

1-12-2012

# Psychotic symptoms in adolescence index risk for suicidal behavior: findings from 2 population-based case-control clinical interview studies.

Ian Kelleher

*Royal College of Surgeons in Ireland, iankelleher@rcsi.ie*

Fionnuala Lynch

*Mater Misericordiae University Hospital*

Michelle Harley

*Royal College of Surgeons In Ireland*

Charlene Molloy

*Royal College of Surgeons In Ireland*

Sarah Roddy

*Royal College of Surgeons In Ireland*

*See next page for additional authors*

## Citation

Kelleher I, Lynch F, Harley M, Molloy C, Roddy S, Fitzpatrick C, Cannon M. Psychotic symptoms in adolescence index risk for suicidal behavior: findings from two population-based case-control clinical interview studies. *Archives of General Psychiatry*. 2012;69(12):1277-1283.

This Article is brought to you for free and open access by the Department of Psychiatry at e-publications@RCSI. It has been accepted for inclusion in Psychiatry Articles by an authorized administrator of e-publications@RCSI. For more information, please contact [epubs@rcsi.ie](mailto:epubs@rcsi.ie).

---

**Authors**

Ian Kelleher, Fionnuala Lynch, Michelle Harley, Charlene Molloy, Sarah Roddy, Carol Fitzpatrick, and Mary Cannon

---

— Use Licence —



This work is licensed under a [Creative Commons Attribution-Noncommercial-Share Alike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/).

---

# Psychotic Symptoms in Adolescence Index Risk for Suicidal Behavior

## Findings From 2 Population-Based Case-Control Clinical Interview Studies

Ian Kelleher, PhD; Fionnuala Lynch, MD; Michelle Harley, MD; Charlene Molloy, MD; Sarah Roddy, PhD; Carol Fitzpatrick, MD; Mary Cannon, MD, PhD

**Context:** Recent evidence from both clinical and population research has pointed to psychotic symptoms as potentially important markers of risk for suicidal behavior. However, to our knowledge, there have been no epidemiological studies to date that have reported data on psychotic symptoms and suicidality in individuals who have been clinically assessed for suicidal behavior.

**Objectives:** To explore associations between psychotic symptoms in nonpsychotic adolescents and risk for suicidal behavior in (1) the general population, (2) adolescents with psychiatric disorder, and (3) adolescents with suicidal ideation.

**Design:** Two independently conducted case-control clinical interview studies.

**Setting:** Population-based studies in Ireland.

**Participants:** Study 1 included 212 adolescents aged 11 to 13 years. Study 2 included 211 adolescents aged 13 to 15 years. Participants were recruited from schools.

**Main Outcome Measures:** Suicidal behavior and psychotic symptoms, assessed by semi-structured diagnostic clinical interview.

**Results:** Psychotic symptoms were associated with a 10-fold increased odds of any suicidal behavior (ideation, plans, or acts) in both the early and middle adolescence

studies (odds ratio [OR], 10.23; 95% CI, 3.25-32.26;  $P < .001$  and OR, 10.5; 95% CI, 3.14-35.17;  $P < .001$ , respectively). Adolescents with depressive disorders who also experienced psychotic symptoms were at a nearly 14-fold increased odds of more severe suicidal behavior (suicide plans and suicide acts) compared with adolescents with depressive disorders who did not experience psychotic symptoms (OR, 13.7; 95% CI, 2.1-89.6). Among all adolescents with suicidal ideation, those who also reported psychotic symptoms had a nearly 20-fold increased odds of suicide plans and suicide acts compared with adolescents with suicidal ideation who did not report psychotic symptoms (OR, 19.6; 95% CI, 1.8-216.1).

**Conclusions:** Psychotic symptoms are strongly associated with increased risk for suicidal behavior in the general adolescent population and in adolescents with (nonpsychotic) psychiatric disorder. In both studies, an absolute majority of adolescents with more severe suicidal behavior (suicidal plans and acts) reported psychotic symptoms when directly questioned about this as part of a psychiatric interview. Assessment of psychotic symptoms should form a key part of suicide risk assessment.

*Arch Gen Psychiatry.* 2012;69(12):1277-1283.

Published online October 29, 2012.

doi:10.1001/archgenpsychiatry.2012.164

### Author Affiliations:

Department of Psychiatry, Royal College of Surgeons in Ireland, Education and Research Centre, Beaumont Hospital (Drs Kelleher, Harley, Molloy, Roddy, and Cannon), and Child and Adolescent Mental Health Service, Mater Misericordiae University Hospital (Drs Lynch and Fitzpatrick), Dublin.

**S**UICIDAL BEHAVIOR IS ONE OF the most important causes of mortality worldwide. There are an estimated 1 million deaths by suicide annually<sup>1</sup> and reducing suicide is a national health priority in many countries.<sup>2-4</sup> The causes of suicidal behavior, however, remain poorly understood.<sup>5</sup> An increased prevalence of suicidal behavior in psychosis is well established. In fact, when Eugen Bleuler first defined schizophrenia in 1911, he recognized the “suicidal drive” as “the most serious of schizophrenic symp-

toms.”<sup>6</sup> Patients with psychosis are at a 12-fold increased risk of completed suicide compared with the general population<sup>7</sup> and as many as half of patients with schizophrenia are believed to make at least 1 suicide attempt.<sup>8</sup> However, psychosis is only known to play a role in a small absolute number of cases of suicidal behavior.

