Heart rate changes in response to an exercise test and to a high intensity interval training session in subjects with normoglycaemic, prediabetes, and type 2 diabetes mellitus state

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Study documents

Scientific background: Exercise training is a cornerstone for the prevention [1-3] and treatment of metabolic disorders and associated cardiometabolic complications such as type 2 diabetes mellitus (T2D) and hypertension [4-7]. Similar to the beneficial health effects after performing conventional continuous exercise modalities, high intensity interval training (HIIT) has been reported as an effective alternative exercise-modality to improve glucose homeostasis in both prediabetes subjects and individuals with T2D diagnosed [5]. In this regard, although multiple HIIT-based interventions commonly report acute and long term benefits on body composition, cardiorespiratory fitness and insulin sensitivity in metabolically compromised subjects, little is known about the acute cardiovascular response (i.e., at heart rate level) during HIIT in subjects with different glucose control. HIIT is described as performing brief periods of exercise at vigorous or maximal intensity, interspersed with inactive or low intensity recovery phases of variable duration[8]. In order to characterize different HIIT-based protocols, exercise intensity is usually defined as relative percentages of individual maximal cardiorespiratory fitness (VO_2max) or relative maximal power output values. Nevertheless, the need for specific technological equipment to assess these parameters usually limit the prescription and recommendations of HIIT in clinical settings and other public health contexts at massive level. Additionally, the use of self-perceived exertion scales [9] and heart rate (HR) variations upon HIIT [4, 10] have been demonstrating to be accessible and feasible strategies to regulate exercise intensity during HIIT. For example, it was reported that HR and self-perceived exertion scores increased progressively in T2D subjects, parallel to the oxygen consumption rate throughout an acute HIIT session performed on cycle ergometer [5]. Consequently, it is conceivable to

hypothesize that determining HR variations during HIIT might optimize the recommendation of this training methodology in metabolically compromised subjects as those at risk or with T2D diagnosed. **Design:** An experimental, and randomized control clinical study. **Methods:** This cross-sectional study will use a non-probabilistic sample of 75 adult subjects, characterized as healthy normoglycaemic and with disturbed glucose homeostasis subjects, all referred by a physician to the exercise programme of our research centre. All volunteers will read and signed an informed consent. The inclusion criteria will be; a) aged 18-60 y; b) previously screened by physician professional; c) diagnosed with normoglycaemic, prediabetes or T2D state; d) and living in Temuco city. The exclusion criteria will be; a) low maximal cardiorespiratory fitness (defined as $VO_2max \leq 21$ ml/kg^{-1}/min^{-1}) below the expected value for the subject's sex and age [11]; b) not receiving pharmacologic hypotensive treatment with β-blockers; and c) having no musculoskeletal limitations to perform exercise cycling. The study will be completed in accordance with the Declaration of Helsinki and was approved by the Ethical Committee of the Physical Activity and Sports Sciences, of the Universidad de Los Lagos.

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Statistical Analysis Plan (SAP): We will apply 2 main forms of statistical analyses a) to report the pre-post changes in mean terms, and b) to report the results according with the inter-individual responses based on the technical error criteria, where according with the error calculated in the three previous measurements registered by the sample that was voluntary. Graphpad Prisma statistical software 5.0 (San Diego, CA, USA) will be used. The normal distribution of all the variables were tested using the D'Agostino-Pearson test. All the continuous variables were expressed as mean ± standard

deviation (SD). The differences between quantitative variables were analysed by ANOVA and Tukey's post-test for multiple comparisons or Kruskal-Wallis and Dunn's post-test. The level of significance used in all the comparisons was $P<0.05$. Secondly, we will classify the subjects in responders and non-responders by the technical error of measurement, and additionally, we will classify the subjects according with a responder and non-responder clinical criteria, where we will classify as responders to all subjects who can be able of changing an initial adverse clinical altered profile for a healthy new classification. Thus, the specific statistical methods that we hope to apply for each analysis are; test of normality and homoscedasticity assumptions using Shapiro-Wilk and Levene's tests, the Student's *t* test for the identification of differences at baseline. An ANCOVA will be conducted (for potential confounders outcomes) in those altered baseline differences outcomes. We also hope to apply the repeated measures of two-way (group, time) to assess occurrence of an actual training effect [*i.e.*, $p<0.05$ for the interaction (group × time) for the different study outcomes]. Among the specific statistical methods we hope to apply the Bonferroni *post hoc* test we hope to apply when we can be seen test differences among groups. Similarly, we hope to apply the Cohen's *d* test in order to detect effect size, using the threshold values of 0.20, 0.60, 1.2, and 2.0 for small, moderate, large, and very large effects, respectively [14], with 95% confidence intervals (CI). The alpha level was fixed at $P<0.05$ for statistical significance.