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Seasonal variations in mood and behavior associate with common chronic diseases and symptoms in a population-based study

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ABSTRACT

The purpose of this study was to assess how seasonality is associated with some of the most common non-communicable diseases (NCDs) in the general Finnish population. The global seasonality score (GSS) was used to measure the magnitude of seasonality in 4689 participants, in addition to which they reported the extent to which the seasonal variations in mood and behavior were experienced as a problem. Regression models and the odds ratios were adopted to analyze the associations adjusted for a range of covariates. Seventy percent of the participants had seasonal variations in sleep duration, social activity, mood, or energy level, and forty percent those in weight and appetite. Angina pectoris and depression were significantly associated with seasonality throughout the analysis. Hypertension, high cholesterol levels, diabetes, other (than rheumatoid) joint diseases and other (than depressive) psychological illnesses were significantly associated with experiencing a problem due to the seasonal variations, with an increase in the GSS, and with seasonal affective disorder and its subsyndromal form. The co-occurrence of the seasonal variations in mood and behavior with certain common NCDs warrants future research to have insights into the etiology and potentially shared pathways and mechanisms of action.

1. Introduction

Seasonal variations in mood and behavior (seasonality) refers to depressive symptoms caused by seasonal changes (Rosenthal et al., 1984a). Seasonal affective disorder (SAD) was first recognized in Diagnostic Statistical Manual Revised Version (DSM-III-R) as a "seasonal pattern" in mood disorders (American Psychiatric Association Committee on Nomenclature and Statistics, 1987). It is characterized by predictable onset of major depression during fall or winter or during summer (Rosenthal et al., 1984a; Wehr et al., 1988). The prevalence of SAD is estimated 5% in the USA (Rohan et al., 2015), 2–3% in Canada (Levitt et al., 2000), and up to 10% in the northern latitudes(Byrne and Brainard, 2008). Epidemiological studies have showed that more than 90% of the general population have some seasonal influence on their mood, social activity, sleep, appetite, weight gain or energy level (Dam et al., 1998; Kasper et al., 1989; Oyane et al., 2008).

Earlier studies have found associations not only between seasonal variations and mood but also between seasonal variations and bulimia nervosa, depression, anxiety and other psychiatric illnesses (Gruber and Dilsaver, 1996; Magnusson, 1996; Oyane et al., 2008). Harmatz and colleagues demonstrated associations between seasonal variations and depression, anger, hostility and irritability, and anxiety (Harmatz et al., 2000). General anxiety disorder, panic disorder, obsessive compulsive disorder, tension anxiety and substance abuse are reportedly more prevalent during fall or winter than during spring or summer (Schlager et al., 1993; Harmatz et al., 2000; Kovalenko et al., 2000; de Graaf et al., 2005). The impacts of seasonal variations has also been studied in common non-communicable diseases (NCDs) such as diabetes, cardiovascular diseases (CVDs), cancer and rheumatic diseases (Hawley et al., 2001; Øyane et al., 2010; Ernst, 2012). Numerous studies have also reported seasonal variations within metabolic syndrome parameters like weight, serum cholesterol level, uric acid, blood pressure, and glucose (Yanovski et al., 2000; Ockene et al., 2004; Liang, 2007; Hayashi et al., 2008; Rintamäki et al., 2008; Alpérovitch et al., 2009). Studies have repeatedly demonstrated higher

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morbidity and mortality of NCDs during winter than during summer (Kloner et al., 1999; Rumana et al., 2008). In European countries, mortality is 16% higher during winter than during summer (Healy, 2003). Moreover, NCDs impose the largest burden on human health globally. Its impact extends beyond ill health and mortality with large financial consequences. It accounted for 68% deaths (38 million) of world's 56 million deaths in 2012 (World Health Organization, 2014).

The etiology of SAD is not certain, but several hypotheses has been presented (Roecklein and Rohan, 2005). Several lines of evidence suggests common etiological factors in many disorder found to co-occur in SAD through indications of common pathophysiological mechanisms, common treatment response and common genetic liabilities (Partonen and Magnusson, 2001). For example, it has been suggested that SAD is caused by vitamin D deficiency (Berk et al., 2007, Gloth, Alam, and Hollis, 1999). This hypothesis is supported by the findings that vitamin D supplementation improves SAD (Lansdowne and Provost, 1998; Gloth et al., 1999). Vitamin D deficiency is also found to be associated with an increased risk for several NCDs such as osteoporosis, cancer, diabetes, autoimmune disorders, hypertension, atherosclerosis, muscle weakness, chronic obstructive pulmonary disease (COPD), vascular disease events in type 2 diabetes, cardiovascular diseases (CVDs), and renal failure (Forman et al., 2007; Holick, 2007; Donaldson and Wedzicha, 2014). Certain neurotransmitters have been implicated in SAD etiology; for example serotonergic system dysregulation has shown to play important role in the regulation of mood, appetite and sleep (Partonen and Lönnqvist, 1998). Further, photon hypothesis in SAD has been proposed, according to which the changing photoperiod during winter has drastic impact on the circadian rhythms and entrainment causing SAD. Low levels of outdoor light exposure during winter months might cause inadequate resetting of the circadian clock, which presumably is also linked to chronic diseases (Laposky et al., 2008). Accordingly, evening types felt better in the summer while morning types in the winter, due to long and short photoperiods within these seasons (Natale et al., 2005).