Recently, a large body of epidemiological research has documented that hallucinations and delusions, the classic symptoms of psychosis, are far more prevalent in the general population than diagnosable psychotic disorder.<sup>9-12</sup> Psychotic symp-

toms are especially common in young people, with a meta-analysis of general population studies demonstrating a median prevalence of 17% in children aged 9 to 12 years and 7.5% in adolescents aged 13 to 17 years.<sup>13</sup> Individuals in the general population who report psychotic symptoms are considered to be part of an “extended psychosis phenotype,” with patients with psychosis at the distal extreme.<sup>14</sup> As well as reporting hallucinations and delusions, these individuals have been shown to share an extensive range of risk factors with patients<sup>15</sup> and are at increased risk of psychotic disorder.<sup>16,17</sup> More recently, however, these individuals have been shown to be at high risk for a broad range of psychopathology, not limited to psychosis.<sup>18-22</sup>

Recent evidence from both clinical and population research has pointed to psychotic symptoms as potentially important markers of risk for suicide. In an emergency psychiatry patient sample, Penagaluri et al<sup>23</sup> noted that patients who reported subclinical hallucinations had more severe suicidal ideation. Similarly, following a review of medical records of patients with suicidal behavior, which showed a high rate of hallucinations in particular in early adolescence, Hysinger et al<sup>24</sup> stressed the need for further research on the role of psychotic symptoms in suicidal behavior. In population-based research, 2 recent questionnaire surveys have linked psychotic symptoms and suicidal behavior. Nishida et al<sup>25</sup> found that adolescents who endorsed a questionnaire item about hallucinations were 3 times more likely to also endorse an item related to suicidal ideation. Saha et al,<sup>26</sup> on the other hand, found that individuals who endorsed questionnaire items about delusions were 2 to 4 times more likely to endorse questionnaire items on suicidal behavior. One further study recently reported that mothers of adolescents who reported psychotic symptoms were 3.7 times more likely to report that their child had made a suicide attempt or engaged in self-harm.<sup>27</sup> However, to our knowledge, there have been no epidemiological studies to date that have reported data on psychotic symptoms and suicidality in individuals who have been clinically assessed for suicidal behavior. Herein, we report the relationship between psychotic symptoms and suicidal behavior from 2 independent population-based studies involving in-depth diagnostic psychiatric interviews of adolescents aged 11 to 15 years and their parents.

## METHODS

Two complementary but independently conducted Irish general population studies provided the data for the current analyses: the Adolescent Brain Development (ABD) study and the Challenging Times (CT) study.

The ABD study was established to investigate the prevalence and clinical significance of psychotic symptoms in the general adolescent population. The study was carried out in Dublin, Ireland, and neighboring counties. A total of 1131 pupils aged 11 to 13 years from 16 schools (52% of the total school population) participated in a survey of psychopathology and psychotic symptoms. Psychopathology was assessed using the Strengths and Difficulties Questionnaire,<sup>28</sup> which is a validated instrument that assesses emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship prob-

lems, and prosocial behavior. Psychotic symptoms were assessed using the Adolescent Psychotic Symptom Screener,<sup>29</sup> which is a validated instrument that assesses for hallucinations and delusions. Written informed consent was obtained from the parent or guardian of participants and from the participants themselves. Participants were asked to indicate on the consent form if they were interested in taking part in a clinical interview study. Of the 1131 adolescents who took part in the survey study, 656 (58%) expressed an interest in taking part in the clinical interview study and a random sample of 212 of these attended for interview. Adolescents who attended for interview were no more likely to have an abnormal or borderline-abnormal score on the Strengths and Difficulties Questionnaire ( $\chi^2=1.22$ ;  $P=.27$ ) and did not differ significantly in their scores on the Adolescent Psychotic Symptom Screener compared with the noninterviewed sample (interviewed group mean [SE] = 1.8 [0.12]; noninterviewed group mean [SE] = 1.9 [0.19];  $t_{1130}=0.26$ ;  $P=.79$ ).

The CT study was established to investigate the prevalence of psychiatric disorders and suicidal behavior among Irish adolescents aged 13 to 15 years. The study was carried out in the geographical catchment area of a Child and Adolescent Mental Health team in Dublin with a population of 137 000. A total of 743 pupils in 8 mainstream schools were screened for psychopathology using the Strengths and Difficulties Questionnaire and the Children's Depression Inventory,<sup>30</sup> which assesses cognitive, affective, and behavioral signs of depression. Written informed consent was obtained from the parent or guardian of participants and from the participants themselves. The participating schools were selected using a stratified random sampling technique, stratified according to the approximate socioeconomic class of the school to approximate to the geographical area population. One hundred forty adolescents scored more than threshold on these instruments, indicating high risk of having mental health problems, and all of these adolescents were invited to interview, of whom 117 (83.6%) agreed to attend for a full psychiatric interview. A comparison group of 173 adolescents, matched for sex and school, were also invited to attend, of whom 94 (54%) agreed.

