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Psychological distress in asthma and allergy: the Västerbotten Environmental Health Study

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With the aim to better understand the association between asthma/allergy and psychological distress, it was hypothesized that levels of stress, exhaustion, anxiety, depression, and health worries for environmental pollution would be higher in allergic asthma, allergic rhinitis, and atopic dermatitis than in non-allergic asthma and in referents without asthma or allergy. Taking part in the population-based Västerbotten Environmental Health Study (aged 18–79 years), 76 respondents reported a physician-based diagnosis of allergic asthma, 86 reported non-allergic asthma, 190 reported allergic rhinitis, and 46 reported atopic dermatitis as the only form of asthma/allergy. A group of 2876 respondents without an asthma/allergy diagnosis constituted as referents. The participants responded to the Perceived Stress Scale, the Shirom-Melamed Burnout Questionnaire, the Hospital Anxiety and Depression Scale, and the Environmental Pollution subscale of the Modern Health Worries Scale. Levels of stress, exhaustion, and anxiety were higher in allergic asthma and atopic dermatitis than in non-allergic asthma, allergic rhinitis, and among referents, and there was a strong tendency of such group differences for depression and health worries. The results imply that stress reduction and treatment of negative affect may in certain cases be fruitful interventions in patients with atopy.

Keywords: anxiety; burnout; depression; stress; worry

Introduction

Allergic asthma, allergic rhinitis, and atopic dermatitis are common forms of atopy, and may have a bidirectional causal relationship with psychological distress (Chida, Hamer, & Steptoe, 2008). There may be a negative loop, such that atopy leads to psychological distress, which, in turn, may reinforce the atopy outcome. Relevant aspects of psychological distress in this context are stress, exhaustion (burnout), anxiety, depression, and health worries. The association between stress on the one hand, and atopy in the form of allergic asthma (Rand et al., 2012; Yonas, Lange, & Celedón, 2012), allergic rhinitis (Mösgees & Klimek, 2007), and atopic dermatitis (Mitschenko, Lwow, Kupfer, Niemeier, & Gieler, 2008), on the other hand, is well documented. Mechanisms underlying stress as a mediator of atopy have been carefully described (Rand et al., 2012; Wright, 2005; Yonas et al., 2012).

In contrast to stress, the picture is not clear regarding associations between atopy and other aspects of psychological distress. For example, no studies have been documented on an association between atopy and exhaustion. Having either generalized

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anxiety disorder or major depressive disorder has been shown to be associated with increased rate of asthma hospital admission (Wainwright, Surtees, Wareham, & Harrison, 2007), and Vamos and Kolbe (1999) reported both anxiety and depression to be associated with asthma. However, other studies show weak or no relations between anxiety/depression and atopy (Hart, Lahey, Hynd, Loeber, & McBurnett, 1995). In another study, anxiety was found to be associated with allergic asthma and allergic rhinitis, but not with atopic dermatitis, and depression was not associated with any of these three atopies (Slattery & Essex, 2011). Taken together, anxiety seems more likely than depression to be associated with atopy. Typically, no distinction has been made between allergic and nonallergic asthma, and to our knowledge investigation of an association between nonallergic asthma, specifically, and psychological distress has not been conducted. Prolonged worry is known to reinforce the development of immunological, endocrine, cardiovascular, and neurovisceral disease (Brosschot, Gerin, & Thayer, 2006; Verkuil, Brosschot, Meerman, & Thayer, 2012). It is most likely that hypersensitivity to environmental allergens will evoke health worries for such environmental exposure, and as a result, possibly also generalize to health worries for environmental pollution.

The objectives were to compare allergic asthma, nonallergic asthma, allergic rhinitis, atopic dermatitis, and nonasthma/allergy (referents) with respect to stress, exhaustion, anxiety, depression, and health worries for environmental pollution. It was hypothesized that the five aspects of psychological distress would be higher in allergic asthma, allergic rhinitis, and atopic dermatitis, but not in nonallergic asthma, when compared to persons with no asthma or allergy, and that depression would have a weaker association than anxiety with the three atopies. This was conducted by means of the population-based Västerbotten Environmental Health Study.

