Very recently the first whole-genome association study (WGAS) reported a strong association between sarcoidosis and ANXA11 (annexin A11) on chromosome 10q22.3, a member of the annexin family of calcium-dependent phospholipid-binding proteins involved in structural organisation of the cell, growth control, calcium signalling, cell division, vesicle trafficking and apoptosis.\(^6\)\(^7\) Different single nucleotide polymorphisms (SNPs) within and downstream of the ANXA11 gene were strongly associated with sarcoidosis, including one non-synonymous SNP rs1049550 (c.68T→C, p.C230R) and several intronic or intergenic SNPs (rs1953600, rs2573346, rs2789679, rs2784773, rs2799679). The associated SNPs were in strong linkage disequilibrium.

To replicate the association in an independent cohort, we performed a case-control association study in 325 patients (mean age 52.1 years) and 364 healthy matched controls (healthy white German subjects, mean age 49.7 years). The diagnosis of sarcoidosis was based on evidence of non-caseating epithelial cell granuloma in biopsy specimens and chest radiographic abnormalities. A chronic course was defined as disease over at least 2 years or at least two episodes in a lifetime. Acute sarcoidosis was defined as one episode of acute sarcoidosis which had totally resolved at the date of the examination. None of the individuals in the control group had a history of lung or other disease by chest radiography or laboratory blood tests.

The C allele frequency of rs1049550 was significantly increased in the patients with sarcoidosis (C=0.6504, T=0.3496 in controls; C=0.5479, T=0.4521 in controls; p=0.00014, table 1). It was significantly associated with an increased risk of sarcoidosis in the individuals carrying the CC genotype (OR 2.18, 95% CI 1.39 to 3.45, p=0.00065). The increased risk was present in both dominant and recessive models (p=0.017 and p=0.0004, respectively). The allelic and genotypic risk of rs2573346 with sarcoidosis was even stronger, as described previously (allelic p=0.00008 and genotypic p=0.00022). The calculated population attributable risk (PAR) for rs2573346 CC homozygotes and CT heterozygotes was 21%. These data independently confirm the strong association between variations in ANXA11 and sarcoidosis and support the hypothesis that ANXA11 represents a strong genetic risk factor for sarcoidosis.

In contrast to the previously reported difference in association to BTNL2 in our patient cohort,\(^5\) there was no statistical difference between acute and chronic forms of sarcoidosis and rs1049550 or rs2573346 alleles, and both groups showed a significant allelic and genotypic association for all SNPs (table 1). However, this effect was slightly more pronounced in the chronic form, which was the larger subgroup with higher statistical power. All p values obtained in our study withstand a conservative Bonferroni correction for multiple testing.

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**Table 1 Statistical analysis of the case-control study**

<table>
<thead>
<tr>
<th>SNPs</th>
<th>Controls</th>
<th>Cases</th>
<th>OR(95% CI)</th>
<th>p Value</th>
<th>Acute*</th>
<th>p Value</th>
<th>Chronic*</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>rs1049550</td>
<td>Allele</td>
<td>T</td>
<td>283 (45%)</td>
<td>244 (35%)</td>
<td>1.54 (1.23 to 1.92)</td>
<td>0.00014</td>
<td>82 (35%)</td>
<td>152 (65%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>343 (55%)</td>
<td>454 (65%)</td>
<td></td>
<td></td>
<td>152 (65%)</td>
<td>0.0073</td>
</tr>
<tr>
<td></td>
<td>Genotype</td>
<td>TT</td>
<td>65 (21%)</td>
<td>48 (14%)</td>
<td>1.31 (0.85 to 2.03)</td>
<td>0.2245</td>
<td>46 (39%)</td>
<td>71 (40%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT</td>
<td>153 (49%)</td>
<td>148 (42%)</td>
<td>2.30 (1.47 to 3.60)</td>
<td>0.0027</td>
<td>53 (45%)</td>
<td>81 (46%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC</td>
<td>95 (30%)</td>
<td>153 (44%)</td>
<td>2.18 (1.39 to 3.43)</td>
<td>0.00065</td>
<td>53 (45%)</td>
<td>81 (46%)</td>
</tr>
<tr>
<td>rs2573346</td>
<td>Allele</td>
<td>T</td>
<td>303 (47%)</td>
<td>260 (37%)</td>
<td>1.55 (1.24 to 1.92)</td>
<td>0.00008</td>
<td>150 (64%)</td>
<td>0.0050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>341 (53%)</td>
<td>452 (65%)</td>
<td></td>
<td></td>
<td>150 (64%)</td>
<td>0.0050</td>
</tr>
<tr>
<td></td>
<td>Genotype</td>
<td>TT</td>
<td>71 (22%)</td>
<td>50 (14%)</td>
<td>1.41 (0.93 to 2.15)</td>
<td>0.1097</td>
<td>50 (42%)</td>
<td>77 (43%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT</td>
<td>161 (50%)</td>
<td>160 (45%)</td>
<td></td>
<td></td>
<td>50 (42%)</td>
<td>77 (43%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC</td>
<td>90 (28%)</td>
<td>146 (41%)</td>
<td>2.30 (1.47 to 3.60)</td>
<td>0.00022</td>
<td>50 (42%)</td>
<td>0.0131</td>
</tr>
</tbody>
</table>

**Significant associations are shown in bold.**

**Only patients with unequivocal classification were included.**
Competing interests None.

Ethics approval This study was conducted with the approval of the University of Bonn 060/05.

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