## INTERVIEW INSTRUMENT

The interview instrument used in both studies was the Schedule for Affective Disorders and Schizophrenia for School-aged Children, Present and Lifetime versions (K-SADS).<sup>31</sup> The K-SADS is a well-validated semi-structured research diagnostic interview for the assessment of all Axis I psychiatric disorders in children and adolescents. Adolescents and parents were interviewed separately, both answering the same questions about the child. In the CT study, interviews were conducted by 1 psychiatrist and 2 psychologists, and in the ABD study, interviews were conducted by 2 psychiatrists and 4 psychologists, all trained in the use of the K-SADS.

## EXPOSURE MEASURES

The psychosis section of the K-SADS was used to assess the participants' psychotic symptoms, specifically hallucinations and delusions. **Table 1** includes sample questions from the psychosis section of the K-SADS. All interviewers recorded extensive notes of potential psychotic phenomena in this section of the interview. Once all interviews had been completed, a research assistant collated all data on potential psychotic symptoms for all participants of the 2 studies. Information from all other sections of the interview was excluded so that ratings of psychotic symptoms were conducted blind to other information, including details on suicidal behavior and diagnoses. These

clinical data were then examined by 2 raters with expertise in psychotic symptoms (M.C. and I.K.). Participants were rated as having ever experienced a psychotic symptom or not.

## OUTCOME MEASURES

The outcome measure in the current study was suicidal behavior. Suicidal behavior refers to a continuum from suicidal ideation to suicidal plans to suicidal acts.<sup>32</sup> Suicidal behavior was assessed as part of the K-SADS interview. Table 1 includes sample questions from this section of the K-SADS. The suicidal behavior section begins with the interviewer asking about whether the individual has ever experienced recurrent thoughts of death, before moving on to ask a series of questions to assess suicidal ideation, suicidal plans, and suicidal acts. Interviews were conducted with parents and children separately and parents' and children's reports of suicidal behavior were both used in the analyses. Participants were rated as having ever had suicidal behavior or not.

## SOCIOECONOMIC STATUS

Socioeconomic status (SES) of each study participant was determined using parental occupation assessed according to the Irish Social Class Scale from the national Central Statistics Office. We divided the sample into 2 major groups according to social class: the first group contained SES groups 1 and 2 (professional/managerial) and the second group contained SES groups 3 to 7 (nonmanual skilled; skilled manual; semi-skilled manual; unskilled manual; and unemployed). The SES of participants in the ABD study approximated national figures: 34.6% of participants were categorized as SES groups 1 and 2 (compared with 32.1% of the national population) and 65.4%, as SES groups 3 to 7 (compared with 67.9% of the national population). Higher SES individuals were slightly over-represented in the CT study compared with the population norm, with 39.9% of participants categorized as SES groups 1 and 2 and 60.1%, as SES groups 3 to 7.

## STATISTICAL ANALYSES

Logistic regression analyses were used to examine the association between the outcome measure, suicidal behavior, and the exposure, psychotic symptoms. First, we report univariate associations in terms of odds ratios (ORs), along with 95% confidence intervals and *P* values, for the association of psychotic symptoms with suicidal behavior in the general population. Second, to control for the effect of comorbid psychiatric illness, we report a regression analysis stratified by the presence of psychiatric disorder. Third, to assess whether psychotic symptoms predict more severe forms of suicidal behavior (suicide plans and acts) in groups at higher risk of suicidal behavior, we report regression analyses stratified by the presence of (1) depressive disorders (specifically major depressive disorder and adjustment disorder with depressed mood), (2) behavioral disorders (attention-deficit/hyperactivity disorder, oppositional defiant disorder, and conduct disorder), and (3) suicidal ideation. All analyses were performed by one of us (I.K.) and were carried out using Stata version 11 (StataCorp).

Ethical approval for the ABD study was received from the Beaumont Hospital Medical Ethics Committee and for the CT study, from the Mater Misericordiae University Hospital Medical Ethics Committee. Following complete description of the study to participants and their parents, informed consent (parents) and assent (children < 18 years) were received. A consultant child and adolescent psychiatrist was available to give guidance for cases that raised clinical concerns (M.H. for the

**Table 1. Sample Stem Questions Adapted From the K-SADS Interview, Used to Assess Hallucinations and Delusions and Suicidal Behavior**

### Sample Stem Question

#### Hallucinations and delusions

- Sometimes people when they are alone hear things or see things and they're not quite sure where they come from. Does that ever happen to you? Tell me about it.
- Was there ever a time when you thought you heard voices when you were alone?
- Was there ever a time when you saw things that were not there, like a person or a ghost?
- Was there ever a time you thought that your imagination was playing tricks on you?
- Did you ever have any ideas about things that you didn't tell anyone because you were afraid they might not understand?
- Do you think that you believe in anything that other people don't believe in?
- Has there ever been a time when you felt someone was out to hurt you?
- Did you ever think that the world was going to end?

