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Trait Anxiety – Possible Consequences for Health

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Abstract

Secretory immunoglobulin A (sIgA) in saliva has been suggested to play an important role in protecting the mucosa of the upper respiratory tract and the oral cavity against viral infections and bacterial adherence. Low concentrations of sIgA are associated with certain diseases, like e.g. caries and repeated infections of the upper respiratory tract. It is known that subjects scoring high on neuroticism and anxiety scales are characterized by lower sIgA baseline levels than low scorers and by a more pronounced reduction of sIgA in certain stress conditions. As shown in many studies, relaxation consistently leads to highly significant increases in sIgA concentrations.

Considering these findings together, the questions emerge whether subjects high in anxiety report higher frequencies of diseases related to low sIgA baseline levels than low anxiety subjects, whether these groups differ with respect to changes in sIgA after relaxation training and with respect to subjective effects of this relaxation exercise.

Two studies were conducted to answer these questions: In the first study 232 subjects (118 females, 114 males) filled in a health questionnaire. As shown by correlations, subjects high in anxiety reported significantly more diseases relevant to sIgA like e.g. gingivitis than subjects low in anxiety. No correlations were found concerning diseases which are not relevant to sIgA, like e.g. infections of the urinary tract.

In a second study 28 females and 28 males took part in an experimental relaxation training. Before and after 10 minutes of relaxation training, saliva was sampled by salivettes for the determination of sIgA. Furthermore, subjects were asked to rate the effects of the relaxation training and to fill in a trait anxiety scale. As shown by correlations, high anxiety subjects showed significantly higher increases in sIgA after relaxation but at the same time felt less relaxed than low anxiety subjects.

These studies indicate that repeated relaxation training can possibly lead to increased sIgA levels, particularly in subjects high in anxiety, and that this may perhaps be effective for the treatment of diseases associated with low sIgA levels (German J Psychiatry 2000; 3[3] 19-23).

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Introduction

Secretory immunoglobulin A (sIgA) in saliva has been suggested to play an important role in protecting the mucosa of the upper respiratory tract and the oral cavity against viral infections and bacterial adherence (Tomasi, 1970). It is therefore one of the most important factors within the so-called "local immune system".

It could be demonstrated that patients suffering from caries have lower sIgA concentrations than healthy subjects (Lehner et al., 1967). The same is true for patients suffering from infections of the upper respiratory tract (McClelland et al., 1982; Calvo et al., 1988; Tenovuo et al., 1986; Norrby, 1993). On the other hand, high levels of sIgA were clearly related to a low prevalence of caries (Gregory et al., 1986; Camling et al., 1987).

Subjects high in neuroticism and anxiety are characterized by lower basal levels of sIgA (Graham et al., 1988; Hennig, 1994) and by more pronounced decreases in sIgA in certain stress

conditions (Hennig, 1994; Hennig et al., 1996) than subjects with low scores.

Several studies demonstrate that relaxation leads to highly significant increases in sIgA concentrations. Dillon et al. (1985) have shown that a humorous movie leads to increases in sIgA suggesting (but not proving) that increases in well-being are accompanied by increases in sIgA-concentrations. Another study by Jasnoski and Kugler (1987) demonstrated that relaxation and relaxation in combination with imagery led to highly significant increases in sIgA. Green & Green (1987) investigated the question whether relaxation-induced responses in sIgA were specific to a certain type of relaxation. Therefore they used four groups, one exercising relaxation, another one with the instruction of imagery, a third receiving a massage, and a fourth group who had to lie down on the floor and received no further treatment. In the first three groups highly significant increases in sIgA could be observed, while the untreated group did not show any changes in sIgA. As concluded in the meta-analysis by van Rood and coworkers (1993) sIgA concentrations can be significantly enhanced by relaxation, which is a stable and reliable phenomenon.

On the basis of these findings in the literature two studies were conducted to answer the following open questions:

(1) Do high anxiety subjects report higher frequencies of diseases associated with low sIgA levels than low anxiety subjects?
(2) Do high and low anxiety subjects show differences with respect to their relaxation induced changes in sIgA as well as with respect to subjective ratings on the effects of the relaxation training?

Method

Study 1

In order to answer the first question, 232 subjects (118 females, 114 males) between 20 and 73 years of age (mean 47.5 ± 10) had to answer selected items of a health questionnaire (Janke et al., unpublished) related to infectious diseases and health problems. Since the question whether short term changes in sIgA in saliva reflect changes in the immunocompetence or a changed “leakage” – phenomenon (see Cripps et al. 1991), items were chosen which can be directly related to diseases restricted to the mouth and related areas. Following this logic, a low concentration of sIgA in saliva may be associated with higher incidence of these diseases, no matter whether immunological or transport-processes are involved. Therefore, five items are related to those diseases (sIgA – related), three of them are not. The sIgA- related diseases were defined as: common cold, tonsillitis, bronchitis, gingivitis, and stomatitis, whereas gastritis, dermatitis, and infections of the urinary tract were considered as control items of a comparable pathogenesis (infection) and comparable prevalence in the population. Each subject had to rate the frequency of these diseases personally experienced on a Likert scale ranging from 0 = not at all, 1 = once per year, 2 = two to four times per year, 3 = five times or more often per year. Furthermore, subjects filled in the trait anxiety scale of the State-Trait-Anxiety-Inventory (STAI, Laux et al., 1981). Subjects obtained STAI scores between 21 and 71 (mean 38.85 ± 10.43).

