

Multiple Metabolic Syndrome Is Associated With Lower Heart Rate Variability

The Atherosclerosis Risk in Communities Study

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OBJECTIVE — To test at the population level whether people with multiple metabolic syndrome (MMS) disorders have reduced cardiac autonomic activity (CAA).

RESEARCH DESIGN AND METHODS — We examined the association between the level of CAA and MMS disorders, at the degree of clustering and the segregate combination levels, using a random sample of 2,359 men and women aged 45–64 years from the biracial, population-based Atherosclerosis Risk in Communities (ARIC) Study. Supine resting 2-min beat-to-beat heart rate data were collected. High-frequency (HF) (0.15–0.35 Hz) and low-frequency (LF) (0.025–0.15 Hz) spectral powers, the ratio of LF to HF, and the SD of all normal R-R intervals (SDNN) were used as the conventional indices of heart rate variability (HRV) to measure CAA. The MMS disorders included hypertension, type 2 diabetes, and dyslipidemia.

RESULTS — HRV indices were significantly lower in individuals with MMS disorders. The multivariable adjusted mean HF was 0.85 (beat/min)² in subjects with all three MMS disorders, in contrast to 1.31 (beat/min)² in subjects without any MMS disorder. At the segregated combination level, the multivariable adjusted means \pm SEM of HF were 1.34 ± 0.05 , 1.16 ± 0.05 , 1.01 ± 0.17 , and 1.34 ± 0.05 (beat/min)², respectively, for subjects without any MMS disorder, with hypertension only, with diabetes only, and with dyslipidemia only, and the means \pm SEM of HF were 0.93 ± 0.04 , 0.70 ± 0.15 , and 1.20 ± 0.05 (beat/min)², respectively, for subjects with diabetes and hypertension, diabetes and dyslipidemia, and hypertension and dyslipidemia. An increase in fasting insulin of 1 SD was associated with 88% higher odds of having a lower HF. The pattern of associations was similar for LF and SDNN.

CONCLUSIONS — These findings suggest that MMS disorders adversely affect cardiac autonomic control and a reduced cardiac autonomic control may contribute to the increased risk of subsequent cardiovascular events in individuals who exhibit MMS disorders.

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Abbreviations: ARIC, Atherosclerosis Risk in Communities; CAA, cardiac autonomic activity; CHD, coronary heart disease; ECG, electrocardiogram; HF, high-frequency spectral power; HRV, heart rate variability; LF, low-frequency spectral power; MI, myocardial infarction; MMS, multiple metabolic syndrome; PSD, power spectral density; SDNN, SD of all normal R-R intervals.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

In recent years, analysis of beat-to-beat heart rate variability (HRV) has emerged as one of the noninvasive methods used for quantitative assessment of cardiac autonomic activity (CAA). Previous work has shown that heart rate oscillations at low frequencies (0.04–0.15 Hz) are influenced by both the sympathetic and the parasympathetic nervous systems, whereas heart rate oscillations at high frequencies (0.15–0.40 Hz) are influenced by the parasympathetic system only and therefore are a marker of cardiac parasympathetic activity (1–9). Techniques to estimate HRV in the time domain, e.g., SD of all normal R-R intervals (SDNN), have also been used extensively (8).

Several clinically based studies have found that lower HRV was associated with higher risk of all-cause mortality in acute myocardial infarction (MI) survivors (10–13). Lower HRV has also been found to be related to sudden cardiac death (14). Results from population-based follow-up studies suggested that lower HRV is also associated with the risk of developing coronary heart disease (CHD) (15,16). It has been proposed that HRV be used as a prognostic factor for MI risk stratification and management (17).

People with hypertension, type 2 diabetes, and/or dyslipidemia, which are sometimes termed the multiple metabolic syndrome (MMS) because of the statistical clustering of these disorders, have a significantly increased risk of cardiovascular disease (18–20). These interrelated disorders associated with MMS most often include those mentioned above (20–23). However, the etiology of MMS is not fully understood, and controversies persist regarding the existence of a syndrome (24), the definition of the component disorders, and the classification of these disorders as a single syndrome.

Hypertension, diabetes, and dyslipidemia have each been reported to be associated with lower HRV. However, the joint effects of these disorders on cardiac autonomic control have not been investigated. This study was designed to investigate