#### Suicidal behavior

- Sometimes when people get upset they think, "I wish I was dead" or "I'd be better off dead." Have you ever thought that?
- Sometimes when people get upset they think about killing themselves. Have you ever thought this?
- Was there ever a time that you thought up a plan to kill yourself? How did you plan to do it?
- Have you ever actually tried to kill yourself? What did you do?

Abbreviation: K-SADS, Schedule for Affective Disorders and Schizophrenia for School-aged Children, Present and Lifetime versions.

ABD study; C.F. for the CT study) and participants were offered referrals to child and adolescent mental health services whenever appropriate. Parents and children were given contact details for the research teams, who were available to answer any questions or concerns that arose during or after participation in the studies.

## RESULTS

### DEMOGRAPHICS, PSYCHOTIC SYMPTOMS, AND PSYCHIATRIC DIAGNOSES

Details of psychiatric diagnoses are included in **Table 2**. Interrater reliability was more than 90% for both studies ( $\kappa = 0.83$  [ABD study] and  $0.85$  [CT study]). Psychotic symptoms reported were principally hallucinations and, in particular, auditory hallucinations. Some degree of delusional ideation was common in association with hallucinations but rarely occurred in the absence of hallucinations. More boys than girls reported psychotic symptoms in the ABD study ( $\chi^2 = 7.03$ ;  $P = .008$ ) and the CT study ( $\chi^2 = 3.62$ ;  $P = .06$ ). Socioeconomic status, however, was not associated with psychotic symptoms in either study (ABD study:  $\chi^2 = 2.83$ ;  $P = .73$ ; CT study:  $\chi^2 = 5.01$ ;  $P = .17$ ).

### PSYCHOTIC SYMPTOMS AND SUICIDAL BEHAVIOR

Findings on the association between psychotic symptoms and suicidal behavior are shown in Table 2. Twenty-



**Table 2. Psychotic Symptoms and Odds of Suicidal Behavior (Ideation, Plans, and Acts) in 2 Population Samples Aged 11 to 13 Years (ABD study) and 13 to 15 Years (CT study)<sup>a</sup>**

	All Suicidal Behavior, Unadjusted for Sex, OR (95% CI)	P Value	All Suicidal Behavior, Adjusted for Sex, OR (95% CI)	P Value
ABD study population sample (n = 212)	9.01 (2.97-27.33)	<.001	10.23 (3.25-32.26)	<.001
CT study population sample (n = 211)	8.52 (2.21-32.91)	.002	10.50 (3.14-35.17)	<.001
ABD study sample with diagnosable psychiatric disorder (n = 78)	5.27 (1.25-22.23)	.02	5.13 (1.15-22.81)	.03
CT study sample with a diagnosable psychiatric disorder (n = 72)	4.37 (1.14-16.79)	.03	5.31 (1.29-21.84)	.02

Abbreviations: ABD, Adolescent Brain Development; CT, Challenging Times; OR, odds ratio.

<sup>a</sup>Diagnoses in the ABD and CT studies included depressive disorders, including major depressive disorder and adjustment disorder with depressed mood (ABD, n = 35; CT, n = 37); behavioral disorders, including attention-deficit/hyperactivity disorder, oppositional defiant disorder, and conduct disorder (ABD, n = 21; CT, n = 18); and anxiety disorders, including generalized anxiety disorder, social phobia, separation anxiety disorder, and obsessive-compulsive disorder (ABD, n = 33; CT, n = 23).

two percent of the ABD sample reported psychotic symptoms, mainly auditory hallucinations. While participants were asked about lifetime psychotic symptoms, in almost all cases adolescents who reported psychotic symptoms had experienced these symptoms within the past year (and most within the past 3 months). Only 3 participants from the entire sample who reported lifetime psychotic symptoms did not report experiencing these symptoms within the past year, indicating that a report of lifetime symptoms in reality almost always indicates recent (within previous 12 months) symptoms. A total of 7% of participants reported suicidal behavior. Specifically, 6.8% (n = 16) reported suicidal ideation, 3.7% (n = 5) reported specific suicide plans, and just 1 participant reported a suicidal act (0.4%). Adolescents who reported psychotic symptoms demonstrated a greater than 10-fold increased odds of suicidal behavior.

Seven percent (n = 14) of the CT sample, aged 13 to 15 years, reported psychotic symptoms, mainly auditory hallucinations, while 13% reported suicidal behavior. Specifically, 13.2% (n = 28) reported suicidal ideation, 5% (n = 11) reported specific suicidal plans, and 3.3% (n = 7) reported a suicidal act. Adolescents who reported psychotic symptoms demonstrated a greater than 10-fold increased odds of suicidal behavior.

