

ORIGINAL ARTICLE

Sensory processing patterns of adults with atopic dermatitis

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Abstract

Background Atopic dermatitis (AD) has been associated with sensory hypersensitivity in children.

Objective To examine the sensory profile of adults with AD using a standardized questionnaire that measures sensory processing and related behaviours in daily living.

Methods Thirty-two patients aged 18–53 years with AD and 32 healthy, sex- and age-matched control subjects completed the Adolescent/Adult Sensory Profile (AASP). Severity of AD was assessed by the Severity Scoring of Atopic Dermatitis (SCORAD).

Results Patients with AD showed higher sensory sensitivity and avoidance than the controls, mainly in the tactile, vestibular, visual and auditory modalities.

Conclusions Adults with AD may suffer from sensory hypersensitivity. Additional studies should examine the influence of the peripheral and the central nervous system on sensory hypersensitivity. Better understanding of the sensory impairment of patients with AD may help improving treatment strategies for the disease.

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Keywords

atopic dermatitis, SCORAD, sensory processing

Conflict of interest

None declared.

Disclosure

The authors have no financial interest in the study.

Introduction

Atopic dermatitis (AD) is a common chronic skin disorder with various manifestations. Pruritus, considered a hallmark of the disease, triggers a vicious cycle of itching, scratching and aggravation of the eczematous skin lesions.¹ AD has also been associated with adverse behavioural traits, such as restlessness, anxiety, rigidity, hostility,² generally attributed to the distress caused by the pruritus itself and the negative feelings of disfigurement.^{3–5}

We previously found a relationship between AD and sensory hypersensitivity, possibly related to ineffective modulation of sensations in the central nervous system.⁶

Sensory processing is the act of registering, modulating and organizing sensory information from the environment. This enables to execute adaptive responses to situational demands and successfully engage in daily activities.⁷ There is growing evidence that some individuals are more sensitive to sensory information

than others^{8,9} and they often perceive sensory events as noxious¹⁰ and exhibit a negative affect,¹¹ similar to the affective responses of patients with AD.

The relationship between sensory sensitivity and behaviour may be explained by Dunn's¹² model of sensory processing patterns. The model is based on the assumption that a person's sensory pattern reflects the interaction between his/her neurological threshold and self-regulation.^{12,13} The neurological continuum defines the amount of stimulation needed for the nervous system to respond to stimuli. Individuals at the low pole of the neurological continuum require low-intensity stimuli to react, and individuals at the high pole require high-intensity stimuli to act or take longer to react to the same stimuli. The two poles of the self-regulation continuum are anchored by passive vs. active coping strategies in relation to their thresholds. Individuals who utilize passive strategies would not counteract to unpleasant stimuli, while those

individuals who use active strategies act to control the amount and type of sensory input.¹⁴ Thus, the interaction of these two continua results in four sensory processing patterns: Individuals with high neurological thresholds are characterized by either *Low Registration* (reflecting passive responses at high neurological thresholds) or *Sensation Seeking* (reflecting active responses at high neurological thresholds). Those with low registration fail to detect stimuli or have slow responses to stimuli; those who seek sensation derive pleasure from a rich sensory environment and exhibit behaviours that create sensation. Individuals with low neurological thresholds are characterized by either *Sensation Avoiding* (an active strategy at low neurological thresholds) or *Sensory Sensitivity* (a passive strategy at low neurological thresholds). People with avoiding patterns engage in behaviours that limit exposure to stimuli, whereas people with sensory sensitivity do not actively limit their exposure to sensory stimuli but they are distracted by it, feel uncomfortable with sensation¹² and may even experience non-harmful sensations as painful.^{10,15,16}

People at the edges of the interaction of these two continua exhibit atypical sensory processing patterns. Those with sensory hypersensitivity, with or without comorbidities, are more likely to express emotional lability and to experience depression, anxiety disorders and rigidity.¹⁷ These physiological and behavioural elements may negatively impact function and significantly reduce quality of life and well-being.¹¹

Some authors have attributed the sensory hypersensitivity reported in AD patients to the dry skin (xerosis) characteristic of the disease.^{18,19} Reports on adults with AD also mention abnormalities in their peripheral and central nervous systems,^{20–22} but the data on the sensory profile of adults with AD in terms of specific sensory modalities and daily living situations are still scarce.

The aim of the present study was to examine the sensory processing patterns of adults with AD and compare them with those of healthy controls. We hypothesized that like children with AD, adults with AD have an abnormal sensory profile.

Methods

Participants

The study group consisted of 32 patients with AD, 8 men and 24 women, aged 18–53 years (mean 31.94 ± 7.86). The study group was recruited from patients diagnosed with AD attending the dermatology outpatient clinic in Haemek Medical Center, Israel. The Diagnosis of AD was made based on the Hanifin and Rajka criteria. Severity of AD was determined according to Severity Scoring of Atopic Dermatitis (SCORAD) which is an objective, validated tool combining the extent and intensity of clinical signs with subjective symptoms.²³ The control group included 32 healthy subjects, 8 men and 24 women, aged 22–50 years (mean age 29.91 ± 7.46), who did not have allergies or other chronic health conditions and did not use any medications on a regular basis. The control group was recruited by an advertisement posted in

neighbourhoods in the north of Israel, which called for participants for a study on responsiveness to sensations in daily living situations.

