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INVESTIGATIVE REPORT

Personality Traits, Depression and Itch in Patients with Atopic Dermatitis in an Experimental Setting: A Regression Analysis

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It is known that itch is associated with psychological variables, but it is not known whether personality characteristics, depression or anxiety are predictors of experimentally induced itch in patients with atopic dermatitis (AD). In this study itch was induced in 27 patients with AD and 28 healthy controls by the presentation of an experimental video on crawling insects and skin diseases. Itch intensity was measured by self-ratings and by observing the number of scratch movements. Itch increase was determined by subtracting itch intensity induced by the experimental video from itch intensity induced by a control video. Psychological variables were assessed using validated questionnaires. In patients with AD, depression was a significant predictor of self-rated induced itch (corrected $R^2 = 0.175$); while agreeableness and public self-consciousness were significant predictors of induced scratching (corrected $R^2 = 0.534$). In healthy controls no associations were found. These results imply that a special group of patients with AD might benefit from certain psychological interventions. ***Key words: atopic dermatitis; psychodermatology; personality characteristics; depression; anxiety.***

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Itch, an unpleasant sensation that evokes the desire to scratch (1), is a widespread phenomenon in the general population (2–5) and especially in patients with skin diseases (6–8). It is a major symptom, e.g. in patients with atopic dermatitis (AD) (6), urticaria (7) and psoriasis (8). Itch can have many causes, and there are several physiological reactions that are associated with the occurrence of itch (9–12), but itch is also associated with psychological variables such as the emotional state of the subjects (13–15). In a recently published study it was, for example, shown that negative emotions, induced by the presentation of films, increased itch intensity in healthy women (13). In another study, state anger was associated with itch intensity in patients with chronic urticaria, while depression was associated with itch intensity in patients with psoriasis (14). Moreover, in patients with psoriasis scratching as well as worrying was related to self-rated itch increase 4 weeks later, but only in times of high daily stressors (15).

In addition, personality, the way individuals think, behave and feel (16), is associated with itch (17, 18). Individuals differ in the degree of personality traits, such as extraversion, neuroticism (emotional lability), conscientiousness, openness to experience and agreeableness (16). In addition, one aspect of self-consciousness was shown to be associated with itch intensity: the more subjects focused on their bodily sensations, the greater was the experimentally induced itch intensity they experienced (17). Furthermore, some older studies found a certain personality structure in patients with the highly itchy skin disease atopic dermatitis: patients with AD were described as more neurotic, hostile, anxious and depressive than healthy controls, and as having more problems dealing with their anger and hostility (19–22). Moreover, a small correlation was found between itch intensity and neuroticism scores in patients with AD and psoriasis (18).

Findings like these, together with the fact that itch intensity cannot always be completely explained by the severity of the skin disease, led to the postulation of a biopsychosocial model of itch (23). This model assumes that internal factors (e.g. personality characteristics) together with external factors (e.g. stressors) lead to certain cognitions, social reactions and/or behaviours, which then might increase or decrease physiological reactions. In this model these physiological reactions lead to itch (23). The purpose of this study was to analyse one part of this biopsychosocial model of itch, namely the relationship between internal factors of a person and induced itch. Concerning internal factors, we were especially interested in personality characteristics, depression and anxiety, because a relationship between these variables and the occurrence of the itchy skin disease AD has already been shown. The objective of this study was to investigate the association between these psychological variables and *induced itch* in this patient group. To our knowledge, this has not been done previously. In order to induce itch we used the method of mental itch induction

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(which comprises the presentation of certain audiovisual material, also see itch induction), which was quite similar to the method used in another, recently published study (24). The advantage of this method is that, in contrast to other methods of itch induction (e.g. the histamine-prick test), it does not need direct manipulation of the skin. This study investigated the research question: Are personality characteristics, depression and anxiety predictors of induced itch in patients with AD?