#### STRATIFICATION BY PSYCHIATRIC DISORDER

A diagnosable psychiatric disorder was also associated with increased risk for suicidal behavior (ABD study: OR, 3.09; 95% CI, 1.08-8.83;  $P < .05$ ; CT study: OR, 7.6; 95% CI, 3.17-18.06;  $P < .001$ ). Therefore, to examine the relationship between psychotic symptoms and suicidal behavior in this higher-risk group, and to allow extrapolation to clinical populations, we conducted secondary analyses limited to adolescents with a history of diagnosable psychiatric disorder. Results are shown in Table 2. In both the ABD and CT studies, adolescents with a diagnosable psychiatric disorder plus psychotic symptoms were at a greater than 5-fold increased odds of suicidal behavior compared with adolescents with a diagnosable psychiatric disorder but no psychotic symptoms.

#### SUICIDE PLANS AND ACTS

Because suicidal behavior varies in severity, with ideation on one end and other forms—suicide plans and acts—further along the continuum of severity, we conducted a further set of analyses to assess the risk for more severe behavior—suicide plans and acts. Because the ABD study contained a younger age group (mean age, 11.5 years) and did not enrich for suicidal behavior, there were few cases of severe suicidal behavior; however, the CT data, with its older population and enrichment for suicidal behavior, facilitated this analysis. Adolescents with a diagnosis of a depressive disorder or a behavioral disorder and adolescents with suicidal ideation were all more likely to have suicide plans or acts (data available on request). To test whether psychotic symptoms helped to differentiate adolescents in these diagnostic groups who had suicide plans or acts from those who did not, we conducted a number of stratified analyses. Among adolescents with depressive disorders or behavioral disorders, those who reported psychotic symptoms were at greatly increased risk for suicidal plans and acts compared with adolescents with the same diagnoses who did not report psychotic symptoms (Table 3). Among adolescents with suicidal ideation, psychotic symptoms were associated with a 20-fold increased odds of suicide plans and acts. Strikingly, a majority of adolescents with suicidal plans or acts reported psychotic symptoms in both the ABD (60%) and CT (55%) studies.

#### COMMENT

Using 2 independent epidemiological studies, we have shown that psychotic symptoms index large increases in risk for (1) suicidal behavior in the general adolescent population, (2) suicidal behavior in adolescents with psychiatric disorders, and (3) more severe forms of suicidal behavior (suicidal plans and acts) among adolescents with depressive disorders, behavioral disorders, and suicidal ideation. In fact, in both studies, psychotic symptoms were reported by the majority of adolescents who reported having formulated specific suicide plans or previous suicidal acts. This is a particularly important fact given that suicide plans and history of parasuicide have been shown

to be among the most predictive risk factors for completed suicide.<sup>33,34</sup> Psychotic symptoms were more common in the early adolescence sample than in the middle adolescence sample, in keeping with existing research, which shows that psychotic symptoms tend to be reported more commonly by younger individuals.<sup>13</sup> However, in both age ranges, suicidal behavior demonstrated the same strong association with psychotic symptoms, suggesting that, while psychotic symptoms in general decline with age, their relationship with suicidal behavior does not show the same decline.

There are a number of possible explanations as to the mechanisms underlying the strong relationship between psychotic symptoms and suicidal behavior. The most obvious is that hallucinations may direct the individual to harm or kill themselves. In fact, a post hoc analysis of the type of psychotic symptoms reported by adolescents with suicidal behavior demonstrated that all included auditory hallucinations. However, only 1 of the participants in either of the studies reported command hallucinations to harm or kill themselves. It is possible, however, that psychotic symptoms may impact suicidal behavior via indirect cognitive mechanisms. Changes in the subjective sense of self, for example, are among the earliest recognizable symptoms of psychosis,<sup>35,36</sup> and a sense of disintegration and fragmentation of the self resulting from intrusive voices or thoughts have been linked to suicidal thinking.<sup>6,37</sup> Similar effects may occur in the extended psychosis phenotype; Bleuler's concept of the "suicidal drive" might not be just the most severe symptom of schizophrenia<sup>6</sup> but the most severe symptom of a much broader psychosis phenotype made up of individuals in the general population who experience psychotic symptoms.

Common causes shared between psychotic symptoms and suicidal behavior may be part of the mechanism underlying the striking relationship between the 2 variables. Individuals with mental disorders who experience psychotic symptoms, for example, may be more unwell in general than individuals with mental disorders who do not experience psychotic symptoms.<sup>22</sup> These symptoms, then, may be an important marker of deteriorating mental health in a way that indexes very high risk for suicidal behavior. The relationship between traumatic experiences and both suicidal behavior<sup>38</sup> and psychotic symptoms<sup>39</sup> may also play a role. Young people who have experienced severe adverse events, such as childhood physical or sexual abuse, have been shown to be at increased risk of psychotic symptoms.<sup>39-41</sup> It is possible that, for some individuals, psychotic symptoms reflect severe psychological distress arising from such traumatic experiences that may place them at very high risk of suicidal behavior.

