Subclinical psychotic experiences in the general population are prevalent in both children and adults, and not generally associated with persistence over time or onset of psychiatric disorder. Nevertheless, literature reviews suggest that a small number will make the transition to a clinical psychotic disorder.1,2

In a previous study on a representative sample of 7- and 8-year-old children in The Netherlands, the prevalence of auditory vocal hallucinations was 9%.3 Although auditory vocal hallucinations in these children were mostly of limited functional impact, a subgroup with serious suffering was considered at risk for more severe psychotic outcomes.

The current study presents a 5-year follow-up of this sample (now 12 and 13 years of age) and examines the persistence and new incidence of auditory vocal hallucinations, as well as their clinical relevance in terms of problem behaviour, severity and associations with aetiological variables. In view of the baseline occurrence of auditory vocal hallucinations was 9%.3 Although auditory vocal hallucinations in these children were mostly of limited functional impact, a subgroup with serious suffering was considered at risk for more severe psychotic outcomes.

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hallucinations were subsequently interviewed with the Auditory Vocal Hallucination Rating Scale (AVHRS). Given evidence for associations between auditory hallucinations and the use of substances and alterations in performance at school, information was also gathered in these domains. Parents completed the Child Behavior Checklist (CBCL), designed for children 4–18 years of age, and a sociodemographic questionnaire. Finally, parents were instructed on how to contact the research team in case they or their children had questions or worries resulting from the interview.

Participants
A total of 337 children were interviewed at follow-up, representing 49% of the baseline sample of 694 and 56% of the 605 that had consented to follow-up. Parents of 48 children were willing to complete the CBCL without their children being interviewed, 112 parents withdrew their informed consent and 108 families could not be contacted because of non-response or (re-)emigration. Children at follow-up, similar to baseline, continued to be evenly distributed regarding baseline case or control status: 170 children with auditory vocal hallucinations (cases) and 167 children without auditory vocal hallucinations (controls). From the combined baseline and follow-up data, four groups could be distinguished:
1. Children hearing voices at baseline and during the 5-year follow-up period: the persistent group;
2. Children hearing voices at baseline but not during the 5-year follow-up period: the remitted group;
3. Children not hearing voices at baseline but positive for auditory vocal hallucinations over the follow-up period: the incident group;
4. Children not hearing voices at both baseline and follow-up: the referent group.

The persistent group was defined as children hearing voices in the year before the baseline interview and (at least occasionally) during one other year over the follow-up period. The incident group was defined as children who heard voices for the first time after baseline assessment, with a minimum duration of 3 months.

Instruments

Children
The 16-item AVHRS is a structured interview, with the characteristics of hearing voices (e.g. frequency, attribution, duration, loudness, negative content, distress, anxiety, control, interference with thinking and with daily life) rated on a 5-point scale. Psychometric properties of the AVHRS are good. During booster sessions, DVD-recorded AVHRS interviews (of consenting patients attending the Voices Outpatient Department) were rated by all interviewers and A.A.B.-V. Total interrater agreement score (weighted Cohen's kappa) was 0.88.

Use of substances (cannabis, synthetic drugs such as ecstasy, amphetamines, cocaine and heroin) was assessed by a self-report questionnaire, in order to avoid socially desirable answers.

Cognitive ability
In order to rate children's performance at school, children and parents were asked to provide the results of the national Dutch end-of-primary-school test, which assesses the continuation level for secondary education. The standard scores range from 1 to 50; children scoring 1–28 are qualified for vocational secondary education, and those scoring 29–50 for pre-academic secondary education. In addition, current secondary school level was assessed.

Parents
The CBCL/4-18 is a self-report questionnaire for parents regarding their child’s behaviour. It consists of 113 items, grouped into nine syndrome scales of behavioural, social and physical functioning. Items are rated on a 3-point scale (0 = not true; 1 = somewhat or sometimes true; 2 = very true or often true). Parents also provided demographic data including their educational level and family income.

Analysis
Conform baseline analysis, an AVHRS severity index, was computed by recoding items to ‘0’ = ‘none or mild consequences’ versus ‘1’ = ‘considerable to severe consequences’. Based on this index, two groups were defined: a severe auditory vocal hallucinations group (children scoring ≥5) and a mild auditory vocal hallucinations group (scores 0–4), that were contrasted with the referent group.