Methods

The study population were inhabitants in the county of Västerbotten in Northern Sweden, which has an age and gender distribution similar to that of Sweden in general (Statistics Sweden, 2012). A random sample of 8600 individuals aged 18–79 years were drawn from the municipal register. The sample was stratified for age and sex according to the age strata 18–29, 30–39, 40–49, 50–59, 60–69, and 70–79 years. Of the 8600 individuals, 8520 could be reached, among whom 3406 (40.0%) volunteered to participate. Age and sex distributions for the sample are given in Table 1.

A total of 530 responders reported having been given at least one of the diagnoses allergic asthma, nonallergic asthma, allergic rhinitis, and/or atopic dermatitis by a physician. Of these, 132 had more than one of the four diagnoses, and were excluded from further analysis. Among the remaining 398 respondents, 76 had allergic asthma, 86 had nonallergic asthma, 190 had allergic rhinitis, and 46 had atopic dermatitis. The

Table 1. Numbers of respondents (and response percentages) across age and sex strata.

Age strata (years)	Women (%)	Men (%)
18–29	307 (32.7)	179 (17.7)
30–39	266 (40.9)	177 (25.2)
40–49	288 (40.7)	230 (31.3)
50–59	367 (51.0)	295 (39.7)
60–69	405 (58.6)	356 (50.7)
70–79	265 (53.8)	271 (63.9)
18–79	1898 (45.2)	1508 (34.9)

2876 respondents who had no asthma or allergy diagnosis constituted a reference group. The five groups are described in Table 2, and did not differ significantly on any of these variables [$p > .05$; one-way analysis of variance and chi-square analysis (Fisher's exact test when cell frequencies < 5)].

The questionnaire used included questions pertaining to background information (Table 2) as well as the Perceived Stress Scale (PSS; Cohen & Williamson, 1988; Cronbach's $\alpha = .83$), the Shirom-Melamed Burnout Questionnaire (SMBQ) with four subscales (Emotional and Physical Exhaustion, $\alpha = .89$; Listlessness, $\alpha = .85$; Tension, $\alpha = .77$; Cognitive Weariness, $\alpha = .92$) and an Overall Index of Exhaustion ($\alpha = .95$; Melamed, Kushnir, & Shirom, 1992), the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983; $\alpha = .85$ for the Anxiety subscale, and .83 for the Depression subscale), and the Environmental Pollution subscale of the Modern Health Worries Scale (MHWS; Petrie et al., 2001; $\alpha = .92$). All respondents received the questionnaire by mail, to be returned by mail with prepaid postage.

Table 2. Characteristics of the respondents.

	Allergic asthma (<i>n</i> = 76)	Non-allergic asthma (<i>n</i> = 86)	Allergic rhinitis (<i>n</i> = 190)	Atopic dermatitis (<i>n</i> = 46)	Referents (<i>n</i> = 2876)
Age (mean $\pm$ SD)	51.4 $\pm$ 17.5	53.8 $\pm$ 17.0	48.4 $\pm$ 16.7	47.8 $\pm$ 15.5	51.7 $\pm$ 16.8
Women (%)	56.6	58.1	51.1	67.4	55.4
University education (%)	38.2	44.7	45.7	52.2	41.2
Marital status (%)					
Married/partner	70.7	77.4	70.9	71.7	74.6
Unmarried/widow	20.0	17.9	19.5	19.5	19.4
Divorced	9.3	9.5	9.5	8.7	5.9
Duration of asthma/allergy (mean $\pm$ SD)	24.9 $\pm$ 15.0	15.3 $\pm$ 11.0	25.1 $\pm$ 15.6	20.0 $\pm$ 11.8	—
Frequency of asthma/allergy exacerbation (%) ^a					
Daily	7.9	14.8	21.7	—	—
Weekly	18.4	14.8	20.7	—	—
Monthly	73.7	70.4	57.6	—	—
Smoking regularly (%)	4.0	7.0	6.3	10.9	9.0
Frequency of physical exercise (%)					
Once a month or more seldom	10.7	9.3	12.8	19.6	12.9
2–4 times a month	22.7	19.8	19.7	30.4	19.8
2 times a week or more often	66.7	70.9	67.5	50.0	67.3
Frequency of alcohol consumption (%)					
Once a month or more seldom	53.3	50.0	49.0	50.0	45.6
2–4 times a month	33.3	38.4	34.6	39.1	42.0
2 times a week or more often	13.3	11.6	16.5	10.9	12.4
Diagnosis (%) ^b					
Posttraumatic stress disorder	0	0	0	0	0.9
Burnout	2.6	5.8	2.1	2.2	4.2
Generalized anxiety disorder	1.3	1.1	2.6	2.2	0.7
Panic disorder	3.9	1.1	1.6	4.3	1.3
Depression	7.9	7.0	6.3	9.6	4.4

Notes: SD = standard deviation.