Pearson correlations were computed between the frequency of the diseases and the STAI-score. The influence of gender was partialled out.

Study 2

In order to answer the second question, 28 males and 28 females between 20 and 35 years of age (mean 24 ± 3.23) took part in a relaxation training. Before and after a ten minutes progressive muscle relaxation task according to Jacobson (1938), saliva was sampled by salivettes (Sarstedt, Nuembrecht, FRG) for exactly five minutes to control for saliva flow rate. Saliva was centrifuged and stored at -20°C until assayed. The concentration of secretory immunoglobulin A was measured by nephelometry as described by Hennig & Netter (1996), and Hennig, Poessel, and Netter (1996). SIgA secretion rate was computed as concentration (mg/dl) multiplied by saliva volume (ml) per minute resulting in µg/min. Furthermore, after the relaxation training subjects filled in a questionnaire on five statements like "I was able to suppress thoughts" or "I felt relaxed" using a Likert scale ranging from 0 = "not at all" to 6 = "very pronounced" as well as the trait anxiety scale of the State-Trait-Anxiety-Inventory (STAI, Laux et al., 1981)[1]. Subjects obtained STAI scores between 22 and 75 (mean 38.17 ± 9.53).

A t-test for dependent groups was computed in order to compare the sIgA secretion rate before and after relaxation. Furthermore, Pearson correlations were computed between changes in sIgA and trait anxiety. The influences of gender and sIgA baseline levels were partialled out. Furthermore, Pearson correlations were computed between subjective ratings on the relaxation training and the STAI score. The influence of gender was partialled out, again.

[1] Because of a mistake in the experimental procedure, 19 subjects did not fill in the STAI, so that correlations refer to only 39 instead of to 58 cases.

Results

Study 1

Highly significant correlations between the number of related diseases and trait anxiety were found: Subjects scoring high on the STAI reported to suffer more frequently from common cold, tonsillitis, bronchitis, gingivitis, and stomatitis than low scorers (see Table 1).

However, no association was found between diseases not related to sIgA and trait anxiety: High anxiety subjects did not differ from low anxiety ones with respect to frequencies reported for gastritis, dermatitis, and infections of the urinary tract (see Table 1).

Considering that the number of computed correlations requires an adjustment of the α-level, the level of significance (.05) was divided by the number of correlations (Bonferroni-adjustment).

Table 1: Partial correlations between scores on trait anxiety (STAI) and the frequency reported for sIgA-related and non-sIgA-related diseases (controlling for gender); n = 232

Condition	$r_{xy.z}$ (p)
Common cold	.33 ($p < .01$)*
Tonsillitis	.27 ($p < .01$)*
Bronchitis	.27 ($p < .01$)*
Gingivitis	.24 ($p < .01$)*
Stomatitis	.23 ($p < .01$)*
Gastritis	.08 (n.s.)
Dermatitis	.06 (n.s.)
Infections of the urinary tract	.05 (n.s.)

* still significant after Bonferroni correction

Study 2

As shown by a t-test for dependent groups, relaxation leads to a highly significant increase of the sIgA secretion rate (µg/min): $\bar{x}_{pre} = 38.69 \pm 26.14$; $\bar{x}_{post} = 48.20 \pm 31.82$; $t_{54} = -3.19$, $p < .001$. The partial correlation indicates a highly significant association between trait anxiety and changes in sIgA secretion rate ($r_{xy.gender} = .39$, $p < .01$). This significant correlation also prevails when sIgA-baseline values are partialled out ($r_{xy.gender;\ sIgA\ baseline\ level} = .32$, $p < .05$). Subjects high in anxiety are characterized by significantly higher sIgA increases after relaxation than subjects low in anxiety.

As also shown by partial correlations, subjects high in anxiety reported to have liked the relaxation task less well ($r_{xy.gender} = -.36$, $p < .05$), were less able to suppress thoughts or somatic sensations during the training ($r_{xy.gender} = -.37$, $p < .05$; $r_{xy.gender} = .49$, $p < .01$), and felt less relaxed ($r_{xy.gender} = -.37$, $p < .05$) than subjects low in anxiety. No relationship between being able to ignore noise ($r_{xy.gender} = -.12$, p = n.s.), or judging the training as stressful and anxiety ($r_{xy.gender} = .25$, p = n.s.) was observed.

Discussion

The two studies showed that high anxiety subjects

(1) more frequently report to suffer from sIgA-related diseases than low anxiety ones,
(2) show more pronounced relaxation induced increases in sIgA, and feel less relaxed by the relaxation training.