Mean age of the follow-up sample was 13.1 years (s.d. = 0.5, range 12.0–14.6). Mean interval between baseline and follow-up assessment was 5.1 years (s.d. = 0.4). Attrition analyses (based on
n = 694) showed that the participation rate was equal for baseline cases (49%) and controls (48%). Registration rates at the PCR-NN were not different for participating and non-participating children (8% v. 10%; OR = 0.83, 95% CI 0.49–1.40, P = 0.48), and these groups did not differ in mean number of psychiatric service contacts: 2.5 (s.d. = 1.3) in the participating children and 2.4 (s.d. = 1.6) in the non-participating children (OR = 1.06, 95% CI 0.75–1.51, \( P = 0.73 \)). The participation rate for girls was significantly higher than for boys (53% v. 44%; \( \chi^2 = 5.50, P = 0.02 \)). There was no evidence for differential attrition as a function of age and urbanicity. A flow chart of follow-up participants (n = 337) is presented in Fig. 1.

Most children in the follow-up sample (90%) lived in a rural environment. Socioeconomic status was evenly distributed (31% low, 39% middle and 30% high). Mean score on the end-of-primary-school test was 37.2 (s.d. = 8.7, range 9–50); 53% of the children were attending higher-level secondary education. In Table 1, demographic data by follow-up status are presented.

### Course of auditory vocal hallucinations and predictors of persistence

The persistence rate of auditory vocal hallucinations was 23.5% and the 5-year cumulative incidence rate in the baseline control sample was 9.0%. Mean duration of hearing voices in the persistent group was 5.7 years (s.d. = 1.9) and in the incident group 3.5 years (s.d. = 1.7).

Children still hearing voices after 5 years, compared with children in the remitted group, at baseline more often belonged to the group with severe auditory vocal hallucinations (40% v. 21%, OR = 2.54, 95% CI 1.19–5.45, \( P = 0.016 \)) (Table 2). Examining distinct baseline auditory vocal hallucination characteristics revealed that hearing more than one voice discriminated best between persistence and remission of baseline auditory vocal hallucinations (OR = 2.81, 95% CI 1.09–7.23, \( P = 0.032 \)). Also, attribution of voices to an external source (e.g. deceased family members or an extra-terrestrial source) discriminated between persistence and remission (OR = 2.35, 95% CI 1.11–4.97, \( P = 0.025 \)).

### Auditory vocal hallucinations and cognitive ability

Children with persistent auditory vocal hallucinations, compared with the referent group, displayed lower end-of-school cognitive test scores (mean score 32 v. 37; OR = 1.07, 95% CI 1.02–1.12, \( P = 0.004 \)) and more often had lower secondary school education (71% v. 48%; OR = 2.63, 95% CI 1.21–5.68, \( P = 0.014 \)). The incident group, however, did not differ from the referent group. Children in the remitted group scored highest on both cognitive ability outcome measures (Table 2).

### Problem behaviour

Compared with the referent group, children with persistent auditory vocal hallucinations, as well as children with incident auditory vocal hallucinations, displayed higher scores on the ‘thought problems’ scale of the CBCL at both baseline and follow-up (Table 3). Also, when the item on auditory hallucinations (item 40) was excluded from this scale, these differences remained (‘thought problems’ baseline: persistent auditory vocal hallucinations, OR = 1.53, 95% CI 1.07–2.19, \( P = 0.02 \); incident auditory vocal hallucinations, OR = 1.82, 95% CI 1.10–3.02, \( P = 0.02 \); ‘thought problems’ follow-up: persistent auditory vocal hallucinations, OR = 1.27, 95% CI 0.93–1.75, \( P = 0.14 \); incident auditory vocal hallucinations, OR = 1.82, 95%
Auditory vocal hallucinations in childhood