^aOnly four participants with atopic dermatitis responded to this question.

^bSelf-report of having been given a diagnosis by a physician.

Table 3. Mean and median scores on measures of psychological distress, and results on overall (H-values) and post hoc Kruskal-Wallis analyses.

	A allergic asthma (n = 76)	B non-allergic asthma (n = 86)	C allergic rhinitis (n = 190)	D topic dermatitis (n = 46)	E referents (n = 2876)	Overall analysis	Post-hoc analysis
PSS ^a							
Mean (SD)	16.1 (6.97)	13.7 (5.78)	14.0 (6.25)	16.6 (7.23)	13.8 (6.30)		
Median (IQR)	15.0 (8.00)	13.5 (7.00)	14.0 (9.00)	16.2 (10.00)	13.0 (9.00)	14.7**	A = D > B = C = E
SMBQ ^b							
Emotional and physical exhaustion							
Mean (SD)	3.54 (1.34)	2.88 (1.26)	2.81 (1.23)	3.37 (1.46)	2.84 (1.25)		
Median (IQR)	3.61 (1.95)	2.63 (1.62)	2.57 (1.72)	3.25 (2.21)	2.63 (1.75)	27.3***	A = D > B = C = E
Listlessness							
Mean (SD)	4.02 (1.28)	3.36 (1.37)	3.38 (1.29)	3.83 (1.52)	3.45 (1.34)		
Median (IQR)	4.10 (1.80)	3.43 (2.00)	3.25 (1.75)	3.75 (2.21)	3.50 (1.75)	17.2**	A = D > B = C = E
Tension							
Mean (SD)	3.23 (1.28)	2.84 (1.19)	2.90 (1.24)	3.30 (1.45)	2.87 (1.25)		
Median (IQR)	3.05 (1.75)	2.50 (1.59)	2.75 (1.75)	3.25 (1.75)	2.75 (1.75)	10.3*	A = D > B = C = E
Cognitive weariness							
Mean (SD)	3.23 (1.57)	2.51 (1.29)	2.58 (1.32)	3.12 (1.61)	2.56 (1.36)		
Median (IQR)	2.67 (2.17)	2.25 (1.73)	2.33 (1.88)	2.67 (2.71)	2.17 (1.83)	20.0***	A = D > B = C = E
Overall index							
Mean (SD)	3.48 (1.22)	2.86 (1.13)	2.87 (1.13)	3.37 (1.37)	2.88 (1.14)		
Median (IQR)	3.38 (1.90)	2.69 (1.56)	2.70 (1.75)	3.35 (2.24)	2.68 (1.57)	24.5***	A = D > B = C = E

(Continued)

Table 3. (Continued)

	A allergic asthma (n = 76)	B non-allergic asthma (n = 86)	C allergic rhinitis (n = 190)	D topic dermatitis (n = 46)	E referents (n = 2876)	Overall analysis	Post-hoc analysis
HADS ^c							
Anxiety							
Mean (SD)	5.53 (4.29)	4.17 (4.10)	4.65 (3.77)	5.54 (4.02)	4.40 (3.73)		
Median (IQR)	5.00 (6.00)	3.00 (5.00)	4.00 (5.00)	5.00 (5.20)	4.00 (5.00)	11.9*	A = D > B = C = E
Depression							
Mean (SD)	3.99 (3.65)	3.06 (3.45)	3.20 (3.10)	3.53 (2.87)	3.10 (3.08)		
Median (IQR)	3.00 (5.00)	2.00 (3.00)	2.00 (4.00)	3.00 (3.00)	2.00 (3.00)	9.3 ^(*)	
MHWS ^d							
Environmental pollution							
Mean (SD)	2.91 (0.99)	2.73 (0.87)	2.65 (1.02)	2.86 (0.96)	2.63 (0.97)		
Median (IQR)	3.02 (1.67)	2.67 (1.25)	2.67 (1.67)	2.82 (1.34)	2.67 (1.50)	8.9 ^(*)	

Notes: ^aPerceived Stress Scale.
^bShirrom-Melamed Burnout Questionnaire.
^cHospital Anxiety and Depression Scale.
^dModern Health Worries Scale.
SD = standard deviation; IQR = interquartile range.
p* < .05, *p* < .01, ****p* < .001, ^(*)*p* < .07, ns = non-significant.

