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Serum albumin correlates with affective prosody in adult males with attention-deficit hyperactivity disorder

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ABSTRACT

The aim of this study was to determine the relationship between serum albumin, affective prosody, and symptoms of attention-deficit hyperactivity disorder (ADHD) found coincidentally in a recently published study. Here, serum albumin levels were assessed as a covariate. Twenty healthy male adults (controls) and 20 adult male patients with ADHD participated in the study on two study days. Serum albumin levels and performance in an affective prosody task were assessed, and correlations were determined. Serum albumin had a significant correlation with performance on an affective prosody task on both of the 2 study days. The same correlations were not significant in the healthy control group. There was no difference in the serum albumin level between patients with ADHD and healthy controls. The association between serum albumin and affective prosody in adults with ADHD is a novel finding. However, to date, there is no clear theory that explains this association. Future research should analyze whether serum albumin influences causes changes in performance in affective prosody using experimental designs.

1. Introduction

In a study concerning the impact of the acute tryptophan depletion (ATD) procedure, which reduces central nervous system serotonin, on affective prosody in adult male patients with attention-deficit hyperactivity disorder (Grabemann et al., 2013), we found an additional result that we wish to report and discuss here.

Hyperactivity, impulsivity, and inattention are the core symptoms of attention-deficit hyperactivity disorder (ADHD). The aim of our primary study was to determine whether affective prosody is impaired in adult patients with ADHD as compared with healthy adults and the contribution of central nervous system serotonin (CNS) to these variables. Affective prosody consists of the emotional tone of language, e.g., happiness, sadness, fear, and anger. It is a component of general prosody, which further includes linguistic, dialectical, and idiosyncratic components (Uekermann et al., 2010). In that study (Grabemann et al., 2013; see Mette et al., 2013; Zimmermann et al., 2012), the authors demonstrated that the processing of affective prosody was impaired in patients with ADHD compared with healthy controls on two study days; however, there was no effect of serotonin on this impairment (Grabemann et al., 2013). As a covariable, the serum albumin level was measured via electrophoresis. Serum albumin is a protein responsible for oncotic pressure and has important roles in transport and storage in the blood. Serum albumin stores and carries free fatty acids, hormones, amino acids, and active ingredients of drugs (Carlson, 2004). Consequently, we describe an association between serum albumin and affective prosody in adult patients with ADHD. Furthermore, we show that affective prosody does not correlate with other proteins in the blood serum (Leucin, Isoleucin, Biblirubin, Phenylalanin).

2. Methods

2.1. Study sample

Twenty male patients diagnosed with ADHD (mean age=30.25 years, S.D.=9.38 years) based on DSM-IV criteria and 20 male healthy controls (mean age=27.90 years, S.D.=6.02 years) participated in this study, which had a repeated measure design (two study days with a delay of one week). Patients were recruited from the ADHD outpatient clinic of the Department of Psychiatry and Psychotherapy of the University Duisburg-Essen, Germany. The control group was recruited from adjacent universities and hospitals. Potential participants diagnosed with asthma, obesity, diabetes, substance abuse, a psychotic disorder, or any

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neurological disease were excluded from the study. Further exclusion criteria for patients with ADHD included co-morbid depression, other mood disorders, or the use of methylphenidate (MPH) on the days the study was conducted. Patients using MPH were instructed to stop their medication 24 h prior to each study day, and these patients confirmed that they had followed these instructions.

Both patients with ADHD and healthy controls were comparable with respect to age ($t_{(32.4)}$=-0.94, $p > 0.05$) and IQ (Wechsler Intelligence Scale $t_{(38)}$=0.41, $p > 0.05$). No participant had an IQ score below 85, which was a further exclusion criterion. Patients did show significantly higher scores than control subjects on both the Wender Utah Rating Scale (WURS; $t_{(33.9)} = -6.1$, $p < 0.01$) and the ADHD self-report scale ($t_{(28.9)}$=28.88, $p < 0.01$). There were no significant differences between groups on the Barrat Impulsiveness Scale, although patients with ADHD achieved higher scores ($t_{(38)}$=1.86, $p > 0.05$). All participants provided verbal and written informed consent. The study was carried out in accordance with the guidelines of the Declaration of Helsinki (as revised in 1983). In addition, the Ethics Committee of the University of Duisburg-Essen assessed and approved the study.

2.2. Measure of serum albumin

On both study days blood samples were collected by a physician. Levels of serum albumin were measured nephelometrically (MLM medical labs, Moenchengladbach, Germany).

2.3. Measure of affective prosody

The "Tubingen Affect Battery" (Breitenstein et al., 1996) is a reliable and valid test that is used to assess the perception of affective prosody. The following subtests were used:

1) Naming the affective prosody of sentences with neutral semantic content.