MATERIALS AND METHODS

Participants

Patients with AD ($n = 30$) and healthy controls ($n = 30$) were recruited through written announcements in a weekly newspaper, or directly addressed at the campus of the University of Gießen, Germany. Patients with AD were additionally recruited at the dermatology department of the university hospital and at surgeries of local dermatologists. Subjects received a 15 € expense allowance for participation in the study.

Through a first telephone interview exclusion and inclusion criteria were determined. Patients were included if they had clinically diagnosed AD. They were instructed not to use any topical itch reducing medication at least 24 h prior to the investigation. Exclusion criteria in patients with AD were: any other somatic and/or psychiatric disease as well as oral medications 4 weeks prior to the study. Healthy controls were excluded if they reported any somatic and/or psychiatric disease, or family history of atopic diseases. The group of AD patients and the group of healthy controls were stratified according to age and gender.

Design overview

All participants came in groups of 3–4 persons to our observation laboratory assuming to evaluate teaching material concerning the skin and its function. Participants were separated by divider walls in order not to influence each other and were then shown 2 videos in counterbalanced order (also see itch induction, below). In this cross-over study, participants were randomized to the order of presentation of the videos. Immediately after each video a "wash-out" period of 30 min followed, during which the participants rated their actual itch intensity and completed questionnaires to measure personality characteristics (see predictor variables). At the end of the appointment, subjects were informed about the true intention of the study (also see ethics). Table I presents the time-line of the study.

Itch induction

Itch was induced by the method of mental itch induction. This method is based on the idea that because of classical conditioning processes (22), certain audiovisual stimulus material is able to induce itch. An experimental video (EV) on "Itch – what is behind it?" was used to induce itch, while a video on "Skin – the communication organ" served as a control video (CV). Pictures included in the EV were selected by 2 itch researchers (UG, JK) according to the stimulus material that was used in a former field-study in which a slide-supported lecture that included pictures of skin diseases and crawling insects induced itch (25). Thus, our EV also included pictures of fleas, flea-bites on a human body, mites under the skin, lice and hair that is affected by lice as well as a body of a girl with AD and the body of a person with contact eczema. In addition, one picture showing people scratching and one showing monkeys lousing each other were included.

The CV contained pictures showing, for example, two touching hands, a kissing or hugging couple, a man lying in a bath, a mother carrying her baby, or two children with the upper part of their bodies naked sitting next to each other on a swing. In the videos, a speaker (UG) talked in the background while pictures were presented as a slideshow. The videos lasted approximately 11 min each and contained 15 pictures.

Assessment of increase in itch

Self-rated itch intensity was determined using a visual analogue scale (VAS) ranging from 0 to 10 (0: no itch; 10: unbearable itch). The criterion variable self-rated induced itch was determined by subtracting self-rated itch intensity measured immediately after the presentation of the EV from self-rated itch intensity measured immediately after the presentation of the CV.

The number of scratch movements (observed itch) was assessed during the whole presentation of the videos. It was rated by 2 independent persons. Here, the criterion variable induced scratching was determined by subtracting the number of scratch movements during the presentation of the EV from the number of scratch movements during the presentation of the CV. To secure that the raters only counted scratch movements and not spontaneous touching, they were instructed and calibrated by a dermatologist (UG) before the beginning of the study. Scratching was defined as any movement that included rubbing and was distinguished from touching, which was defined as any rapid contact of an extremity including movement, but not rubbing. The inter-rater reliability for the EV was $r = 0.99$ ($p \leq 0.001$), and for the CV $r = 0.93$ ($p \leq 0.001$).

Assessment of predictor variables

Personality characteristics, depression and anxiety were taken into consideration as predictors of induced itch. The following questionnaires were used to measure personality characteristics, depression and anxiety:

- The Neo Five-Factor Inventory (NEO-FFI) includes 60 items and measures 5 personality traits: neuroticism, extraversion, openness to experience, agreeableness and conscientiousness (26).
- The Hospital Anxiety and Depression Scale (HADS), a 14-item questionnaire, measures anxiety and depression (27).
- The Self-Consciousness Scale (SCS) includes 27 items and measures private as well as public self-consciousness (28).

