Adolescence is a vulnerable period for the development of psychiatric disorders such as depression which often shows a chronic course with relapses in adulthood (Patton et al., 2014). Investigating the neural correlates of psychiatric disorders early in life offers the opportunity to bypass effects of previous medication and/or by changes in neural processing due to a chronic course of a disorder (Cullen, 2012). Psychotherapeutic treatment effects are only sparsely investigated in adults (Fu et al., 2008) and even less empirical investigations exist in adolescents (Straub et al., 2015). In this study, we compared neural connectivity, measured by means of resting-state magnetic resonance imaging (rsfMRI), of adolescent patients with depression (PAT) and matched healthy controls (HC) and analysed pre-to-post connectivity changes of PAT after participation in a brief cognitive behavioural group psychotherapy (CBT).

### Methods

#### Study Design

![Image]

**Table 1** Study design: CBT = cognitive behavioral therapy; PAT = depressed patients that received CBT; CDRS-R = Children’s Depression Rating Scale-Revised; BDI-II = Beck Depression Inventory-Revised; fMRI = functional magnetic resonance imaging.

**Inclusion criteria**

- CDRS-R sumscore ≥ 36; Diagnosis of a depressive episode according to ICD-10; comorbidities were allowed (except for schizophrenia, bipolar disorder and substance abuse); no contradictions to fMRI scans; age between 13 and 18 years; IQ within normal range; medication naive.

**Subjects**

<table>
<thead>
<tr>
<th>PAT (N=19)</th>
<th>HC (N=19)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>16.76±1.39</td>
<td>16.35±1.47</td>
</tr>
<tr>
<td>Gender</td>
<td>15 females (79%)</td>
<td>15 females (79%)</td>
</tr>
<tr>
<td>Handedness¹</td>
<td>16 right-handed (94.7%)</td>
<td>17 right-handed (93.5%)</td>
</tr>
<tr>
<td>IQ</td>
<td>88.39±7.53</td>
<td>102.61±12.33</td>
</tr>
<tr>
<td>Depression subtype²</td>
<td>Depressive disorder, mild (N=12); moderate (N=1); severe (N=4)</td>
<td>none</td>
</tr>
<tr>
<td>Secondary diagnosis²</td>
<td>Social phobia (N=4); Specific phobia (N=1); Attention deficit without hyperactivity (N=1); Socialized conduct disorder (N=1)</td>
<td>none</td>
</tr>
<tr>
<td>Smoker</td>
<td>1 (5.3%)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Diagnostic instruments:**

- Children’s Depression Rating Scale-Revised (CDRS-R);
- Beck Depression Inventory Revision (BDI-II).

**Psychotherapeutic treatment:** CBT comprising five sessions á 75-90 minutes and one booster session (Spröber et al., 2012).

**fMRI paradigm:** resting state; Functional connectivity was calculated using SPM8 and the DPRSF toolbox on the whole brain level for spherical seed regions of interest (Amygdala, sgACC) based on previous studies, investigating differential connectivity with these regions between depressed and healthy adolescents.

References


### Results

**Clinical symptoms**

- PAT and HC differed with respect to the mean pre-test CDRS-R ($W=190, z=-5.28, p<0.001$) and BDI-II ($W=194, z=-5.16, p<0.001$). Within group analyses revealed significant pre-to-post reductions in the CDRS-R ($F(1,18)=13.93, p=0.002$) and BDI-II ($F(1,18)=10.94, p=0.004$) for PAT (Straub et al. 2015).

**Comparing PAT and HC**

**Comparing PAT pre to post**

**Correlation between symptom improvement and connectivity changes pre- to post CBT**

**Conclusions**

Comparing functional connectivity of PAT after compared to before CBT revealed greater connectivity between emotionally relevant regions of the affective network (Amygdala, sgACC) with regions of both, the salience network (dACC, Insula) and the default mode network (precuneus) are depicted in red; regions of the cognitive control network (dACC) with regions of the affective network (Amygdala, sgACC) and default mode network (precuneus) are depicted in red; regions of the cognitive control network (dACC) with regions of the affective network (Amygdala, sgACC) and default mode network (precuneus).