CI 1.29–2.55, \( P = 0.001 \)). Odds ratios were highest when only the narrow psychotic symptoms of the ‘thought problems’ scale (i.e. ‘Strange behaviour’, ‘Strange ideas’ and ‘Sees things that aren’t there’) were included (baseline: persistent auditory vocal hallucinations, \( OR = 2.40, 95\% CI \ 1.15–5.02, \ P = 0.020 \); incident auditory vocal hallucinations, \( OR = 3.19, 95\% CI \ 1.33–7.62, \ P = 0.009 \); follow-up: persistent auditory vocal hallucinations, \( OR = 2.37, 95\% CI \ 1.10–5.10, \ P = 0.027 \); incident auditory vocal hallucinations, \( OR = 4.06, 95\% CI \ 1.84–8.97, \ P = 0.001 \)). Child Behavior Checklist scores at follow-up were more often in the clinical range for both the persistent and the incident group (Table 3).

### Severity of auditory vocal hallucinations

At baseline, 27\% of children with auditory vocal hallucinations (\( n = 347 \)) reported severe suffering associated with auditory hallucinations, compared with 35\% of children with auditory vocal hallucinations at follow-up (\( n = 53 \)). The proportion of children with severe auditory vocal hallucinations at follow-up was higher in the incident group (60\%) than in the persistent group (25\%) (\( \chi^2 = 5.91, \ P = 0.02 \)). Children with severe auditory vocal hallucinations (but not children with mild auditory vocal hallucinations), compared with the referent group, were more likely to show problem behaviour (CBCL total score: baseline, \( OR = 1.03, 95\% CI \ 1.00–1.05, \ P = 0.033 \); follow-up, \( OR = 1.04, 95\% CI \ 1.02–1.06, \ P < 0.001 \). At follow-up, children with severe auditory vocal hallucinations were more likely to score in the clinical range of psychopathology (OR = 5.45, 95\% CI 2.10–14.16, \( P < 0.001 \)). Severity of auditory vocal hallucinations at follow-up was not associated with gender (\( \chi^2 = 1.09, \ P = 0.58 \)), SES (\( \chi^2 = 3.49, \ P = 0.48 \)) or urbanicity (\( \chi^2 = 4.23, \ P = 0.38 \)). Children with severe auditory vocal hallucinations had lower end-of-primary-school test scores than children with mild auditory vocal hallucinations; both groups had lower scores than control children (\( F = 6.69, \ P = 0.001 \)). Children with severe (but not mild) auditory vocal hallucinations were more likely to attend a lower secondary school type than the referent group (OR = 4.40, 95\% CI 1.41–13.73, \( P = 0.01 \)).

### Risk factors

Compared with the referent group, children with incident auditory vocal hallucinations more often lived in an urban environment (OR = 3.86, 95\% CI 1.08–13.89, \( P = 0.038 \)). Severity of auditory vocal hallucinations at follow-up was not associated with urbanicity (OR = 1.02, 95\% CI 0.23–4.63, \( P = 0.98 \)). Substance use in the sample was negligible; those who ever used cannabis (the only substance used) were in the incident (\( n = 1 \)) and referent (\( n = 2 \)) groups.

### Discussion

#### Summary of findings

The majority (76\%) of the children with auditory vocal hallucinations at age 7 or 8 years no longer heard voices at the age of 12 and 13 years. This is in line with remission rates presented in a recent systematic review,\(^1\) which reported that approximately 75–90\% of developmental psychotic experiences are transient and disappear over time. Although the samples in the systematic review all involved older children (from about 11 years of age), the current study suggests that the natural transitory course also applies to children aged 7–8 years at baseline.

The current results suggest that auditory vocal hallucinations may influence variables indexing cognitive ability, as these variables showed strong associations with persistence, but not with incidence. Persistence was associated with greater severity of auditory vocal hallucinations at baseline with some attenuation by the time of follow-up, when incident auditory vocal hallucinations were associated with the greatest level of severity. In line with this was the finding that the incident group displayed a nearly 5 times, and the persistent group an approximately 2.5 times greater risk for CBCL scores in the clinical range at follow-up. Psychotic thought problems were associated with incident and persistent auditory vocal hallucinations, both at baseline and at follow-up. However, the higher odds ratios for psychotic ideation in the incidence group suggest a higher risk in this group.\(^{2,5,26}\) These differences between the incident and the persistent groups suggest that (a) persistent auditory vocal hallucinations may improve over time (the proportion in the severe range dropped from 40\% at baseline to 25\% at follow-up) and (b) the first manifestation of auditory vocal hallucinations in later childhood may be indicative of more severe underlying pathology.