From a neurobiological perspective, psychotic symptoms appear to index subtle differences in brain structure<sup>42</sup> and function,<sup>43,44</sup> which may contribute to the increased risk for suicidal behavior. Jacobson et al<sup>42</sup> recently showed volumetric differences in the cingulum and orbitofrontal cortex in a sample of adolescents with psychotic symptoms, 2 centers that are known to play important roles in emotion processing and stress regulation.<sup>45</sup> Abnormalities in the orbitofrontal cortex have also recently been highlighted as an area of interest in magnetic resonance imaging studies of suicidal patients.<sup>46</sup> Using functional magnetic resonance

**Table 3. Prevalence and Odds of Suicide Plans and Acts Among Stratified Samples of Middle Adolescence (CT) Study**

	Prevalence of Suicide Plans or Acts, %			
	No Psychotic Symptoms	Psychotic Symptoms	Unadjusted OR (95% CI)	Adjusted OR <sup>a</sup> (95% CI)
CT sample with depressive disorder (n = 37)	16	67	10.4 (1.9-56.0)	13.7 (2.1-89.6)
CT sample with behavioral disorder (n = 18)	0	75	b	b
CT sample with suicidal ideation (n = 28)	24	86	19.2 (1.8-200.0)	19.6 (1.8-216.1)

Abbreviations: CT, Challenging Times; OR, odds ratio.

<sup>a</sup>Adjusted for sex.

<sup>b</sup>Odds ratio not calculable because there were zero participants in the comparison group.

imaging, we have also demonstrated reduced activity within the right frontal and bilateral temporal cortices during response inhibition tasks in adolescents with psychotic symptoms and, using digital tractography imaging, overall reduced integrity of frontotemporal pathways,<sup>42</sup> supporting a profile of a relative disinhibition/proimpulsivity phenotype. These neurobiological findings fit with clinical findings of increased symptoms of emotional and behavioral problems among adolescents with psychotic symptoms.<sup>22,27,47</sup> In terms of suicidal behavior, this combination of depressive and impulsive traits poses a high-risk phenotype.

For clinicians, these findings highlight the importance of a thorough assessment for psychotic symptoms in patients presenting with suicidal behavior. From our clinical experience, young people will rarely volunteer information on psychotic symptoms unless questioned directly about such experiences (see Table 1 for question examples). Adolescents are usually willing to talk openly about their experiences, however, in response to direct but sensitive questioning. This is especially important in child mental health clinics, where psychosis can sometimes be seen as an "adult psychiatry" issue and therefore not fully explored. For researchers, these findings highlight a complex novel aspect in the study of the etiology of suicidal behavior. While the current report includes participants in early and middle adolescence, suicidal behavior in childhood and adolescence predicts suicidal behavior throughout the life course. Reinherz and colleagues,<sup>48</sup> for example, showed that adolescents who reported suicidal ideation were, at age 30 years, 15 times more likely to report suicidal ideation and 12 times more likely to have attempted suicide. Therefore, the association between suicidal behavior and psychotic symptoms in adolescence is likely to continue into adulthood. Whether psychotic symptoms are as prevalent in individuals who demonstrate suicidal behavior in adulthood, however, remains to be investigated.

Strengths of the current work include that assessments involved in-depth clinical interview and that we were able to test interactions between psychotic symptoms and psychiatric disorders in predicting suicidal behavior. In addition, we were able to replicate our findings across 2 inde-



pendent studies. The age ranges of participants were also complementary across the 2 studies and allowed us to demonstrate the relationship between psychotic symptoms and suicidal behavior from early through middle adolescence (ages 11-15 years). The use of 2 studies was also complementary in terms of balancing sensitivity with interviewer/information bias. The ABD study was set up specifically to study psychotic symptoms and associated psychopathology, and thus, interviewers may have expected increased prevalence of psychopathology in association with these symptoms. This would have improved sensitivity to detect a relationship but risk of information bias was also increased. On the other hand, the CT study was not designed specifically to test associations with psychotic symptoms, and while this may have resulted in reduced sensitivity in detecting the relationship between psychotic symptoms and suicidal behavior, being blind to hypotheses in this study minimized the risk of information bias. As with any in-depth clinical interview study, its strength is its weakness: it is not possible to conduct this type of research with very large numbers of participants in the same way as can be done with questionnaire or lay interview studies. As a result, subgroup analyses involved relatively small groups and, because of this, confidence intervals are wide. Both studies, however, showed the same strong relationship between psychotic symptoms and suicidal behavior, demonstrating that this is a robust finding. Nonetheless, further replication of our work in samples enriched for suicidal behavior will be valuable. Further work is also needed to investigate the relationship between psychotic symptoms and suicidal behavior in later adolescence and into adulthood. In addition, while we found that only 1 individual with psychotic symptoms and suicidal behavior reported command hallucinations to harm/kill themselves, further studies that explicitly explore potential relationships between the content of psychotic symptoms and suicidal behavior will be valuable. Because both studies reported in the current article were cross-sectional in nature, it is not possible to say when precisely psychotic symptoms arose in relation to suicidal behavior. Further research with more temporal information will help to address this point.