In summary, understanding the role of hormones and circadian systems biology may bring a new perspective on the influence of SAD on the course and outcomes of NCDs. It could help in designing more appropriate treatment regimes.

In the present study, we examined the relationship between seasonality and some of the most common NCDs (hypertension, high cholesterol, cardiac insufficiency, angina pectoris, diabetes, cancer, bronchial asthma, chronic obstructive pulmonary disease, gallstones, rheumatoid arthritis, other joint disease, degenerative arthritis, depression, other psychological illnesses, renal failure, and proteinuria). To elucidate this association, we measured the degree of seasonality among Finnish participants suffering from NCDs. In Finland (60–69°N), the seasonal temperature and daylight fluctuations are intense, and thus the Finnish population is a good subject for to study seasonality. The current study is part of a larger national FINRISK health examination survey, carried out at every-five-year intervals since 1972 in Finland.

2. Methods

2.1. Participants

Random samples of Finns, aged 25–74 years, were invited to the National FINRISK Study 2012 from five large geographical areas in Finland. The sample was derived from the population information system of the national population register center. Total participants (n=6424) answered and attended to the health examinations of the study. Participants (n=4800) responded to each item of the seasonal variations in sleep duration, social activity, mood, weight, appetite, and energy level (the maximum n=4852 reported the seasonal variation in sleep duration). Participants (n=4777) reported their experience on the seasonal variations as a problem and produced the global seasonality score (n=4770). Finally, a total of 4689 participants reported both their experience and scored on the GSS (see Table 2).

2.2. Covariates

The surveys included a self-administered questionnaire (mainly including questions on socioeconomic factors, medical history, health behavior, and psychosocial factors), physical examination and laboratory measures. Socioeconomic covariates were age as continuous variable, sex as male or female, marital status as living together with somebody (either married, cohabitating or registered partnership) or alone (either single, separated or divorce, widow), education as low (less than four years of high school), medium (either high school only or 1–3 years post high school) or high (4 or more years post high school) level, region as living in North Karelia and Kuopio, North Savo, Turku and Loimaa, Helsinki and Vantaa, or Oulu. Lifestyle covariates were smoking as smokers (either smoked daily or occasionally) or non-smokers (smoked not at all), alcohol consumption as alcohol intake (at least once or more than once a month) or no alcohol intake (no alcohol consumption at all) and exercise as regular exercise (at least 3–4 h per week or several times a week) or no-exercise. The participants were asked if the doctor has diagnosed or treated them in the past 12 months for the following NCDs: hypertension, high cholesterol, cardiac insufficiency, angina pectoris, diabetes, cancer, bronchial asthma, COPD, gallstone, rheumatoid arthritis, other joint diseases, degenerative arthritis of the back, depression, other psychological illnesses, renal failure, and proteinuria.

2.3. Global seasonality score

Seasonality was measured in this study by a modified self-rating Global Seasonality Score (GSS), a central subscale of the Seasonal Pattern Assessment Questionnaire (SPAQ) (Rosenthal et al., 1984b). The GSS investigates the seasonal variations in sleep duration, social activity, mood, weight, appetite, and energy level. Each item is a Likert-like scale scored as 0 (no variation) to 3 (marked variation), yielding the total sum score from 0 to 18. The higher the GSS is, the higher the degree of seasonality is. In addition, the item about the experience on the seasonal variations as a problem is scored from 0 (no problem) to 4 (severe problem). In the current study, SAD refers to 8–18 points on the GSS and 3–4 points on the experienced problem; sub-syndromal SAD (S-SAD) refers to 8–18 points on the GSS and 2 points on the experienced problem, or 6–7 points on the GSS and 2–5 points on the experienced problem; and normal seasonality refers to the remaining. The GSS has been shown to have an acceptable reliability and validity in epidemiological studies (Thompson et al., 1988; Magnusson, 1996).

2.4. Statistical analysis

The data was analyzed using appropriate statistical methods with IBM SPSS Statistics 21 software. Group differences were measured, and the statistical significance was tested. Chi-square test was used to measure the distribution between SAD, S-SAD and socio-demographic factors. Bivariate and multiple regression models with NCDs as dependent variables and the seasonality items as independent explanatory variables were generated, after controlling for the background covariates (age, gender, education, civil status, alcohol consumption, physical activity, smoking, and