#### Findings and initial hypotheses

The course of auditory vocal hallucinations did not always follow an orderly pattern. Thus, children in the persistent group had been hearing voices for an average period of more than 5.7 years, and all had heard voices in the past year. Approximately 50\% of the persistent group heard voices on a more or less regular (continuous) basis, some of them as long as they could remember. However, in other children, the course seemed intermittent during the 5-year follow-up period. Despite the underlying variability in frequency and duration, persistence of hearing voices more often occurred in children with more severe auditory vocal hallucinations at baseline, confirming the first hypothesis.

The second hypothesis was also confirmed. The pattern of results was that baseline psychotic symptoms were associated with incidence and persistence of auditory vocal hallucinations, and had strong associations with CBCL scores in the clinical range. These findings suggest that auditory vocal hallucinations that are associated with a broader range of psychotic symptoms fare worse and give rise to clinical problem behaviour.

At baseline, the rate of auditory vocal hallucinations was higher in rural areas; however, hallucinations were of greater severity and had more functional impact in urban areas. At follow-up, children in the incident group more often lived in an urban environment, but auditory vocal hallucinations severity was not associated with an urban environment, thus only partly confirming the third hypothesis. At baseline, level of urbanicity was established by primary school postal code because children’s home addresses were not available. This procedure seemed justified because primary school addresses mostly were in close range of the children’s home address. At follow-up, however, home addresses were available, which we used as estimates because the majority of children living in a rural area would then attend secondary schools in an urban environment.

Logistic regression analyses with baseline auditory vocal hallucination characteristics as covariates showed that hearing more than one voice and the attribution of these voices to an external source were the strongest predictors of hearing voices after 5 years. This confirms our fourth hypothesis, in line with findings of Escher and colleagues,\(^4\) suggesting that children with a secondary attribution of their voices (i.e. the child had indicated explanations of the voices being caused by spirits, ghosts, special gifts, etc.) had a higher risk of voice persistence. Previous work suggests that individuals who continue to hear voices and
### Table 2  Multinomial regression analyses of cognitive abilities and auditory vocal hallucinations severity (n = 337)

<table>
<thead>
<tr>
<th>Cognitive ability</th>
<th>Incident group (n = 15)</th>
<th>Persistent group (n = 40)</th>
<th>Remitted group (n = 130)</th>
<th>Referent group (n = 152)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Mean (s.d.) OR (95% CI)</td>
<td>% Mean (s.d.) OR (95% CI)</td>
<td>% Mean (s.d.) OR (95% CI)</td>
<td>% Mean (s.d.) OR (95% CI)</td>
</tr>
<tr>
<td>End-of-primary-school-test score(^b)</td>
<td>35.33 (6.43) 1.03 (0.96–1.10) 0.47</td>
<td>31.90 (8.90) 1.07 (1.02–1.12) 0.004</td>
<td>39.08 (8.94) 0.97 (0.94–1.01) 0.12</td>
<td>37.22 (8.14) 0.67 (0.43–1.13) 0.14</td>
</tr>
<tr>
<td>Secondary school, low level</td>
<td>47 0.94 (0.32–2.71)</td>
<td>7.1 2.63 (1.21–5.68) 0.014</td>
<td>39 0.67 (0.43–1.13)</td>
<td>48</td>
</tr>
<tr>
<td>AUDITORY VOCAL HALLUCINATIONS SEVERITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe (baseline)(^c)</td>
<td>–</td>
<td>40 2.54 (1.19–5.45) 0.016</td>
<td>21 –</td>
<td>48</td>
</tr>
<tr>
<td>Severe (follow-up)(^d)</td>
<td>60 4.50 (1.28–15.81) 0.19</td>
<td>25 –</td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) The reference comparison group in the multinomial regression analysis.  
\(^b\) Odds ratios were inversed (1/OR) so that higher ORs reflect worse performance.  
\(^c\) The reference group is the remitted group.  
\(^d\) The reference group is the persistent group.  
Significant differences are shown in bold.