Instruments

The Adolescent/Adult Sensory Profile (AASP)²⁴ is a 60-item self-report tool based on Dunn's model of sensory processing.¹² Participants are asked to indicate how often they respond to the sensory event described in the item on a Likert scale from 1 (*almost never*) to 5 (*almost always*). All the sensory systems are covered. Sample items are as follows: for taste/smell processing: 'I leave or move to another section when I smell a strong odour in a store'; for movement processing: 'I'm afraid of heights'; for auditory processing: 'I startle easily at unexpected or loud noises'; for tactile processing: 'I'm uncomfortable wearing certain fabrics'. The items are sorted equally into quadrants, namely, Low Registration, Sensation Seeking, Sensory Sensitivity and Sensation Avoiding (based on factor analysis), with the score for each quadrant ranging from 5 to 75. In a national sample of 950 adolescents and adults (ages 11–90 years), the AASP authors calculated the cut-off beyond which the score of an individual is considered significantly different from his/her peers. Each age group (11–17, 18–64, 65 years and older) had a different norm. This questionnaire has good internal consistency, with coefficient alpha values of 0.692 for Low Registration, 0.639 for Sensation Seeking, 0.657 for Sensory Sensitivity and 0.699 for Sensation Avoiding.²⁵ This questionnaire was translated into Hebrew and back-translated into English by bilingual occupational therapists.

Procedure

Each participant completed a demographic questionnaire and underwent a general physical and dermatological examination, during which the physician completed the SCORAD. Thereafter, the study participants were asked to complete the AASP.

The study was approved by the local Ethics Committee.

Data analysis

Multivariate analysis of variance (MANOVA) and *t*-tests were performed to examine the significance of differences between groups. Pearson correlation was used to examine the relationship between age and AASP and SCORAD scores in the study group. Probabilities at or below 0.05 were considered significant.

Results

Sensory processing patterns

Table 1 shows the scores on the AASP for the two groups by quadrant. The patients with AD had significantly higher scores for sensory sensitivity and sensory avoiding than the healthy controls. Within the AD group, no significant differences were found in the scores for the sensitivity and avoiding scales by patient gender.

Table 1 Scores on the Adolescent/Adult Sensory Profile (AASP) in patients with atopic dermatitis (AD) and healthy controls

AASP factors	AD group (n = 32)		Healthy controls (n = 32)		T-value	Typical range†
	Mean	SD	Mean	SD		
Low Registration	31.22	8.47	34.46	5.12	-1.86	24–35
Sensation Seeking	46.09	6.02	47.44	7.51	-0.79	43–56
Sensory Sensitivity	48.22	8.24	41.09	8.91	3.32*	26–41
Sensory Avoiding	48.63	9.36	38.12	8.79	4.62**	27–41

†According to AASP manual.¹³* $P \leq 0.05$; ** $P \leq 0.001$.**Table 2** Scores on the Sensory Sensitivity and Sensory Avoiding factors of the Adolescent/Adult Sensory Profile by modality in patients with atopic dermatitis (AD) and healthy controls

Sensory modality	Factor	AD group (n = 32)		Healthy controls (n = 32)		F	ES- η^2
		Mean	SD	Mean	SD		
Taste/smell processing	Sensitivity	2.78	1.21	2.53	1.13548	0.001	0.000
	Avoiding	5.81	1.89	5.22	1.82	3.25	0.051
Movement processing	Sensitivity	11.01	2.27	7.65	2.81	27.56**	0.311
	Avoiding	4.51	1.04	1.87	1.58	55.79**	0.478
Visual processing	Sensitivity	9.68	3.06	8.37	2.26	5.09*	0.077
	Avoiding	10.18	2.52	7.41	2.31	17.58**	0.224
Touch processing	Sensitivity	12.81	2.21	10.37	2.87	14.31**	0.190
	Avoiding	9.62	2.64	7.53	2.81	8.09*	0.117
Activity level	Sensitivity	3.01	1.12	3.41	0.91	0.88	0.014
	Avoiding	8.96	2.02	8.43	2.07	3.21	0.050
Auditory processing	Sensitivity	9.32	2.54	8.75	2.87	1.41	0.023
	Avoiding	9.83	2.63	7.65	2.45	10.77*	0.150

* $P \leq 0.05$; ** $P \leq 0.001$.

On application of the 'most than more people' interval in the norms described in the AASP manual, we found that 84.4% of the study group had an above-normal score for both sensory sensitivity and sensory avoiding. Between-group comparison of the sensory processing patterns by modality (Table 2) yielded significant differences in vestibular, tactile, visual and auditory processing. The highest estimated effect size was calculated for the vestibular modality, emphasizing its impact on the sensory hypersensitivity of patients with AD.

