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MOOD-WORSENING WITH HIGH-POLLEN-COUNTS AND SEASONALITY: A PRELIMINARY REPORT

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Abstract

Background: Because aeroallergens produce inflammation in the respiratory airways, and inflammation triggers depression in vulnerable individuals, we hypothesized that mood sensitivity to pollen, the most seasonal aeroallergen, will be associated with a greater seasonality of mood. Since pollen is absent during winter, we specifically predicted that mood sensitivity to tree pollen will predict non-winter SAD but not winter SAD.

Methods: A convenience sample of African and African American college students who lived in the Washington DC metropolitan area for at least the past 3 years completed the Seasonal Pattern Assessment Questionnaire (SPAQ), from which the Global Seasonality Score (GSS) was calculated, a diagnosis of cumulative SAD (syndromal or subsyndromal SAD) was derived, a seasonal pattern (winter vs non-winter) identified, and self-reported mood changes during high pollen counts obtained. A Mann Whitney test was used to compare GSS between participants *with* versus *without* mood worsening during high pollen counts. The capability of mood worsening with high pollen counts, gender, ethnicity, and age to predict non-winter SAD was analyzed with logistic regressions.

Results: GSS was greater ($z=5.232$, $p<0.001$) in those who reported mood worsening with high pollen counts. Mood sensitivity to pollen predicted non-winter SAD ($p=0.017$), but not winter SAD.

Limitations: The SPAQ is not a definitive tool to assess seasonality, and self-reported mood worsening with high pollen counts relies on recollection. No direct measures of depression scores or pollen counts were collected. The non-winter SAD concept has not been previously established.

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Conclusions: Our study, which should be considered preliminary in light of its limitations, suggests that self-reported mood-worsening with high pollen count is associated with a greater seasonality of mood, and predicts SAD of non-winter type.

Keywords

Seasonal affective disorder; seasonality; allergy; pollen

Introduction

It is now well accepted that a proportion of patients with depression decompensate during a particular time of the year. This pattern of depressive episodes associated with a particular season is termed seasonal affective disorder (SAD). The occurrence of depressive episodes during fall and winter, with remission in spring and summer represents the winter type of SAD, which is the most consistently described seasonal pattern of SAD (Rosenthal et al., 1984). Moreover, a reverse pattern with depression in summer and remission in fall and winter has also been described (Boyce & Parker, 1988; Wehr et al., 1987; Wehr & Rosenthal, 1989). Seasonal changes in environmental light drive seasonal depressive symptoms in individuals with winter SAD (Kasper et al., 1989; Rosenthal et al., 1985a; Rosenthal et al., 1987; Wehr et al., 2001), and bright light treatment is effective in reducing winter depressive symptoms in SAD (Terman et al., 1998; Eastman et al., 1998; Lewy et al., 1998; Postolache & Oren, 2005). In addition, it has been suggested, although not yet empirically tested, that high temperatures drive seasonal depressive symptoms in summer SAD (Boyce & Parker, 1988; Wehr et al., 1987; Wehr & Rosenthal, 1989).

Recently, we have examined the contribution of other seasonal environmental factors as potential triggers for seasonal changes in mood. One such factor, known to induce seasonal allergies in a large proportion of the population, is high pollen counts (Mothes et al., 2004; Traidl-Hoffmann et al., 2003). Pollen induces a strong inflammatory response of the respiratory tract in allergic individuals, and inflammatory triggers have been associated with acute worsening of mood in healthy individuals (Reichenberg et al., 2001). We hypothesize that pollen-related worsening of mood will predict a greater seasonality of mood. In fact, Bartko and Kasper (1989) reported an association between high pollen counts, mood worsening in winter, and winter SAD. However, given that high pollen concentrations are encountered during all seasons *except* winter, we further hypothesize that mood worsening with high pollen counts will predict a non-winter pattern of SAD. Because a stronger association between depression and allergy was previously reported in females (Timonen et al., 2002; 2003), we hypothesize that the relationship between non-winter SAD and high pollen counts will be greater in females than in males. In this preliminary study, we have used a convenience sample of college students at local universities in Washington, DC. As there was a great preponderance of African and African American students, we decided to focus our study to that population. As exposure to an allergen during early childhood may convey protection to future sensitization to the allergen (Fasce et al., 2005), we also hypothesize that mood worsening with high pollen counts will more strongly predict non-winter SAD in Africans (who are less likely to have history of exposure to the prevalent flora of the Washington, DC metropolitan area as children), than in African Americans. As an alternative hypothesis, a longer history of exposure to local pollens and urbanization could increase African Americans' exposure to pollutants that foster sensitization and inflammation, resulting in a stronger association mood worsening with high pollen counts with non-winter SAD in African Americans than in Africans (Almqvist, 2005; D'Amato et al., 2005; Lau et al., 2005;).