### Table 3  Multinomial regression analyses of CBCL indices (n = 337)

<table>
<thead>
<tr>
<th>Problem behaviour (baseline CBCL)</th>
<th>Incident group (n = 15)</th>
<th>Persistent group (n = 40)</th>
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<th>Referent group (n = 152)</th>
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</tr>
<tr>
<td>Problem behaviour (baseline CBCL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thought problems</td>
<td>1.8 (2.3) 1.92 (1.25–2.97) 0.003</td>
<td>1.3 (1.7) 1.66 (1.21–2.72) 0.002</td>
<td>0.6 (1.1) 1.13 (0.86–1.49) 0.40</td>
<td>0.5 (0.8)</td>
</tr>
<tr>
<td>Without item on AVH</td>
<td>1.4 (2.3) 1.82 (1.10–3.02) 0.02</td>
<td>1.0 (1.3) 1.53 (1.07–2.19) 0.02</td>
<td>0.4 (0.8) 0.91 (0.65–1.28) 0.99</td>
<td>0.5 (0.8)</td>
</tr>
<tr>
<td>Only 3 psychotic symptoms</td>
<td>0.7 (1.5) 3.19 (1.33–7.62) 0.009</td>
<td>0.4 (0.9) 2.40 (1.55–3.02) 0.02</td>
<td>0.1 (0.3) 0.98 (0.43–2.27) 0.97</td>
<td>0.1 (0.3)</td>
</tr>
<tr>
<td>Internalising</td>
<td>7.5 (7.4) 1.06 (0.95–1.18)</td>
<td>0.31</td>
<td>7.2 (7.0) 1.05 (0.98–1.12) 0.14</td>
<td>5.7 (6.2) 1.01 (0.96–1.06) 0.72</td>
</tr>
<tr>
<td>Externalising</td>
<td>5.3 (5.3) 0.96 (0.82–1.10)</td>
<td>0.43</td>
<td>9.7 (7.3) 1.05 (1.00–1.10) 0.07</td>
<td>8.4 (7.9) 1.03 (0.99–1.07) 0.17</td>
</tr>
<tr>
<td>Total</td>
<td>23.8 (21.8) 1.01 (0.97–1.05)</td>
<td>0.64</td>
<td>29.9 (21.3) 1.03 (1.01–1.05) 0.02</td>
<td>23.8 (19.4) 1.01 (0.99–1.02) 0.42</td>
</tr>
<tr>
<td>Clinical range</td>
<td>25</td>
<td>1.10 (0.21–5.23) 0.91</td>
<td>30</td>
<td>1.41 (0.58–3.42) 0.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problem behaviour (follow-up CBCL)</th>
<th>Incident group (n = 15)</th>
<th>Persistent group (n = 40)</th>
<th>Remitted group (n = 130)</th>
<th>Referent group (n = 152)</th>
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<td>% Mean (s.d.) OR (95% CI)</td>
</tr>
<tr>
<td>Thought problems</td>
<td>1.9 (2.6) 1.68 (1.26–2.25)</td>
<td>0.69</td>
<td>1.0 (1.3) 1.33 (1.02–1.72)</td>
<td>0.03</td>
</tr>
<tr>
<td>Without item on AVH</td>
<td>1.6 (2.1) 1.82 (1.29–2.55)</td>
<td>0.001</td>
<td>0.7 (1.1) 1.27 (0.93–1.75)</td>
<td>0.14</td>
</tr>
<tr>
<td>Only 3 psychotic symptoms</td>
<td>0.7 (1.3) 4.06 (1.84–8.97)</td>
<td>0.001</td>
<td>0.2 (0.6) 2.37 (1.10–5.31)</td>
<td>0.03</td>
</tr>
<tr>
<td>Internalising</td>
<td>11.9 (10.2) 1.15 (1.07–1.23)</td>
<td>&lt; 0.001</td>
<td>9.3 (7.1) 1.11 (1.05–1.17)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Externalising</td>
<td>8.7 (13.6) 1.05 (0.99–1.12)</td>
<td>0.11</td>
<td>7.1 (6.1) 1.03 (0.98–1.08)</td>
<td>0.25</td>
</tr>
<tr>
<td>Total</td>
<td>35.5 (31.4) 1.04 (1.02–1.10)</td>
<td>0.001</td>
<td>28.3 (19.7) 1.03 (1.01–1.04)</td>
<td>0.006</td>
</tr>
<tr>
<td>Clinical range</td>
<td>47</td>
<td>4.67 (1.55–14.08) 0.006</td>
<td>33</td>
<td>2.57 (1.16–5.67) 0.020</td>
</tr>
</tbody>
</table>

CBCL, Child Behavior Checklist; AVH, auditory vocal hallucinations.  
\(^a\) The reference comparison group in the multinomial regression analysis.  
Significant differences are shown in bold.

