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Neurological soft signs in Chinese adolescents with antisocial personality traits

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ABSTRACT

The current study was designed to explore the specific relationship between neurologic soft signs (NSSs) and characteristics of antisocial personality traits in adolescents, and to investigate particular NSSs linked to certain brain regions in adolescents with antisocial personality traits. The research was conducted on 96 adolescents diagnosed with ASP traits (ASP trait group) using the ASPD subscale of the Personality Diagnostic Questionnaire for the DSM-IV (PDQ-4+) and 96 adolescents without traits of any personality disorder (control group). NSSs were assessed using the soft sign subscales of the Cambridge Neurological Inventory. Adolescents with ASP traits showed more motor coordination, sensory integration, disinhibition, and total NSSs than the control group. Seven NSSs, including stereognosia in right hand, finger agnosia and graphesthesia in both hands, left-right orientation, and go/no go stimulus, were significantly more frequent in teenagers with ASP traits. Sensory integration was positively associated with ASP traits. Adolescents with antisocial personality traits might have abnormalities in the central nervous system, and sensory integration might be the particular indicator of antisocial personality disorder.

1. Introduction

Neurologic soft signs (NSSs) were usually subtle but observable impairments in motor and sensory functions. They were neither localized to a specific region of the brain nor characteristic of any specific neurological condition (Bombin et al., 2005). However, recent studies using brain imaging technologies demonstrated that NSSs may be associated with specific brain regions or even brain connections. For instance, research indicated that higher rates of soft neurologic signs were associated with a reduction of gray matter volume of subcortical structures, including putamen, globus pallidus, and thalamus, in both patients with first-onset schizophrenia and healthy volunteers (Dazzan et al., 2004, 2006). Further, another study found that fist–edge–palm task, one of the NSSs, induced significant activations within the cortical networks that contain bilateral sensorimotor, supplementary motor area, left parietal, and the right cerebellum in healthy subjects (Chan et al., 2006; Rao et al., 2008).

Antisocial Personality Disorder (ASPD) develops mostly during childhood or early adolescence and persists into adulthood. It is characterized by dysfunctional interpersonal relationships, a lack of empathy and remorse, impulsivity, and aggression (Glenn et al., 2013). Several studies investigated the biological mechanisms underlying these behaviors. Neuroimaging studies found structural and functional abnormalities of people with ASPD. For example, Rankin et al. revealed that the medial orbitofrontal cortex (OFC) and ventral striatal structures contributed to empathy, and the right anterior temporal areas were essential for real-life empathic behavior (Rankin et al., 2006). Meantime, some research demonstrated the relationship between brain structure and impulsive aggressive behavior. Researchers found that aggressive impulsive behavior was associated with reduced metabolism in the orbitofrontal, anterior medial frontal, and left anterior frontal regions (Goyer et al., 1994). Hoptman et al. found that the inferior frontal white matter microstructure (Hoptman et al., 2002) and amygdalofrontal functional disconnectivity (Hoptman et al., 2010) was associated with aggressive and antisocial behavior. Further, reduced metabolism was found in the superior parietal cortex in aggressive patients (Hirono et al., 2000), and individuals with impulsive personality disorders (Siever et al., 1999).

There are some previous studies correlating NSSs and ASPDs or antisocial behavior. A study recruited inpatients with schizophrenia with violent behavior, and patients were classified into

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high ($n=28$), low ($n=27$), or no ($n=34$) violence groups. This study found that the high violence group showed more neurologic and neuropsychologic abnormalities than the other two groups in the area of integrative sensory and motor functions (Krakowski et al., 1989). Another study comprised 14 homicidal men with ASPD according to a forensic psychiatric examination. Ten healthy volunteers served as controls. The NSSs scores of antisocial offenders were dramatically increased as compared with normal controls (Lindberg et al., 2004). These aforementioned researches may indicate that antisocial behavior or ASPD was related to a certain neurophysiology deficit.

The Cambridge Neurological Inventory was a clinical instrument for assessment of soft neurologic signs, and it consisted of three subscales: the motor coordination, sensory integration, and disinhibition. These subscales have been devised to investigate the putative areas of the prefrontal, parietal, and frontal lobes, respectively (Chen et al., 1995; Chan and Gottesman, 2008). Given the aforementioned researches, the purpose of this study was to investigate the specific relationship between NSSs and characteristics of antisocial personality traits in adolescents, and to explore the particular NSSs linked to certain brain regions in adolescents with antisocial personality traits. In addition, considering adolescence was a vulnerable period and facilitates the start of risk behaviors (Garcia and Costa, 2008), such as cannabis abuse (Dervaux et al., 2010), smoking, unprotected sex, and so on, and higher levels of psychopathic traits in adolescence predicted violent recidivism (Gretton et al., 2004), we chose teenagers as our experimental subjects.

