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Topic of research: Modulation of Cardiac Autonomic Control by Concurrent Exercise Training in Type 2 Diabetes Mellitus

FINDINGS

This doctoral research comprehensively investigates the modulation of cardiac autonomic control in individuals with Type 2 Diabetes Mellitus (T2DM) through Concurrent Exercise Training (CET). The thesis comprises five interrelated studies aimed at addressing the prevalence, predictors, and physiological consequences of Cardiac Autonomic Neuropathy (CAN) in T2DM and the efficacy of CET as an intervention strategy.

The first study, a cross-sectional analysis conducted on 323 participants, reported a high prevalence of CAN (70.6%) among individuals with T2DM. It identified resting heart rate (HR_{rest}), triglycerides, and body fat percentage (%BF) as significant predictors. Multivariate analysis affirmed HR_{rest} as an independent predictor, with a threshold value of >80 bpm showing moderate sensitivity and specificity in ROC analysis. These findings underscore HR_{rest}'s role as a clinically relevant marker in routine screening of CAN.

The second study was a randomized controlled trial evaluating the impact of CET over 13 weeks. It demonstrated statistically significant improvements in heart rate variability (HRV), blood pressure, glycemic control (HbA1c, fasting and postprandial glucose), lipid profile, and cardiorespiratory fitness (CRF). Notably, parasympathetic markers like RMSSD and SDNN significantly improved in the CET group, suggesting enhanced autonomic balance and vagal modulation. The intervention also led to improvements in HR recovery and body composition.

The third study examined the sequence effect of aerobic and resistance exercises within CET. No significant differences were found between aerobic-first and resistance-first groups, suggesting the flexibility of sequencing in clinical implementation of CET protocols.

The fourth study analyzed the correlation between HRV and CRF, particularly VO₂max. A positive correlation was observed, confirming that higher cardiorespiratory fitness is associated with improved autonomic regulation. This reinforces the clinical significance of VO₂max and HRV as integrated markers for cardiovascular health in diabetic populations.

The fifth study validated the Hindi version of the Audit of Diabetes-Dependent Quality of Life (ADDQoL-19). Psychometric analysis confirmed strong internal consistency, reliability, and construct validity, making it a culturally appropriate tool for assessing diabetes-specific quality of life in Indian populations.

The collective findings from this thesis establish CET as a highly effective, non-pharmacological intervention for improving autonomic, metabolic, and cardiovascular outcomes in T2DM patients with CAN. The research further contributes to clinical practice by

identifying HRrest as a predictive marker, validating an important QoL tool, and demonstrating CET's adaptability through flexible sequencing options.

These findings advocate for the inclusion of CET in routine diabetic care, support the integration of HRV and CRF metrics in clinical assessments, and provide culturally validated tools for patient-centered outcome evaluation.