## CONCLUSIONS

Suicidal behavior is a major cause of mortality across all countries and therefore represents an important public health concern. The results of 2 studies reported herein demonstrate that psychotic symptoms index greatly increased risk for suicidal behavior in adolescents in the general population and in adolescents with diagnosable psychiatric disorder. Furthermore, the presence of psychotic symptoms greatly increases the risk for more severe suicidal behavior among adolescents with suicidal ideation. The results of both studies showed that, when directly questioned, the majority of adolescents with suicidal plans and acts reported psychotic symptoms, in particular auditory hallucinations. The immediate clinical relevance of these findings is that all patients presenting at risk for suicidal behavior should receive a thorough assessment of psychotic symptoms and not just a screening to rule out psychotic disorder. Research has shown that the largest increase in suicide risk in the gen-

eral population occurs after there has already been contact with mental health services<sup>49</sup> and that approximately half of patients who complete suicide have contact with primary care providers in the month preceding their death.<sup>49</sup> Thus, it is important that clinicians are aware of the significance of psychotic symptoms in nonpsychotic patients in terms of risk for suicidal behavior. Among patients presenting with mood or behavioral disorders or with suicidal ideation, our results suggest that disclosure of psychotic symptoms, particularly hallucinations (regardless of their phenomenological content), indicates a greatly increased risk for more severe suicidal behavior. Further epidemiologic and neuroscientific research is necessary to understand the mechanisms underlying the risk indexed by psychotic symptoms, which may involve a number of neurobiological, neurocognitive, and other factors, knowledge of which may help to inform public health strategies and lead to a reduction in future attempted and completed suicides.

**Submitted for Publication:** November 7, 2011; final revision received December 22, 2012; accepted February 10, 2012.

**Published Online:** October 29, 2012. doi:10.1001/archgenpsychiatry.2012.164

**Correspondence:** Ian Kelleher, PhD, Department of Psychiatry, Royal College of Surgeons in Ireland, Education and Research Centre, Beaumont Hospital, Dublin 9, Ireland (iankelleher@rcsi.ie).

**Author Contributions:** Drs Kelleher and Cannon had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

**Financial Disclosure:** None reported.

**Funding/Support:** The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement HEALTH-F2-2010-241909 (Project European Network of National Schizophrenia Networks Studying Gene-Environment Interactions [EU-GEI]). The ABD study was supported by an Essel-National Alliance for Research on Schizophrenia and Depression/Brain and Behavior Research Foundation Independent Investigator award and a Clinician Scientist Award (CSA/2004/1) from the Health Research Board (Ireland) (Dr Cannon). The CT study was supported by Friends of the Children's University Hospital (Dublin), the American Foundation for Suicide Prevention, the Health Service Executive Northern Area, and the Mater Misericordiae University Hospital.

**Role of the Sponsors:** The study sponsors had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript.

**Additional Contributions:** We thank the Clinical Research Centre at Beaumont Hospital for use of research rooms.

## REFERENCES

1. The global burden of disease: 2004 update. World Health Organization website. <http://www.who.int/evidence/bod>. Accessed November 2, 2011.
2. Goldsmith SK, Pelimar TC, Kleinman AM, Bunney WE, eds. *Reducing Suicide: A National Imperative. Committee on Pathophysiology and Prevention of Adoles-*