2. Methods

2.1. Participants

The adolescents were recruited from five cities in China (Beijing, Changsha, Suzhou, Chengdu, and Yinchuan). Adolescents or their family members with a history of psychotic illness were excluded on the basis of a brief questionnaire. Eventually, 2861 effective questionnaires were collected, comprising 1395 boys and 1466 girls. Permission was taken from the Medical Ethics Committee of Central South University, and written informed consent was obtained from all participants.

2.2. Personality Diagnostic Questionnaire-4+, PDQ-4+

Antisocial personality disorder subscale of the Personality Diagnostic Questionnaire was used to screen out personality traits of all the participants. The Chinese version of PDQ-4+ has been found to have adequate test reliability and validity. According to Chinese researches, the criterion of all kinds of personality disorder adjusted to a score of 5-6 in Chinese adolescents (Wang et al., 2013). In this study, the cut-off score of the antisocial personality disorder subscale of PDQ-4+ was 5. Adolescents with only antisocial personality traits were ASP traits group, and adolescents without any pathological personality traits we detected were in the control group.

2.3. Cambridge Neurological Inventory, CNI

Soft sign examinations of the Cambridge Neurological Inventory (CNI) was a scale used to assess severity of NSSs in the population (Chen et al., 1995). The instrument had 29 items, which encompassed motor coordination, sensory integration, and disinhibition. The motor coordination subscale consisted of items assessing rapid motor movements such as finger-thumb opposition, fist-edge-palm test, and Oseretsky test. The sensory integration subscale included items estimating tactile sensation such as finger-agnosia, stereognosis, and left-right orientation. The disinhibition subscale contained items for withholding or inhibiting associated movements. The CNI has been shown to have good construct, external validity, and interrater reliability (Zhang et al., 2015).

The CNI was administered in a standardized manner according to a fixed order. In the original scale, scoring indicated “normal” response (scored as 0), “equivocal normal” response (scored as 0.5), “abnormal” response (scored as 1), “grossly abnormal” response (scored as 2), and “missing” response (scored as 9). In the present study, scores were dichotomized into either “0” (covering normal or equivocal) or “1” (covering abnormal or grossly abnormal) (Cai et al., 2013).

2.4. Data processing and analysis

The data were pooled and analyzed using SPSS version 20. First, chi-square test was applied to assess the rate of prevalence of NSSs (the percentage of score of “1”) between two groups. Second, the Mann-Whitney U test was used to compare the difference between the ASP-trait and control groups. Effect sizes of the group comparisons were calculated in the light of *Cohen's d* (Cohen, 1988). Finally, binary logistic regression was applied to find the contribution of NSSs to antisocial personality traits. A two-tailed p value of less than 0.05 was considered statistically significant.

3. Results

3.1. Demographics

Ninety-six adolescents with only antisocial personality traits were detected according to the cut-off score of antisocial personality disorder subscale of PDQ-4+. Further, 96 healthy controls were recruited by random selection from the enrolled teenagers without any pathological personality traits we detected, and they were matched for age and gender. Meantime, none of the subjects reported cannabis or other drug abuse. As demonstrated in Table 1, there were no significant between-group differences in age, gender, and dominant hand ratio.

3.2. Comparisons of NSSs between adolescents with ASP traits and normal controls

The prevalence rate of score “1” of NSSs in antisocial personality traits and healthy controls are shown in Table 2. The chi-squared test showed that teenagers with antisocial personality traits exhibited a higher prevalence of NSSs in most of the items, especially in stereognosia in the right hand, finger agnosia and graphesthesia in both hands, left-right orientation, and go/no-go stimulus. Since the p was very close to 0.05 ($p=0.044$) in the fourfold table of chi-square distribution of the left Oseretsky test, we undertook Fisher probabilities in 2×2 table data.

The scores of NSSs subscales and the NSSs total scale are demonstrated in Table 3. All scores are dramatically different

Table 1
The demographic data of ASP group and control group.

	ASP group $n=96$	Control group $n=96$	t or χ^2	p
Age	16.10 ± 1.138	16.17 ± 1.063	0.393	0.695
Gender (male:female)	75:21	74:22	0.030	0.863
Dominant hand (right: left)	95:1	95:1	0.000	1.000