Ethics

The study design was approved by the local ethics committee, which found that the study protocol conformed to the Declaration of Helsinki. All participants provided their written, informed consent to the study and were free to withdraw from the

Table I. *Timeline of the study. Videos 1 and 2 were presented in counterbalanced order*

Actions	0–10 min Introduction	10–20 min Video 1	20–50 min Wash-out Period 1	50–60 min Video 2	60–90 min Wash-out Period 2	90–100 min Debriefing
Measurements		Number of scratch movements	Subjective itch intensity + personality characteristics	Number of scratch movements	Subjective itch intensity + anxiety, depression and self-consciousness	

study at any time. At the beginning of the study, participants were told a cover story intended to make them believe, that they took part in a study that aimed to measure the quality of teaching material. The title of the study was: "Evaluation of video-material concerning different functions of our skin – a comparison of patients with AD and healthy controls." At the end of the investigation all participants were debriefed and informed about the true intention of the study.

Statistical analysis

To be able to detect changes in itch intensity due to the different video presentations we aimed to recruit a sample size of $n = 54$ to achieve a statistical power of 95% with a given significance level of 5% for medium effect sizes ($f = 0.25$). To allow for possible missing data and outlier scores, we examined a total of 60 subjects (30 in each group) to secure a final sample size of $n = 54$. The final sample size was 55, because we had to exclude 5 participants (3 patients with AD and 2 controls with healthy skin) who reported having chronic diseases (see sample characteristics). The identification of predictors of itch increase in the 2 subsamples followed an exploratory approach.

Statistical analyses were performed using SPSS 20. Kolmogorof-Smirnov Goodness-of-Fit Test indicated no violation of the normal distribution assumption for any predictor or criterion variable. To compare patients with AD and healthy controls regarding sociodemographic data and personality characteristics, *t*-tests for independent samples or χ^2-tests were calculated. To analyse whether patients with AD and healthy controls differed concerning self-rated or observed itch intensity after/during the presentation of the EV, 1-way analyses of covariance with factor group (AD vs. healthy controls) and the respective baseline measure as covariate (self-rated or observed itch intensity after/during the presentation of the CV) were conducted. To identify predictors of itch increase in the group of patients with AD or controls with healthy skin, a stepwise forward linear regression analysis was conducted for each group: Personality factors, anxiety and depression, as well as private and public self-consciousness were used as predictor variables, while the difference between CV and EV concerning the number of scratch movements or itch intensity was used as the criterion variable.

RESULTS

Sample characteristics

A total of 30 subjects with clinically diagnosed AD and 30 healthy controls were examined. Despite the inclusion of subjects after the telephone interview (due to negotiation of exclusion criteria), 5 subjects had to be excluded after participation in the study. Three patients with AD had to be excluded because they reported having asthma, allergies or idiopathic thrombocytopenic purpura in addition to their skin disease. Similarly, 2 participants in the control group had to be excluded because of asthma or diabetes mellitus. Thus, the group of controls with healthy skin comprised 18 female and 10 male subjects; 12 patients with AD were male and 15 were female. Groups did not differ concerning age: the mean ± SD age in the group of healthy subjects was 23.3 ± 2.1 and 23.6 ± 3.7 in the group of patients with AD. Moreover, *t*-tests indicated no group difference concerning conscientiousness [$t\ (53) = 0.757$; $p = 0.453$], openness to experience [$t\ (53) = 0.610$; $p = 0.545$], anxiety [$t\ (53) = –1.193$; $p = 0.238$], private [$t\ (53) = –1.043$; $p = 0.302$] or public self-consciousness [$t\ (53) = –0.848$; $p = 0.400$]. Significant differences were observed for neuroticism [$t\ (53) = –2.491$; $p = 0.016$], extraversion [$t\ (53) = 2.613$; $p = 0.012$], depression [$t\ (53) = –2.961$; $p = 0.005$] and agreeableness [$t\ (53) = 2.142$; $p = 0.037$]. Patients with AD were more neurotic, less extraverted, less agreeable and more depressed than controls with healthy skin. The means and SDs concerning the personality characteristics, anxiety and depression are presented for both groups separately in Table II.

