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**The impact of the psychosocial work environment on cardiac
autonomic activity and the metabolic syndrome**

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Background

Cardiovascular diseases (CVD) including essential hypertension and metabolic syndrome (MetS) are major causes of morbidity and mortality global for men and women across all age groups. CVD accounts for 48% of deaths from non-communicable diseases, and for 10% of global disease burden resulting in an estimated 35 million deaths per year. MetS is one major risk factor for the development of CVD and type 2 diabetes (T2D). Emerging risk factors for CVD are psychosocial factors, in particular stress at work. Prospective evidence that chronic stress leads to MetS development is provided for example by the Whitehall study, showing that civil servants exposed to chronic stress are more than twice as likely to develop the MetS. Yet the underlying mechanisms remain unclear, but autonomic nervous system (ANS) dysfunction had been suggested as a potential pathway.

A framework was suggested that states the necessity to cross four levels of functioning for a more integrative understanding of mind-body interactions. These levels are (1) mental or psychological or behavioral states and traits (2), the brain itself (3), information transfer systems, and (4) body proper. The purpose of this thesis was to examine relationships between work stress (Level 1) and MetS components (Level 4) and to explore the potential mediating role of cardiac ANS function (Level 3). Evidence will be provided, that ANS function, as indicated by measures of heart rate variability (HRV), might be a final common pathway in stress regulation and the transition of stress into somatic diseases.

Method & Results

Four potential pathways were necessary to be investigated, labeled [A] [B] [C] [C']. These paths guide the overall structure of this dissertation. First, a systematic literature review summarizes the evidence between different work stress models and cardiac ANS function [Path A]. The conclusion from this systematic review is, that workplace stressors are associated with decreases in neural vagal control of the heart indicating diminished adaptivity of autonomic nervous system response to environmental challenges.

Second, the relationship between measures of ANS function and MetS components are investigated [Path B]. Two independent cross sectional dataset (Dataset A N=3,331 Dataset B N=657) on healthy employees from the Mannheim Industrial Cohort Study (MICS) were analyzed using linear regression models to determine the role of vagally-mediated HRV in glycemic regulation. These studies provide evidence supporting the hypothesis of a clinically relevant cholinergic pathway in glucose regulation.

Third, the relationship between work stress and glycemic status is explored [Path C]. Logistic regression models are applied to show associations between work stress and the presence of diabetes and prediabetes in a healthy working cohort (Dataset A). It can be concluded, that the presence of workplace stressors is associated with increased risk of prediabetes and diabetes.

Fourth, the relationships between work stress and MetS components are analyzed considering the potential mediator ANS function [Path C']. Here, structural equation modeling using cross sectional data (Dataset C N=14,431) explores the potential mediating role of vagally-mediated HRV in the work stress and glycemic status association.

The conclusion from this unique study is, that this association is partly mediated through vagally-mediated HRV, over and above inflammatory regulations. Although this is shown in cross sectional data and therefore inferences on causal relationship can only be assumed and not drawn from the results, we have some confidence in the results. This is because a large body of previous literature

has shown already that work stress precedes elevated glycemic status as well as diminished HRV and that diminished HRV precedes elevated glycemic status.

Discussion

This work provide evidence that chronic stress at work contributes to the development of the MetS and thus is a risk factor for T2D and CVD development. Furthermore it is distinctly shown, that vagally-mediated HRV accounts for up 25% of the association between chronic stress at work and glycemic status. The relevance of this work for occupational public health arises from the fact, that chronic work stress is avoidable.

In the face of the demographic change and tightened by political decisions such as the raised retirement age from 65 to 67 years in Germany, it is even more important to early prevent development of risk factors for chronic diseases. Employers, unions and politicians as important social entities need to sustain health in employees to maintain a healthy workforce. This work provides additional knowledge about possible risk factors of this global public health issue and may assist the development of prevention strategies.