In this subtest, participants heard 15 semantically neutral sentences. Their task was to identify the affective prosody of these sentences. The emotions displayed were "happiness," "anger," "fear," "sadness," and "neutral."

2) Naming congruent and incongruent semantic prosody.

In this subtest, 32 sentences were presented. In 24 of the sentences, the semantic content did not match the affective prosody; in 8 sentences, both aspects were congruent. Participants were asked to name the affective content of the voice and to ignore the semantic content of the sentences. The emotions displayed were the same as those from task 2.

2.4. Data analysis

Separate correlations were calculated between serum albumin and affective prosody for both groups (patients with ADHD and healthy controls) on both study days. A *t*-test was performed to determine whether serum albumin levels differed significantly between patients with ADHD and healthy controls. SPSS Version 21 (IBM® Armonk, New York) was used for data analysis.

3. Results

On the first study day, we found a significant correlation between affective prosody and serum albumin in the group of patients with ADHD (r=0.57, p=0.009). The same correlation was not statistically significant in the control group (r=0.098, p=0.68). Fig. 1 shows the scatter plots for these correlations for both groups. We did not identify any outlier that could have caused the significant correlation in the group of patients with ADHD. In addition, the scatter plot seemed to be coherent in the group of patients with ADHD. According to the statistical analysis for the healthy control group, the scatter plot seemed to decay at the bottom and top. Therefore, homoscedasticity did not exist.

On the second study day, we also found a significant correlation between serum albumin and performance in affective prosody (r=0.557, p=0.011). In addition, there was no significant correlation between these variables in the healthy control group (r=0.117, p=0.622) (Fig. 2). The scatter plot of the group of patients with ADHD seems to be coherent, and there is no indication that an outlier causes the relationship between serum albumin and affective prosody on the second study day. In the healthy control group, the scatter plot seems to decay at the top and bottom. In this case, homoscedasticity did not exist.

Furthermore, we analyzed whether serum albumin levels differ between group of patients with ADHD and the control group (Table 1). The *t*-tests did not reveal significant differences between the groups (study day 1: $t_{(38)}$=1.098, p=0.279; study day 2: $t_{(38)}$=1.31, p=0.199). On both days the analyses of premises of parametrical testing conducted with Kolmogorov–Smirnov-Tests demonstrated that homoscedasticity and normal distribution of residua were given (day 1: $K_{(40)}$=0.098, $p > 0.2$, day 2: $K_{(40)}$=0.11, $p < 0.2$) Therefore, the use of *t*-tests were indicated.

4. Discussion

The results from the present study demonstrate that serum albumin correlates with the processing of affective prosody only in adult male patients with ADHD, which is a novel finding. These associations were found on two separate study days.

In this paragraph, we discuss the hypothesis that serum albumin contributes to impairments in processing affective prosody and influences the degree of this impairment which was described by Grabemann et al. (2013). In the field of ADHD there are no studies which report a similar association. Several studies have reported correlations between serum albumin and higher

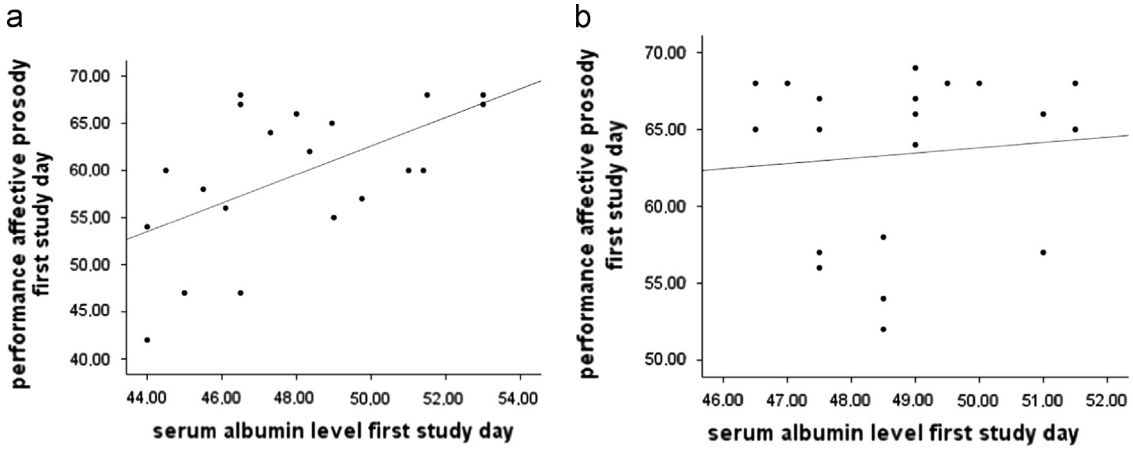

Fig. 1. Scatter plots for both correlations on study day 1 (a: Patients with ADHD, and b: Healthy controls).