Manipulation check "itch induction"

Self-rated itch intensity measured after watching the EV was rated as significantly higher than itch intensity after watching the CV [$F\ (1/52) = 8.025$; $p = 0.007$; $\eta^2 = 0.134$]. The mean ± SD of itch intensity immediately after the presentation of the CV was 1.91 ± 2.96, while it was 4.71 ± 3.64 immediately after the EV. Moreover, the number of scratch movements was significantly higher while watching the EV compared with watching the CV [$F\ (1/52) = 19.492$; $p \leq 0.001$; $\eta^2 = 0.273$]. The mean ± SD of the number of scratch movements increased from 3.22 ± 3.73 during the presentation of the CV to 9.28 ± 8.71 during the presentation of the EV.

Self-rated itch intensity increased in 21 patients with AD, in 3 it decreased and in 3 it remained the same. In patients with AD, the mean ± SD of itch intensity immediately after the presentation of the CV was 2.56 ± 3.46, while it was 5.89 ± 3.51 immediately after the presentation of the EV. In 20 healthy controls the self-rated itch intensity increased, while in 7 the itch intensity remained the same. Itch intensity decreased in only one healthy person. In healthy controls the mean ± SD of itch intensity immediately after the presentation of the CV was 1.29 ± 2.28, while it was 3.57 ± 3.45

Table II. *Population characteristics concerning the predictor variables*

Predictor variables	AD patients ($n = 27$) Mean ± SD (range)	Controls ($n = 28$) Mean ± SD (range)
Depression	5.30 ± 3.69 (0–12)	2.75 ± 2.62 (0–11)
Anxiety	7.33 ± 3.97 (0–15)	6.21 ± 2.92 (1–12)
Private self-consciousness	3.63 ± 0.56 (2.38–4.77)	3.48 ± 0.50 (2.38–4.54)
Public self-consciousness	3.53 ± 0.55 (2.21–4.57)	3.41 ± 0.51 (2.57–4.57)
Neuroticism	2.02 ± 0.66 (0.83–3.67)	1.59 ± 0.61 (0.50–2.83)
Extraversion	2.26 ± 0.55 (0.67–3.50)	2.64 ± 0.53 (1.58–3.67)
Openness to experience	2.70 ± 0.60 (1.50–3.75)	2.79 ± 0.47 (1.75–3.67)
Agreeableness	2.53 ± 0.57 (1.50–3.58)	2.84 ± 0.50 (1.75–3.58)
Conscientiousness	2.47 ± 0.71 (0.58–3.25)	2.60 ± 0.61 (1.50–3.50)

immediately after the presentation of the EV. Results of the analysis of covariance (ANCOVA) (self-rated itch intensity after the CV as covariate) indicated that, by trend, patients with AD reported a higher itch intensity than healthy controls after the presentation of the EV [$F(1/52) = 3.528$; $p = 0.066$; $\eta^2 = 0.064$].

