Metabolic syndrome and long-term heart rate variability: a systematic review and meta-analysis

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Introduction: Metabolic syndrome (MS) is defined as the convergence over time of a group of non-communicable chronic diseases (hypertension, diabetes, dyslipidemia, obesity). There is agreement that MS is related to pathological changes in the behavior of the autonomic nervous system (ANS). Heart rate variability (HRV) is a very useful tool for assessing autonomous behavior, widely used and that could be useful for the diagnosis and monitoring of MS. However, to date, there are no quantitative analyses using meta-analysis (MA) that have addressed the changes that MS causes on the ANS. Therefore, the objective of this systematic review and MA is to evaluate changes in long-term HRV in patients with MS, in order to characterize the cardiac autonomic dysfunction induced by this pathological condition and the most frequently reported explanatory variables.

Methods: We searched PubMed, Web of Science and Scopus electronic databases for original works with long-term HRV recordings (24-h holter) that compared people with MS (MS+) versus healthy people as a control group (MS-). The search was carried out between June 25th, 2022 and September 1st, 2022. In the databases selected, the terms used were "metabolic syndrome" linked to "heart rate variability" (HRV), "cardiac autonomic control", "cardiac autonomic function", or "cardiac autonomic modulation". This systematic review and MA was performed according with PRISMA guidelines and registered at the International Prospective Register of Systematic Reviews (CRD42022358975). Results are reported as standard mean difference [95% CI].

Results: Thirteen articles were included in the qualitative synthesis and seven of them met required criteria to be included in the MA. MS decreased SDNN (-0.33 [-0.57, -0.09], p=0.008), LF (-0.40 [-0.51, -0.28], p<0.0001), VLF (-0.35 [-0.50, -0.21], p<0.0001) and TP (-0.24 [-0.43, -0.05], p=0.01). The MA did not find significant differences in rMSSD (-0.09 [-0.31, 0.13], p=0.41), HF (-0.29 [-0.61, 0.03], p=0.07) and LF/HF (-0.04 [-0.45, 0.36], p=0.84). No article reported information by gender. In the case of the non-linear variables, the information reported was not enough to carry out the MA, but the qualitative analyses showed no change in SD1 of the Poincare plot and a decrease in the multiscale entropy. For the SD2 of the Poincare plot and alfa-1 of the detrended fluctuation analyses, the results are not conclusive.

Conclusions: The analysis of HRV (time-domain) in long recording periods showed that patients with MS have lower values in the SDNN and no significant changes in rMSSD. Regarding the frequency domain analysis, we found that MS induced a significant decrease in LF, VLF and TP. The MA did not show changes in HF and LF/HF, and quantitative analyses of non-linear parameters could not be performed.