Results

Mean and median scores (non-normal distributions) on the measures of psychological distress are presented in Table 3, together with results from overall Kruskal-Wallis analysis. The analyses yield significant group differences for the PSS, the five SMBQ scales, and the HADS Anxiety subscale. There was a strong tendency ($p < .07$) for group differences on the HADS Depression subscale and on the MHWS Environmental Pollution subscale. These tendencies can be referred to higher scores in the allergic asthma and atopic dermatitis groups. The outcome from post hoc pairwise Kruskal-Wallis analysis (Table 3) shows that the groups with allergic asthma and atopic dermatitis did not differ from each other, but these two groups had significantly higher scores than the groups with nonallergic asthma, allergic rhinitis, and the referents. The latter three groups did not differ from each other. These post hoc results regard the PSS, the five SMBQ scales, and the Anxiety subscale.

Discussion

The hypotheses that stress, exhaustion, anxiety, depression, and health worries for environmental pollution would be higher than normal in allergic asthma, allergic rhinitis, and atopic dermatitis, but not in nonallergic asthma, was partly supported. Stress, exhaustion, and anxiety were found to be higher than normal in allergic asthma and atopic dermatitis, but not in nonallergic asthma or allergic rhinitis, whereas there was a tendency of such abnormalities ($p < .07$) regarding depression and health worries. However, the result of depression being less prominent than anxiety in allergic asthma and atopic dermatitis followed the hypothesis.

In addition to overall exhaustion, all subscales of exhaustion (i.e. emotional and physical exhaustion, listlessness, tension, and cognitive weariness) were higher than normal in allergic asthma and atopic dermatitis. This suggests that the high stress level in these conditions is likely to have been present for a long time, resulting in exhaustion.

The association between atopy and psychological distress may possibly be referred to a bidirectional relationship (Chida et al., 2008), with a negative loop, such that atopy leads to psychological distress which in turn reinforces atopy. Rand and associates (2012) list mechanisms that may explain the high stress level that we observed in atopy. These include stress (i) influencing symptoms due to increased inflammation, (ii) affecting airway physiology through noninflammatory mechanisms, (iii) affecting adherence to medications and self-management strategies, (iv) leading to adverse health behaviors that increase an individual's exposure to known asthma triggers. Di Marco and collaborators (2011) propose that stress may induce hyporesponsiveness of the hypothalamus-pituitary-adrenal axis, resulting in reduced cortisol secretion in asthma. Busse et al. (1995) suggests that chronic stress may not cause inflammation in the asthmatic individual, but enhances its expression through a number of mechanisms, and that the resulting increase in asthma severity may not be responsive to standardly used treatment. The anterior cingulate cortex and insula may be activated in relation to a late-phase response to inhaled antigen, and these brain signals appear to be predictive and associated with airway inflammation.

The high anxiety in allergic asthma may be referred to panic attacks. It is well known that panic attacks are associated with asthma (Goodwin & Eaton, 2003), and likely to have a bidirectional relationship (Hasler et al., 2005). Regarding the high anxiety and stress in atopic dermatitis, Hashizume and Takigawa (2006) suggest a

psychoneuroimmunological mechanism. Atopic patients with emotional problems may develop a vicious cycle between anxiety and symptoms. Acute stress, which repeatedly and chronically affect these patients, increase anxiety. This enhances Th2-type responses due to dysregulation of the neuroimmune system, leading to worsening of allergic symptoms.

The group with allergic rhinitis did not differ significantly from the referents on any variables of psychological distress. Typical symptoms of allergic rhinitis (e.g. nasal congestion) may be less aggravating than symptoms of allergic asthma (e.g. shortness of breath), and atopic dermatitis (e.g. intense itching).

Although the stronger health worries for environmental pollution in allergic asthma did not reach statistical significance, explorative analysis showed that this group had significantly stronger health worries than the referents on the item "other environmental pollution". This motivates further investigation of environmental health worries in allergic asthma.

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