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Psychosocial risk factors for the metabolic syndrome: A prospective cohort study

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ABSTRACT

Background/Objectives: Metabolic deregulations and development of metabolic syndrome may be an important pathway underlying the relationship between stress and cardiovascular disease. We aim to estimate the effect of a comprehensive range of psychosocial factors on the risk of developing metabolic syndrome in men and women.
Methods: The study population consisted of 3621 men and women from the Copenhagen City Heart Study who were free of metabolic syndrome at baseline and reexamined after 10 years. The data was analyzed by multivariable logistic regression models adjusted for age, education, income, menopausal status and life style factors.
Results: We found major life events in adult life (OR 1.48, 95% CI 0.93 to 2.36) and major life events at work (OR 2.75, 95% CI 1.38 to 5.50), lacking a confidant (OR 1.94, 95% CI 1.07 to 3.53) and dissatisfaction with social network (OR 1.53, 95% CI 1.11 to 2.11) to be risk factors for developing the metabolic syndrome in women, while vital exhaustion (OR 2.09, 95% CI 0.95 to 4.59) and intake of sleep medications (OR 2.54, 95% CI 0.92 to 5.96) may play a more important role in men.
Conclusions: Experiencing major life events in work and adult life and/or dysfunctional social networks is a risk factor for metabolic syndrome in women, and stress reactions such as vital exhaustion and intake of sleep medications may play a more important role in the development of metabolic syndrome men.

1. Introduction

Chronic stress is becoming an established risk factor for cardiovascular disease [1,2]. Evidence of mechanistic pathways is essential for drawing causal inference and the metabolic syndrome is promising in this regard. The metabolic syndrome is a cluster of risk factors that increases the risk of heart disease and type 2 diabetes mellitus and a maladaptive adjustment to environmental demands has been suggested to play an important role in its etiology [3–6].In a systematic review based on primate models, Black argues that stress alone can cause early manifestations of diabetes and metabolic syndrome [7]. Thus the metabolic syndrome may represent a plausible pathway linking stress to cardiovascular disease.

The majority of studies on psychosocial factors and risk of metabolic syndrome have been cross sectional in nature [5,8–13] and the existing prospective studies [14] identified have primarily focused on exposures to stress in a single domain of life, such as major life events in work [15] and private life [4], marital quality [16,17] or work-related stress [13,15,18]. We aim to bridge this gap in existing knowledge by estimating the effects of a comprehensive range of psychosocial factors on the risk of developing the metabolic syndrome in a large prospective study with ten years of follow-up. We use comprehensive measures of psychosocial factors encompassing the three main stress theories. The *stimulus oriented theories* of stress focus on external events and are represented by major life events (MLE) in childhood, work and adult life, living alone, having no regular contact to family and/or friends, and lacking a confidant; the *response oriented theory* focuses on the response to demands [19] and is measured by vital exhaustion and severe sleeping problems in the current study; and the *interactional theory* of stress focuses on the perception and appraisal of stress [20] and is represented by dissatisfaction with social network. Furthermore, we hypothesize that a clustering of psychosocial risk factors may exceed the sum of their individual effects and therefore also aim to analyze how accumulation of psychosocial risk factor exposition affects development of the metabolic syndrome.

2. Methods

The Copenhagen City Heart Study is a longitudinal study initiated in 1976. An age-stratified random sample of 19,698 men and women

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20–93 years of age were invited to participate in the study and a total of 14,223 individuals attended the first examination in 1976–78. At subsequent waves of the study in 1981–83, 1991–93 and 2001–03 the entire original sample and a number of new individuals were invited and additional study assessments were performed. The present study included information on psychosocial factors from the third wave of the study which took place from 1991 to 93 (n = 10,135). The 7952 surviving participants were invited to the fourth wave of the study in 2001–03 and 5008 choose to participate. Participants with metabolic syndrome (n = 871), ischemic heart disease (n = 249), type 2 diabetes (n = 22), and missing covariates (n = 74) at baseline or missing data on any metabolic syndrome components at wave four (n = 175) were excluded leaving 3621 men and women with complete data for analyses.

2.1. Metabolic syndrome

Data on metabolic syndrome was collected at waves three and four during the clinical examination. A slightly modified version of the National Cholesterol Education Program's Adult Treatment Panel III report (ATP III) clinical criteria was used to define the metabolic syndrome. The ATP III clinical criteria is defined as having at least three of the following five risk factors: abdominal obesity measured by a waist circumference >102 cm in Europid men, and >88 cm in Europid women, triglycerides ≥150 mg/dl, HDL cholesterol <40 mg/dl in men and <50 mg/dl in women, blood pressure ≥130/85 mm Hg measured in a sitting position after five minutes rest or taking hypertensive medication and fasting glucose ≥110 mg/dl [21]. Unfortunately, we did not have access to fasting glucose levels so a non-fasting glucose level >200 mg/dL was used, based on recommendations of the American Diabetes Association [22], or alternatively self-reported use of diabetes medications or diabetes.