Methods

Sample

We analyzed data we previously collected for a larger study on seasonality in African American students (Agumadu et al., 2004). We used a convenience sample ($n=845$) of African American and African college students aged 17-67 years (mean = 29.7; SD = 9.39) from four academic sites in Washington, DC who had lived in the metropolitan DC area for at least 3 years prior to beginning the study. The sample included 523 females (62.7%) and 311 males (37.3%) of whom 521 (61.7%) completed the data collection instruments in their entirety. The study was approved by the Institutional Review Board of the Department of Mental Health Services of the District of Columbia. The questionnaires were presented to student respondents as a group in a classroom setting where written informed consent was obtained.

Seasonal Pattern Assessment Questionnaire (SPAQ)

The SPAQ (Kasper et al., 1989b) consists of several sections: a) demographic data, b) seasonal changes in sleep length, social activity, mood, weight, appetite, and energy level (Likert scales scored 0-4, used to calculate a Global Seasonality Score or GSS), c) the severity of the degree to which seasonal changes present a “problem” for the individual (either none present, mild, moderate, marked, severe or disabling; the problem score and the GSS are used to define the categorical diagnoses of SAD and subsyndromal SAD), d) the months of the year of feeling worse (used to define the seasonal pattern of SAD), e) sensitivity of mood to environmental variables. For (e), we used only the items regarding mood sensitivity to high pollen counts and mood sensitivity to short days, converting the responses from ordinal ratings to a dichotomous variable for mood worsening (a rating of -3, -2, or -1) or not (a rating of 0 or higher). We used the criteria of Magnusson and Stefansson (1993) to define SAD and subsyndromal SAD (S-SAD) or the lack of either. For SAD, a subject had to meet the following criteria: a) GSS score of 11 or above, and b) reported a problem with seasonal mood changes, rated as at least moderate in degree. To be categorized as subsyndromal SAD, the criteria require a) a GSS of 11 or more with a problem severity rating of none or only mild or b) a GSS of 9 or 10 with a problem severity rating of at least mild. We defined the “cumulative SAD” category for those meeting criteria for either SAD or subsyndromal SAD. Based on the month of “feeling worst”, we defined a winter type (December, January, February) and a non-winter type (the rest of the year). Only 521 participants (61.7%) completed all four measures (GSS, “problem”, seasonal pattern and mood sensitivity to pollen) and were included in the statistical analysis.

Statistical Analysis

For comparing GSS between those with and without mood worsening with high pollen counts, because of the skewed distribution of the GSS (Pearson's $\chi^2 = 0.48$), we used the Mann Whitney rank sum. Stepwise logistic regressions with backwards elimination were used to test if mood worsening with high pollen counts, mood sensitivity to short days, ethnicity, gender, age, and prior length of stay in the area, or their interactions, predicted non-winter cumulative SAD and winter cumulative SAD. The criterion α , two tailed, was 0.05. All statistical analyses were conducted using Stata™ version 8.2 and Systat version 10.2.

Results

Descriptive analysis

The respondents were primarily African American (70.9%) and under the age of 35 (71.6%). The average age was 29.4 years for people reporting sensitivity to pollen and 29.5 for those who did not report sensitivity to pollen (difference non-significant). The average duration of residence in the study area was 19.3 years for those not reporting sensitivity and 20.4 years for

those reporting sensitivity to pollen (non-significant), with two-thirds of the respondents living in the area for more than 10 years. 41% met the criteria for cumulative SAD (either syndromal or subsyndromal). More than two-thirds (68.3%) of respondents reported that high pollen worsened their moods, compared with about half (55.35%) who made the same claim about short day lengths. More than one in four (26.5%) respondents met criteria for non-winter cumulative SAD compared with about one in seven (15.3%) for winter SAD.