In 22 patients with AD the number of scratch movements increased, in 4 it was unchanged, and only one patient with AD scratched less during the presentation of the EV than during the presentation of the CV. In the patient-group, the mean ± SD of the number of scratch-movements during the presentation of the CV was 3.28 ± 3.35, while it was 12.7 ± 10.36 during the presentation of the EV. In 19 healthy controls the number of scratch-movements increased, while it was unchanged in 4 participants. Five controls scratched less often during the presentation of the EV than during the presentation of the CV. In the group of healthy participants, the mean ± SD of the number of scratch movements during the presentation of the CV was 3.16 ± 4.12, while it was 5.98 ± 5.05 during the presentation of the EV. Results of the ANCOVA (observed number of scratch movements while watching the CV as covariate) indicated that patients with AD showed significantly more scratch movements than healthy controls during the presentation of the EV [$F(1/52) = 15.385$; $p \leq 0.001$; $\eta^2 = 0.228$]. The increase in scratch movements was not significantly related to the increase in itch intensity, neither in the group of patients with AD ($r = 0.278$; $p = 0.161$) nor in the group of healthy controls ($r = 0.072$; $p = 0.714$).

Fig. 1. illustrates the itch intensity immediately after the presentation of the videos and the number of scratch movements during the presentation of the videos in patients with AD and healthy controls.

Personality characteristics, depression and anxiety as predictors of itch increase in patients with atopic dermatitis

An initial regression analysis revealed that depression was a significant predictor of induced itch in patients with AD. Of the variance of the increase in itch intensity from CV to EV, 17.5% (corrected $R^2 = 0.175$) could be predicted by this psychological variable. Patients with high scores on the depression scale (HADS-D) reported higher increases in itch intensity than patients with low scores on the depression scale. The results of the regression analysis are shown in Fig. S1[1]. In healthy controls, the increase in self-rated itch intensity could not be predicted by personality characteristics, depression or anxiety.

A second linear regression analysis revealed that 53.4% (corrected $R^2 = 0.534$) of the increase in the number of scratch movements from CV to EV could be predicted by the combination of public self-consciousness and agreeableness in patients with AD. Patients who scored high on public self-consciousness and low on agreeableness showed a higher increase concerning the number of scratch movements than patients with the opposite scores in these scales. The results of this regression analysis are also shown in Fig. S1[1]. In healthy controls, the observed increase in the number of scratch movements could not be predicted by personality characteristics, depression or anxiety.

DISCUSSION

In line with the results of another study (24) we were able to show that itch can be induced not only by direct skin-manipulation, but also by the presentation of certain video material. Furthermore, corresponding to the results of the earlier study (24), in the present study AD patients were also more sensitive to itch-inducing material than healthy controls.

The important novelty of this study is that, in addition, personality characteristics and depression could be identified as predictors of experimentally induced itch in patients with AD. Patients who scored highly on depression reported higher induced itch than patients, who stated not being depressive. This interesting result is in accordance with the results of other studies (14, 29, 30), in which associations between itch intensity and

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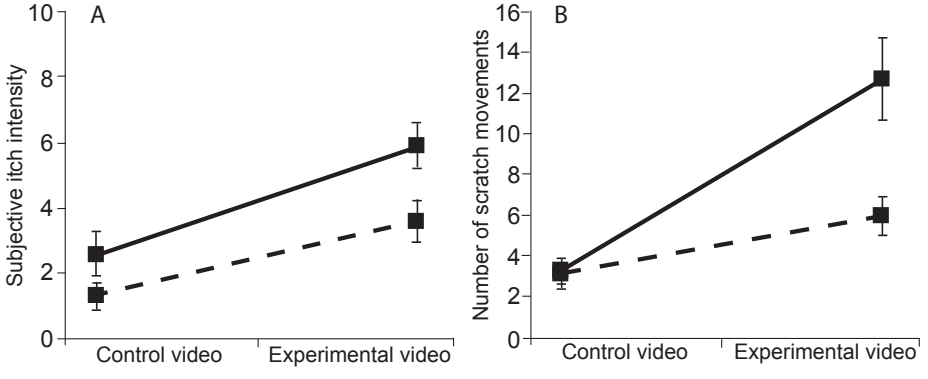

Fig. 1. Mental itch induction. Subjective itch intensity (A) immediately after the presentation of the videos and the number of scratch movements (B) during the presentation of the videos in patients with atopic dermatitis (*continuous line*; $n = 27$) and healthy controls (*dotted line*; $n = 28$).

depression were shown for skin patients. The difference between the results of these studies and our study is that itch was not experimentally induced in the other studies. Instead, itch was measured in a point-wise measurement using self-reports. Thus, the other studies do not allow a statement on whether *induced itch* is associated with depression, while the present study provides preliminary evidence for this association.

