INPLASY PROTOCOL

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Conflicts of interest:
None declared.

Effect of exercise on heart rate variability in healthy adults - a systematic review and network meta-analysis

Wang, C[1]; Yang, FM[2].

Review question / Objective: **The purpose of this network meta-analysis of randomized controlled trials was to assess the effects of exercise on the autonomic nervous system in healthy adults.**
Condition being studied: **Research has found that autonomic function is a key determinant of cardiovascular health and prognosis and plays an important role in the development of CVD. One of these tests, HRV, is the small difference in adjacent R-R intervals over time between beats in the ECG, reflecting heart rate changes due to fluctuations in sympathetic and parasympathetic function, and is a new non-invasive test for quantitative clinical assessment of cardiac autonomic function. One study found that high HRV reflects an individual's ability to continually adapt to changes in the micro-environment and cardiovascular health. Where a relatively low HRV indicates relatively high sympathetic activity and low parasympathetic activity, which can lead to autonomic dysfunction. And relative reduction in HRV is also an independent predictor of CVD risk and all cause mortality. Studies have shown that HRV abnormalities have an important pathophysiological role in the early stages of primary hypertension, myocardial infarction and chronic heart failure, causing coronary vasoconstriction, increasing myocardial oxygen consumption and leading to an increased risk of fatal events. Therefore, the prevention of HRV abnormalities due to ageing or senescence is a challenge that clinicians continue to address.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 06 May 2023 and was last updated on 06 May 2023 (registration number INPLASY202350026).

INTRODUCTION

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prognosis and plays an important role in the development of CVD. One of these tests, HRV, is the small difference in adjacent R-R intervals over time between beats in the ECG, reflecting heart rate changes due to fluctuations in sympathetic and parasympathetic function, and is a new non-invasive test for quantitative clinical assessment of cardiac autonomic function. One study found that high HRV reflects an individual's ability to continually adapt to changes in the micro-environment and cardiovascular health. Where a relatively low HRV indicates relatively high sympathetic activity and low parasympathetic activity, which can lead to autonomic dysfunction. And relative reduction in HRV is also an independent predictor of CVD risk and all cause mortality. Studies have shown that HRV abnormalities have an important pathophysiological role in the early stages of primary hypertension, myocardial infarction and chronic heart failure, causing coronary vasoconstriction, increasing myocardial oxygen consumption and leading to an increased risk of fatal events. Therefore, the prevention of HRV abnormalities due to ageing or senescence is a challenge that clinicians continue to address.

METHODS

Participant or population: Healthy individuals with a mean age ? 18 years, free of endocrine disease, hypertension, heart disease,neurological disease, psychiatric disease, lung disease, liver and kidney disease and Parkinson's disease,non-cancerous, post-bariatric surgery and pregnant women, and non-smokers.

Intervention: The types of exercise in the intervention group were aerobic exercise, resistance exercise, aerobic combinedwith resistance exercise, and high-intensity interval training.

Comparator: The control group was a blank control group or an exercise different from the intervention group.

Study designs to be included: (1) study type: randomised controlled trials (RCTs).

Eligibility criteria: (1) study type: randomised controlled trials (RCTs) [1], language limited to Chinese or English; (2) studypopulation: healthy individuals with a mean age ?18 years, free of endocrine disease, hypertension, cardiacdisease, neurological disease, psychiatric disease, lung disease, liver and kidney disease and Parkinson'sdisease, non-cancerous, post - bariatric surgery and pregnant women, and no history of smoking; (3)Interventions: type of exercise in the intervention group was aerobic training (AT), resistance training (RT),aerobic combined with resistance training (CBT), high-intensity interval training (HIIT), and in the controlgroup was a blank control group or an exercise intervention different from the intervention group; (4)Intervention period ? 4 weeks or 8 times; (5) Outcome indicators: short-range HRV analysis in the quietstate, without restriction on measurement posture (supine/sitting/standing), including time domain indicatorsSDNN, RMSSD Frequency domain indicators HF, LF and LF/HF (including absolute and log-transformedvalues of the indicators).

Information sources: Two reviewers read, assessed and extracted data from the literature that met the inclusion criteria, reading the titles and abstracts to exclude any literature that was clearly ineligible. Literature data were extracted including information on: first author, year of publication, sample size, subject characteristics (age, gender, BMI), intervention characteristics (intervention type, intervention period/number), HRV test protocol (test method, breathing pattern, posture, length of analysis), and outcome indicators. When the literature included measurements of outcome indicators in different positions, the order of selection was supine, sitting and standing; when measurements of different intervention cycles were included, data for longer intervention cycles were included; when data in the literature could not be extracted, the first author or corresponding

author was contacted by e-mail to seek the original data.

Main outcome(s): Short-range HRV analysis in quiet state does not limit the measurement posture (supine / sitting / station), including time domain index SDNN, RMSSD, frequency domain index HF, LF and LF/HF (including index absolute value and logarithmic conversion value).

Quality assessment / Risk of bias analysis: Two researchers independently assessed the risk of bias (ROB-2) against the Cochrane Handbook version 5.3.0 tool for ROB-2 in RCTs (Cochrane, London, UK). The following seven domains were considered: (1) random sequence generation, (2) concealment of treatment allocation, (3) blinding of participants and (4) personnel, (5) incomplete outcome data, (6) selective reporting, and (7) other sources of bias. Based on the number of components with potentially high ROB - 2, the trial categorised ROB - 2 into three levels: high risk, low risk, and unclear risk.

Strategy of data synthesis: First, we studied the effect of different types of exercise on heart rate variability (HRV) in healthy adults, so we chose to use continuous variables for statistical analysis. To calculate the results more conservatively, we use the post-intervention data minus the baseline data to express the magnitude of the intervention effect. As the outcome data for our analysis requires logarithmic transformation and functional calculations, we choose to use standardised mean differences (SMD) rather than standard deviations (SD) for our calculations. As there is inevitably variation between the original studies, we have chosen to calculate a random effects model rather than a fixed effects model in order to make the results more scientific [4, 5]. Secondly, this study used Stata 16.0 software to present network evidence plots, which are important in the NMA. In network evidence plots, different plots have different meanings: (1) each node represents an exercise intervention; (2) the size of a node indicates the sample size of subjects who performed this intervention; (3) an indirect comparison between nodes is indicated if there are no line segments between each node, and a direct comparison between nodes if there are line segments; (4) an indication of the original study sample size is given by the thickness of the line segments between nodes; (5) size of nodes and thickness of line segments are positively correlated with the number [6]. Similarly, we used Stata 16.0 software to conclude and analyse the NMA using a Markov chain Monte Carlo modelling chain in a Bayesian-based framework. therefore, in the ranking scale, the treatments are ranked from best to worst along the leading diagonal. Above the main diagonal are estimate from pairwise meta analysis, while below the main diagonal are estimates from network meta-analysis (NMA) [7]. Finally, a ranking of the efficacy of the SUCRA was calculated in Stata 16.0 software and used as a criterion to evaluate the effect of the exercise intervention, which is a percentage with a maximum value of 1 and a minimum value of 0. The closer it is to 1, the more effective the intervention is, and the closer it is to 0, that the intervention is less effective. A funnel plot will be generated to evaluate possible publication bias in the study.

Subgroup analysis: None.

Sensitivity analysis: None.

Country(ies) involved: China.

Keywords: exercise, HRV, healthy adults.

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