Hypothesis-driven analyses

Respondents reporting mood worsening with high pollen counts had significantly higher GSS totals (median=9.0) compared to those with no mood worsening with high pollen counts (median=6.5) (Mann-Whitney $z=5.232$, $p<0.001$). Mood worsening with high pollen counts significantly increased the odds of meeting non-winter SAD criteria by 1.68 times (95% CI: 1.15-2.45). Mood worsening with high pollen counts also significantly predicted non-winter cumulative SAD, increasing its odds by 1.65 times (95% CI: 1.06-2.69, $p=0.017$, sensitivity 0.267, specificity 0.743), while its prediction of winter cumulative SAD was not significant. Our predicted effects of gender and ethnicity were not confirmed. Gender, ethnicity, age, length of stay, and their interactions had non-significant predictive effects on the non-winter type of cumulative SAD.

Discussion

This study found an association between self-reported mood worsening during periods of high pollen counts and greater dispositional seasonality. In addition, participants who endorsed mood worsening when pollen count is high were more likely to meet criteria for non-winter SAD and non-winter cumulative SAD (i.e., including subsyndromal SAD). Our findings are consistent with those of Bartko and Kasper (1989). However, our current study adds a somewhat greater degree of temporal specificity in that our analysis indicates that mood sensitivity to tree pollen specifically predicts *non-winter* SAD and not *winter* SAD. The results are also consistent with the reported association between allergy and depression (Bell et al., 1991; Hashiro and Okumura, 1998; Marshall et al., 2002; Postolache et al., 2005b; Timonen et al., 2001; Timonen et al., 2003a; Timonen et al., 2003b; Timonen et al., 2002;). The potential relevance of the association between allergy and depression is highlighted by the very high (>50%) prevalence of a positive skin reaction to allergens in the general population (Arbes et al., 2005).

Concomitant to spring peaks in tree pollen (Kosisky & Carpenter, 1997), a spring peak in completed suicides across continents, countries, and hemispheres has been consistently reported (Petridou et al., 2002; Maes et al., 1993; Chew and McCleary, 1995, among others). The precipitating factor of this spring peak in suicide is unknown. Photoperiod, changes in photoperiod, and light intensity have been proposed as possible environmental triggers (Goodwin and Jamison, 1990). However, upon careful scrutiny, the peak times of suicide occurrence (summarized in Altamura et al., 1999) do not match the peak of photoperiod (centered on the Summer Solstice in late June) or the time when photoperiodic changes are at their greatest (centered on the Spring equinox in March; Barker et al., 1994; Linkowski et al., 1992; Souetre et al., 1987; Tietjen & Kripke, 1994; Terao et al., 2002). Based on the temporal coincidence between seasonal peaks in tree pollen and peaks of suicide, we have hypothesize that seasonality of suicide could be driven by a combination of environmental triggers and vulnerability, i.e. seasonal aeroallergens and a triple vulnerability for allergy, depression, and suicide (Postolache et al., 2005b). Using a large scale epidemiological approach, we have preliminarily reported an association between windows of high tree pollen and higher suicide rates (Postolache et al., 2005a). The mechanisms that might explain the association between allergy and depression, in general, and suicide, specifically, are poorly understood. A number

of potential underlying processes have been considered and are under investigation (Postolache et al. 2005b).

Limitations

Our sample included only African American and African students and, therefore, our results may not be generalizable to the entire population. However, they confirm certain results of a previous study using an ethnically diverse sample (Bartko & Kasper 1989). The prevalence of asthma and allergies is higher among African Americans, and the severity of their symptoms is greater, as they are more likely to die from an acute asthma attack than whites (Fagan et al., 2001; Gold and Acevedo-Gargia, 2005, Arbes et al 2005). No direct measures of either depression scores or pollen counts were performed. Similarly, no data on allergies was collected. SPAQ (although validated in college students) estimates seasonality, but is not a definitive tool to assess it. The concept of nonwinter SAD has not been previously established. One could also argue that our results are an expression of circular reasoning. Thus, more refined epidemiological, observational and experimental work is necessary to confirm our hypothesis. On a clinical level, there is a need for further studies that will directly and longitudinally measure depression, allergy symptoms, inflammation markers, and pollen counts. Until then, our results should be considered as preliminary.

In conclusion, our results, suggest that a non-winter pattern of SAD may be related to seasonal exposure to pollen, an environmental factor that sharply fluctuates with the seasons. This may be particularly relevant to depression in spring, when a massive peak of tree pollen overlaps with, and potentially relates to, a highly replicated peak of suicide. Identifying an aeroallergen-induced seasonal depression will require multiple levels of inquiry and could be conducive to future novel prognostic, preventative and therapeutic approaches for mood disorders.

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