the calculations which lead to body fat percentage are from lean populations) and only estimate subcutaneous fat depots, thus limiting interpretation.

Thank you for this comment. We agree with the reviewer and have detailed the measurement information on page 19 lines 422-428 to indicate the methodologies that will be employed to be as accurate as possible with the measures of body fat percentage.

Line 424: add "per week" after 66 minutes to clarify.

Per week added on page 22, line 506.

Line 439: please add a reference for lack of time being cited as a primary reason.

Reference 28 added on page 23 line 521.

Line 458: Provocatively, how is "home-based own-body weight" HIIT any different to HIIT performed in the lab? i.e. why would the mechanisms of improvements to cardiometabolic health be any different?

Thank you for this thought-provoking comment. Indeed, physiologically one would not expect home-based HIIT to be any different to HIIT conducted in a lab or clinic in terms of the effects on cardiometabolic health or cardiorespiratory fitness. We might only expect it to be better if exercise prescription is adhered to however, in other clinical populations (people attending cardiac rehabilitation) barriers such as clinic environment and transport influence attendance at exercise programmes. In line with the comments from the first reviewer we have therefore included feasibility as an outcome measure, i.e. we wish to report on adherence to this type of programme. We have also expanded on the literature in the background to further justify our choice of home-based protocol.