Furthermore, in patients with AD, more than 50% of the variance in induced scratch movements could be predicted by agreeableness and public self-consciousness: patients who reported not being very agreeable and at the same time scored high on public self-consciousness showed a higher increase in the number of scratch movements than agreeable patients who did not care much about what others thought about them. This finding widens the result of another study, in which attention to bodily sensations was positively associated with experimentally induced itch (17). In the present study it was not awareness of oneself, but rather awareness of others nearby, that was of importance regarding induced itch. One explanation for this finding could be that patients with AD, similarly to patients with psoriasis, feel stigmatized because of their skin disease (31), and therefore develop feelings of being critically observed or excluded by others. This explanation would also fit with the finding that patients with AD feel more uncertain and determined by others and have a lower self-esteem than healthy controls (32). In addition, low agreeableness was associated with an increase in scratch movements. Persons with low scores on this personality scale are described as aggressive and rude (16). In earlier studies patients with AD were shown to anger more quickly than healthy controls, but at the same time were less able to express and cope with their anger (21). The present study is the first to show that this personality trait in combination with high public self-consciousness is also associated with induced itch in this patient group.

The results of this study not only support the view that psychological concepts, such as depression and personality characteristics, are associated with induced itch in AD, but also emphasize that psychological interventions could be a helpful addition in the treatment of this patient group. Positive effects of psychological interventions have already been shown for patients with AD (33–38). This study even goes a step further, because it suggests that a special group of patients with AD might benefit from certain psychological interventions: patients showing a psychological phenotype that comprises high depression, low agreeableness and high public self-consciousness would probably benefit from psychological interventions, such as cognitive restructuring, anger management and self-assertiveness training, because these interventions might be able to modulate the extent of the personality characteristics that are associated with induced itch. As a consequence, the appearance of itch-inducing stimuli might not automatically have to lead to scratching behaviour, which is associated with a worsening of inflammation (itch-scratch-cycle; 39).

There are also some limitations to the study. First, because we only included patients with AD without any other somatic and/or psychiatric disease (including other atopic diseases) we cannot generalize the results of the present study to other populations of patients with AD, e.g. patients with more than one atopic disease. Since patients with AD often have a combination of atopic diseases (40) and not only AD, a possible way of minimizing this selection bias would be to include patients with more than one atopic disease in future studies and to investigate whether the same personality characteristics are associated with induced itch in these patients. Secondly, at this point we are not able to determine whether our itch-inducing video also caused stress, because we did not assess stress-parameters such as cortisol after presentation of the EV. For future studies it would therefore be interesting to compare the possibly evoked stress reaction by the video with a stress reaction induced by a validated laboratory stressor (e.g. after using a public-speaking paradigm) in order to gain an impression of whether stress can be considered a mediator for itch induction. A third limitation lies in the fact that we did not consider the severity of AD as a predictor of itch increase, because we did not assess it. In future studies it would be valuable to assess the severity of the skin disease (in patients with AD, e.g. by means of the SCORAD (SCORing Atopic Dermatitis) (41) or POSCORAD (Patient-Oriented SCORAD) (42)) to be able to include it in the regression analysis as a possible predictor.

In conclusion, this study shows that a considerable amount of the alteration in induced itch in patients with AD can be predicted by personality characteristics and depression. If these results can be replicated in further studies, this finding may enable a first approach to identify patient groups who might especially benefit from certain psychological interventions (e.g. anger management).

The authors declare no conflicts of interest.

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