Given the results from the literature that high scores in anxiety are, on the one hand, associated with low baseline levels of sIgA and, on the other hand, with marked decreases of sIgA in certain stress conditions, our study nicely matches these observations by the finding that high anxiety subjects report higher frequencies of diseases referring to low sIgA levels, like common cold, bronchitis, gingivitis, tonsillitis, and stomatitis than low anxiety subjects. High anxiety scores go along with high scores in neuroticism, so that one can assume that subjects with high anxiety scores are perhaps more willing to report complaints about health than low scorers or that they tend to complain a lot more. Therefore, subjective reports about diseases related to sIgA have to be compared to reports on non-sIgA-related diseases and diseases of approximately the same prevalence. Interestingly, no signifcant correlations with non-sIgA-related diseases (gastritis, dermatitis, infections of the urinary tract) were found, so that probably no response styles are responsible for the correlations between trait anxiety and sIgA-related diseases. It is well known that the sIgA secretion rate can be enhanced by relaxation, which was replicated in our study. More interestingly, high anxiety subjects showed more pronounced increases in sIgA than low anxiety subjects.

The physiological mechanism underlying the strong and rapid response of the local antibody production in saliva is still unsolved. Contrary to all expectations, the relationship between anxiety and physiological responses to stress are inconsistent in the literature (e.g. Born et al., 1980; Deffenbacher, 1986; Hinton, 1991). However, since subjects high in anxiety feel chronically stressed, probably the tonic autonomic arousal is enhanced because of a shift in output and chronically enhanced catecholamine release. So if high anxiety subjects show particularly high relaxation induced increases of sIgA, this could support the hypothesis that the autonomic nervous system is involved in this process. Possibly there is an increase of plasma cell activity in the lamina propria of the oral mucosa, which is induced by direct sympathetic innervation or hormonal influences. One could assume that the sympathetic activity protects the organism from an over-production of dimer sIgA in plasma cells. A reduction of sympathetic activity would then lead to an increase of sIgA production. The concept of reduced inhibition as a source for promoting immunological processes is quite well accepted. Also results

indicating an inverse relationship between sIgA and sympathetically induced physiological changes upon stress, like increases in body temperature or neuromuscular activity, are suitable to confirm this concept (Hennig, 1994).

In general, relaxation training is also supposed to influence the immune system in a positive way. The present knowledge about the clinical meaning of stimulation of special immune parameters has to be understood purely as an increase and not in the sense of favouring the organism. Therefore a possible clinical impact of these results can only be carefully suggested, particularly, since the correlations are significant but not very powerful so that they explain only a small part of the variance. Relaxation induced increases of sIgA are not only a consistent finding in the literature (see the meta-analysis by van Rood et al., 1993), but also an intraindividually stable phenomenon (Hennig, 1998). Furthermore, Green et al. (1988) have shown that repeated relaxation training leads to an enduring increase of sIgA. Also in this study there was a significant positive correlation between relaxation induced changes in sIgA and the amount of experience subjects reported to have with relaxation training (r_{xy} = .45; p < .45). Therefore, one could assume that high anxiety subjects are able to increase their sIgA secretion rate by repeated relaxation training, which possibly leads to a reduction of health problems associated with low sIgA secretion rates. So Andrews and Hall (1990) e.g. reported a reduction of ulcera in the oral cavity by relaxation training in subjects suffering from repeated viral infections of the mucous membrane of the mouth.

But high anxiety subjects are often not ready to take part in relaxation training, since they feel they are unable to relax. Also in this study high anxiety subjects reported to have less fun, not to be able to suppress thoughts and somatic sensations, and to have felt less relaxed than low anxiety subjects. As shown by partial correlations (controlling for gender), there are significant negative relationships between changes in sIgA and subjective ratings concerning the relaxation training, like being able ignore disturbing noise ($r_{xy.gender}$ = -.29; p < .05), feeling relaxed ($r_{xy.gender}$ = -.28; p < .05), and liking this relaxation tasks ($r_{xy.gender}$ = -.36; p < .01) in the total group. After dividing subjects into high (n = 20) and low anxiety subjects (n = 19) according to the median of the STAI, no significant partial correlations were found between changes of sIgA and ratings on the training in low anxiety subjects, but some significant relations for high anxiety subjects: The variables of being able to ignore disturbing noise ($r_{xy.gender}$ = -.42; p < .10), rating the training as stressful ($r_{xy.gender}$ = .49; p < .05), and liking this relaxation tasks ($r_{xy.gender}$ = -.59; p < .01) were related to relaxation induced changes in sIgA. In order to reduce the discrepancy between objective (sIgA increase) and subjective (e.g. feeling relaxed) relaxation responses, biofeedback of sIgA increases by relaxation may be helpful.

A possible prophylactic and therapeutic consequence of these studies could be to convince high anxiety subjects that they can possibly benefit from relaxation training. However, more clinical studies are needed to supply evidence for the validity, the mechanism, and the positive effects for patients with specific immunological deficits.

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