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**Table 3 Multinomial regression analyses of CBCL indices (n = 337)**

- **Table 2 Multinomial regression analyses of cognitive abilities and auditory vocal hallucinations severity (n = 337)**
- **Table 3 Multinomial regression analyses of CBCL indices (n = 337)**
attribute auditory vocal hallucinations to an external source may be more at risk of developing secondary psychotic ideation.\( ^7\)

Cognitive ability (indexed by end-of-primary-school test and secondary school level) of children with persistent auditory vocal hallucinations was significantly lower compared with children whose auditory vocal hallucinations were only transient, and thus may be indicative of risk of transition to psychotic disorder, as suggested by recent studies.\( ^{17–20,28–30}\) The incident group did not (yet) show alterations in cognitive ability. However, they did have a lower mean score on the end-of-primary-school test (albeit non-significant), which arguably represents a better measure of cognitive ability than secondary school level, given that many other factors intervene in the choice for secondary school type.

In addition, the number of children in the incident group was small \( (n = 15)\). Taken together, these findings provide some support for the fifth hypothesis.

At baseline, associations were tested using prospective data on pre- and perinatal complications, derived from routine infant health service records at baseline assessment;\( ^5\) no clear pattern of association was found. Variables tested at baseline included dichotomous measures on pregnancy, delivery and condition of the child right after birth, as well as continuous variables on early developmental characteristics (in the child’s first 12 months of life), summarised in three variables for analysis: fine motor activity, gross motor activity and communication.\( ^5\) Post-hoc examination of these perinatal and developmental variables in relation to the groups at follow-up similarly revealed no significant association for any of the variables (data not shown), indicating that the absence of a clear pattern of association between auditory vocal hallucinations and these variables at baseline was valid.

Clinical implications

Based on our results, it may be concluded that the majority of auditory hallucinations at baseline are benign and will be transient. If presented in the context of behavioural problems or with other psychotic experiences, it may be advisable for parents to seek help for their child, in order to prevent a poor prognosis.

However, parental recognition of the child’s auditory hallucinations was low. At baseline, 13% of the parents indicated that their child may hear ‘things’, whereas at follow-up, only 25% of the parents of the persistent group indicated correct recognition of the phenomenon. For clinicians, the findings may be helpful in the sense that in the case of children presenting with somatic complaints, behavioural problems, lower school results or thought problems, the possibility of underlying auditory hallucinations should be considered. On the other hand, when a child reveals the existence of uncomplicated auditory hallucinations, explanations of the mostly transitory nature of the experience may be appropriate.

Limitations

We could not include all children of the baseline case–control sample. First, 13% of the parents had already indicated at baseline that they did not want to participate in a follow-up study. Second, despite maximum efforts to include as many children as possible, follow-up participation was not always possible, as parents were sometimes protective towards their children who had just started secondary school and were in a process of adjustment. Third, there is good reason to assume that a number of children did not want to participate \( a \) priori. Fourth, some of the non-responding families could not be traced or contacted by telephone. There were, however, no indications that non-response or refusal rates were due to (psychiatric) problems of the children. Baseline participation rates of children with auditory vocal hallucinations and controls were almost equal (50%). Likewise, the follow-up participation rate of children with severe and mild auditory vocal hallucinations at baseline equals the proportion at baseline (25% severe and 75% mild). These considerations were confirmed by data from the PCR-NN, in which referral and contact rates at group level also showed no differences. Finally, the study design did not permit us to gather any clinical information, including diagnostic assessments, from treatment providers. This would have shed more light on the association between childhood auditory hallucinations and clinical disorders.

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