The SCORAD scores in the AD group ranged from 5 to 46; Median = 30. The mean score was 28.78 ± 10.62 .

No significant correlations were found between age, sensory processing and SCORAD scores among patients with AD.

Discussion

This study focused on the sensory profile of adults with AD. Although AD is more common in the paediatric age group, symptoms may persist into adulthood or even begin in adulthood (adult-onset atopic dermatitis). AD may also be the most common cause of occupational skin disease in adults.¹ The need to examine the sensory profile of adult patients with AD raised from previous reports about sensory hypersensitivity of patients with AD (e.g. Tobin *et al.*²⁶; Yosipovitch & Papoiu²⁷) which, combined with the

symptoms of the disease, can negatively influence the quality of life and impair functions of daily living (e.g. Krueger²⁸; Weiss *et al.*²⁹).

However, previous studies of sensory sensitivity used mainly neurophysiological tools (e.g. Seike *et al.*³⁰; Ishay *et al.*³¹). There is also a need to examine the manner in which sensory hypersensitivity is expressed in daily living situations. The present study investigated the sensory profile of adults with AD in routine activities and related behavioural responses.

The results of this study clearly demonstrate that adults with AD, like affected children (Engel-Yeger *et al.*⁶), have sensory hypersensitivity. This sensory hypersensitivity may be expressed in different sensory modalities. It is interesting that that sensory hypersensitivity was expressed in additional modalities in adults in the present study, compared with children. While the vestibular modality was not found to differ between children with AD and healthy controls, adults with AD did show sensory hypersensitivity in this modality. To better understand whether differences in sensory hypersensitivity exist between children and adults with AD, additional studies with larger samples are needed. According to the model of Dunn,¹² the use of passive or active behavioural strategies relative to the neurological threshold leads to exhibiting sensory sensitivity or sensory avoidance respectively.

Our study also found that the sensory hypersensitivity of patients with AD was expressed in specific sensory modalities: tactile, visual, auditory and vestibular. The tactile hypersensitivity may be explained by the skin lesions^{21,32} and the imbalance of the cutaneous nervous system.²⁰ The hypersensitivity in the other sensory modalities strengthens earlier suggestions of a pathogenic role of the central nervous system in AD, leading to enhanced sensory sensitivity (e.g. Tanaka & Matsuda²²; Sugiura *et al.*³³). This sensory sensitivity may contribute considerably to symptoms of AD, such as itch^{27,34}, and involve structural modifications such as enhanced release of neuropeptides from peripheral afferents and alterations in the sensorineural circuitry of the dorsal horn of the spinal cord.³⁰ However, the results of the present study suggests that the involvement of the central nervous system may also lead to unmodulated sensations in various modalities. The highest impact was noted for the vestibular system.

Our study supports the hypothesis that the affective symptoms of adult AD are not only caused by the skin lesions but may also be a consequence of the sensory hypersensitivity. Accordingly, Ishiui *et al.*³⁴ documented significant brain activity attributable to histamine-induced itch among patients with AD. The authors suggested that the brain activity in specific areas, such as the posterior insular cortex in AD patients, is most probably associated with their capability to process convergent information to produce an emotionally relevant context for sensory experience. Current treatments for AD are directed mainly at the skin lesions. Improved understanding of the sensory processing impairment in AD could lead to the development of novel treatment strategies.

The lack of a significant correlation of sensory results and the SCORAD score in this study is in line with our previous findings^{6,35} and may suggest that the sensory hypersensitivity involvement in AD is unrelated to either patient's age or disease severity. However, it is noteworthy that the SCORAD was determined at a specific time point, which may not accurately reflect the nature of the disease.

In the present study, the sensory hypersensitivity in AD was clearly reflected by application of standardized questionnaires on sensory processing patterns in daily scenarios. This highlights the burden and the emotional distress people with AD face each day, and corroborate earlier reports of restlessness, insecurity, anxiety, emotional lability, rigidity, hostility, neuroticism and depression in this patient group.^{2,36} As AD is known to be worsened by psychological stress,³⁷ clinicians should take into account the possible involvement of impaired sensory processing in the emotional reactions of patients with AD.

In summary, AD increases patients' psychological distress and adversely affects the quality of life.^{5,38–41} We recommend that interventions for AD should shift from a focus solely on the skin lesions, to a multidisciplinary, medical and paramedical approach, targeting also the sensory hypersensitivity and emotional distress.⁴¹ They might include environmental adaptation exercises to modulate the response to sensory stimuli in daily life combined with

psychological counselling. In addition, improved understanding of the pathogenesis of AD may also help researchers develop new drugs targeted at the physiological parameters underlying sensory hypersensitivity. Further studies are needed to investigate the relationship between sensory sensitivity, level of anxiety and stress among patients with AD.

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