2.2. Psychosocial measures

Psychosocial factors were assessed by questionnaire at the third wave of the study. The following psychosocial factors were included: childhood MLE (long-term disease in parents, being placed in care outside of the home, serious family conflicts, parents' long-term unemployment, and serious economic problems in childhood), work MLE (job loss, serious conflicts with colleagues, supervisors or charges, not being promoted, and not achieving educational goals), adult MLE (long-term illness or serious accident, having children with educational problems, serious conflicts with adult children, marital problems, death or long-term illness in a close family member, and serious economic problems). The MLE questionnaire is based on a shorter and modified version of the Social Readjustment Rating Scale [23]. Vital exhaustion, characterized by unusual fatigue, loss of energy, increased irritability and feelings of demoralization is considered a risk factor for cardiovascular disease [24]. It was assessed by a 17 item yes/no questionnaire based on Apples' Vital Exhaustion Scale and items were summed into an item score ranging from 0 to 17 and subsequently categorized into the following scores, 0, 1 to 4, 5 to 9 and 10 to 17 based on previous categorizations used in studies addressing vital exhaustion in this population and an assumption of nonlinearity [25]. Cohabitation was assessed with a dichotomous questionnaire item, regular contact with family was defined as having contact with parents, children, and/or other family and contact with friends was defined as having contact with childhood friends and other friends (a few times or more per month were defined as regular contact, and seldom, never and have none were defined as no contact). To assess satisfaction with social network participants were asked “How satisfied are you with your social contacts?” (very satisfied/somewhat or very dissatisfied) and to assess lacking a confidant they were asked “Is there someone you can talk to about personal issues?”(yes/no), the daily use of sleeping medications was used as a proxy measure of severe sleeping problems and was assessed by a dichotomous questionnaire item.

The number of psychosocial risk factors analysis included the sum of the following: 1) ≥1 childhood MLE, 2) ≥1 adult or work MLE, 3) vital exhaustion score between 8 and 17, 4) ≥1 adverse structural aspects of social network: not cohabiting, no contacts to friends and/or family, 5) ≥1 adverse functional aspects of social network: lacking a confidant and/or dissatisfaction with social network, and 6) daily use of sleep medication. To gain power for the statistical analysis the number of psychosocial risk factors was categorized into 0 to 1, 2 to 3 and 4 to 6.

2.3. Covariates

Other covariates included age (continuous), educational attainment according to the Danish education system (< 8 years, 8–10 years, ≥11 years), annual household income under 100,000 DKK (approximately 18,100 USD) for non-retired subjects (≤68 years), tobacco smoking (never, former, 1–14 g/day, 15–24 g/day and >24 g/day), alcohol consumption (< 1,1–7, 8–14, 15–21, ≥22 drinks/week), physical activity during leisure time, (sedentary or very light activity <2 h/week, light activity 2–4 h/week, light activity >4 h/week or 2 to 4 h of high level activity, and competitive level of activity >4 h/week) and menopausal status in women (“Has your menstruation stopped?”). All covariates were measured at baseline in 1991–1993.

2.4. Statistical analyses

Confounders were identified based on previous knowledge and the methods of directed acyclic graphs [26]. The data was analyzed by multivariable logistic regression models. The first model was unadjusted; the second adjusted for age, education, annual income and menopausal status and the final model was further adjusted for physical activity, tobacco smoking and alcohol consumption. Self-reported health behaviors were adjusted for in a separate analysis as it was unclear if they were confounders or factors on the causal pathway. Age was included as a continuous variable after testing the assumption of linearity. All analyses were stratified by sex.

3. Results

During ten years of follow-up, 186 women (9%) and 120 men (8%) developed metabolic syndrome. The mean age at baseline was 52 for women and 49 for men and ranged from 21 to 84 years and 61% of the study population was female (Table 1). Approximately 12% of women and 10% of men had experienced between 4 and 6 psychosocial risk factors. Baseline characteristics by number of psychosocial risk factors are presented in Table 1.

Three or more *major life events* in work life (OR 2.75, 95% CI 1.38 to 5.50) and in adult life (OR 1.48, 95% CI 0.93 to 2.36) were associated with a higher risk of metabolic syndrome in women, although we found no gradient in these associations (Table 2a). No clear associations were observed between major life events and development of the metabolic syndrome in men (Table 2b).

Vital exhaustion was associated with a higher risk of metabolic syndrome in an exposure dependent manner in women ($P = 0.02$). A higher risk of metabolic syndrome was observed in men with high versus low vital exhaustion (OR 2.09, 95% CI 0.95 to 4.59) although these findings were only based on 13 cases.

Social network and particularly the functional aspects including lacking a confidant (OR 1.94, 95% CI 1.07 to 3.53) and dissatisfaction with social network (OR 1.53, 95% CI 1.11 to 2.11) were associated with a higher risk of metabolic syndrome in women, but not in men. On the contrary not having regular contact with friends appeared to