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Balancing the load: how training duration and intensity impact coronary artery disease risk in middle-aged endurance athletes

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Background: Recent studies, including the Master@Heart (M@H) study, reported an increased prevalence of coronary artery disease (CAD) in middle-aged, male endurance athletes compared to healthy controls. However, the impact of training load (TL), such as duration and intensity, on this phenomenon remains unclear. Prior studies relied on self-reported TL, which recent research has shown to correlate poorly with objectively measured data from wearables.

Purpose: This study aimed to investigate the relationship between self-reported and objectively measured TL, and their association with CAD in middle-aged endurance athletes versus less active controls.

Methods: 242 M@H participants (mean age 54.4 ± 6.3 years) provided self-reported and objectively measured TL data. Self-reported TL included training duration (hours per week, h/wk) and an estimation of intensity, from which metabolic equivalent of task-minutes (MET-min) per week was derived. Objective TL was derived using in-house developed software, which incorporated maximal heart rate from wearables to define intensity zones. Training duration (h/wk) and Edwards training impulse (eTRIMP, weekly average in arbitrary units), a composite metric of duration and intensity, were calculated based on three consecutive training months. Coronary artery calcification (CAC) scores and the presence of coronary plaques were assessed using computed tomography coronary angiography. Logistic regression analysis was used to assess the relationship between TL (in quartiles, Q1-4) and the likelihood (odds ratio, OR) of having ≥1 coronary plaque and CAC>100 (in Agatston units), adjusted for age.

Results: Self-reported TL significantly predicted CAC>100 in Q4 versus Q1 with OR 2.80 [95% CI 1.10-7.09] for training duration. However, self-reported training duration was not a significant predictor of ≥1 coronary plaque (p=0.055), nor did MET-min per week significantly predict ≥1 coronary plaque or CAC>100 (p=0.217 and p=0.135, respectively). In contrast, higher objectively measured TL was significantly associated with the presence of CAD (Figure). Participants in Q4 of measured duration had a significantly higher likelihood of having ≥1 coronary plaque and CAC>100 compared to those in Q1 with OR 2.34 [95% CI 1.08-5.10] and OR 2.60 [95% CI 1.06-6.42], respectively. Also, participants in Q4 of eTRIMP had a significantly higher probability of having ≥1 coronary plaque and CAC>100 compared to those in Q1 with OR 3.66 [95% CI 1.62–8.24] and OR 2.64 [95% CI 1.04–6.72], respectively. However, Q2 and Q3 of self-reported and objectively measured TL showed no significant difference to Q1.

Conclusion: This study highlights the importance of considering both training duration and intensity, as athletes engaging in high-duration, high-intensity exercise are at an elevated risk of developing CAD. Moreover, objective TL using training duration and eTRIMP outperforms self-reported TL in predicting CAD in middle-aged endurance athletes.

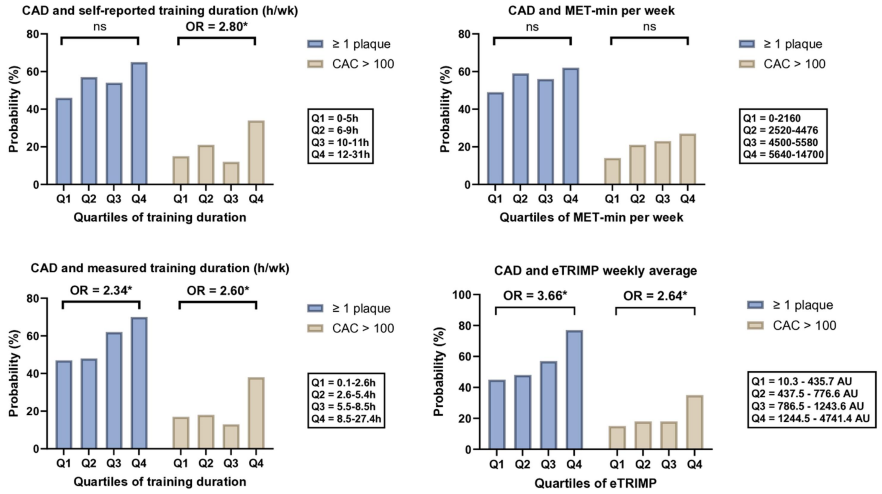

Figure. The relationship between self-reported, objectively measured training load quartiles and coronary artery disease (CAD) is illustrated. Odds ratios (OR) represent the comparison between quartile 4 (Q4) and Q1. OR are adjusted for age. Statistically significant OR are marked with an asterisk (*). Notably, intermediate quartiles of training load (Q2 and Q3) showed no significant difference with Q1. Other abbreviations: ns = not significant; CAC = coronary artery calcification in Agatston units; eTRIMP = Edwards training impulse; MET-min = metabolic equivalent of task multiplied by minutes of training; h = hours; wk = week; AU = arbitrary units.