- cent and Adult Suicide, Board on Neuroscience and Behavioral Health, Institute of Medicine of the National Academies. Washington, DC: National Academies Press; 2002.
3. Health Service Executive; the National Suicide Review Group; Department of Health and Children. *Reach Out: Irish National Strategy for Action on Suicide Prevention*. Dublin, Ireland: Health Service Executive; 2005.
  4. *National Suicide Prevention Strategy for England*. London: Department of Health; 2002.
  5. Batty GD, Whitley E, Deary IJ, Gale CR, Tynelius P, Rasmussen F. Psychosis alters association between IQ and future risk of attempted suicide: cohort study of 1,109,475 Swedish men. *BMJ*. 2010;340:c2506.
  6. Bleuler F. *Dementia Praecox or the Group of Schizophrenias*. Zinkin J, trans. New York, NY: International Universities Press; 1911.
  7. Dutta R, Murray RM, Hotopf M, Allardyce J, Jones PB, Boydell J. Reassessing the long-term risk of suicide after a first episode of psychosis. *Arch Gen Psychiatry*. 2010;67(12):1230-1237.
  8. Roy A, Mazonson A, Pickar D. Attempted suicide in chronic schizophrenia. *Br J Psychiatry*. 1984;144:303-306.
  9. van Os J, Linscott RJ, Myin-Germeyns I, Delespaul P, Krabbendam L. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis proneness-persistence-impairment model of psychotic disorder. *Psychol Med*. 2009;39(2):179-195.
  10. Bartels-Velthuis AA, Jenner JA, van de Willige G, van Os J, Wiersma D. Prevalence and correlates of auditory vocal hallucinations in middle childhood. *Br J Psychiatry*. 2010;196(1):41-46.
  11. Laurens KR, Hodgins S, Maughan B, Murray RM, Rutter ML, Taylor EA. Community screening for psychotic-like experiences and other putative antecedents of schizophrenia in children aged 9-12 years. *Schizophr Res*. 2007;90(1-3):130-146.
  12. Kelleher I, Jenner JA, Cannon M. Psychotic symptoms in the general population: an evolutionary perspective. *Br J Psychiatry*. 2010;197(3):167-169.
  13. Kelleher I, Connor D, Clarke MC, Devlin N, Harley M, Cannon M. Prevalence of psychotic symptoms in childhood and adolescence: a systematic review and meta-analysis of population-based studies. *Psychol Med*. 2012;42(9):1857-1863.
  14. Wigman JT, Vollebergh WA, Raaijmakers QA, Iedema J, van Dorsselaer S, Ormel J, Verhulst FC, van Os J. The structure of the extended psychosis phenotype in early adolescence: a cross-sample replication. *Schizophr Bull*. 2011;37(4):850-860.
  15. Kelleher I, Cannon M. Psychotic-like experiences in the general population: characterizing a high-risk group for psychosis. *Psychol Med*. 2011;41(1):1-6.
  16. Poulton R, Caspi A, Moffitt TE, Cannon M, Murray R, Harrington H. Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. *Arch Gen Psychiatry*. 2000;57(11):1053-1058.
  17. Welham J, Scott J, Williams G, Najman J, Bor W, O'Callaghan M, McGrath J. Emotional and behavioural antecedents of young adults who screen positive for non-affective psychosis: a 21-year birth cohort study. *Psychol Med*. 2009;39(4):625-634.
  18. Varghese D, Scott J, Welham J, Bor W, Najman J, O'Callaghan M, Williams G, McGrath J. Psychotic-like experiences in major depression and anxiety disorders: a population-based survey in young adults. *Schizophr Bull*. 2011;37(2):389-393.
  19. Yung AR, Nelson B, Baker K, Buckby JA, Baksheev G, Cosgrave EM. Psychotic-like experiences in a community sample of adolescents: implications for the continuum model of psychosis and prediction of schizophrenia. *Aust N Z J Psychiatry*. 2009;43(2):118-128.
  20. Scott J, Martin G, Bor W, Sawyer M, Clark J, McGrath J. The prevalence and correlates of hallucinations in Australian adolescents: results from a national survey. *Schizophr Res*. 2009;107(2-3):179-185.
  21. Scott J, Martin G, Welham J, Bor W, Najman J, O'Callaghan M, Williams G, Aird R, McGrath J. Psychopathology during childhood and adolescence predicts delusional-like experiences in adults: a 21-year birth cohort study. *Am J Psychiatry*. 2009;166(5):567-574.
  22. Kelleher I, Keeley H, Corcoran P, Lynch F, Fitzpatrick C, Devlin N, Molloy C, Roddy S, Clarke MC, Harley M, Arseneault L, Wasserman C, Carli V, Sarchiapone M, Hoven CW, Wasserman D, Cannon M. Clinicopathological significance of psychotic experiences in non-psychotic young people: evidence from four population-based studies. *Br J Psychiatry*. 2012;201:26-32.
  23. Penagaluri P, Walker KL, El-Mallakh RS. Hallucinations, pseudohallucinations, and severity of suicidal ideation among emergency psychiatry patients. *Crisis*. 2010;31(1):53-56.
  24. Hysinger EB, Callahan ST, Caples TL, Fuchs DC, Shelton R, Cooper WO. Suicidal behavior differs among early and late adolescents treated with antidepressant agents. *Pediatrics*. 2011;128(3):447-454.
  25. Nishida A, Sasaki T, Nishimura Y, Tani H, Hara N, Inoue K, Yamada T, Takami T, Shimodera S, Itokawa M, Asukai N, Okazaki Y. Psychotic-like experiences are associated with suicidal feelings and deliberate self-harm behaviors in adolescents aged 12-15 years. *Acta Psychiatr Scand*. 2010;121(4):301-307.
  26. Saha S, Scott JG, Johnston AK, Slade TN, Varghese D, Carter GL, McGrath JJ. The association between delusional-like experiences and suicidal thoughts and behaviour. *Schizophr Res*. 2011;132(2-3):197-202.
  27. Polanczyk G, Moffitt TE, Arseneault L, Cannon M, Ambler A, Keefe RS, Houts R, Odgers CL, Caspi A. Etiological and clinical features of childhood psychotic symptoms: results from a birth cohort. *Arch Gen Psychiatry*. 2010;67(4):328-338.
  28. Goodman R, Ford T, Simmons H, Gatward R, Meltzer H. Using the Strengths and Difficulties Questionnaire (SDQ) to screen for child psychiatric disorders in a community sample. *Br J Psychiatry*. 2000;177:534-539.
  29. Kelleher I, Harley M, Murtagh A, Cannon M. Are screening instruments valid for psychotic-like experiences? a validation study of screening questions for psychotic-like experiences using in-depth clinical interview. *Schizophr Bull*. 2011;37(2):362-369.
  30. Kovacs M. The Children's Depression Inventory (CDI). *Psychopharmacol Bull*. 1985;21(4):995-998.
  31. Kaufman J, Birmaher B, Brent D, Rao U, Ryan N. *The Schedule for Affective Disorders and Schizophrenia for School-aged Children: Present and Lifetime Version*. Pittsburgh, PA: University of Pittsburgh, Western Psychiatric Institute and Clinic; 1996.
  32. Nock MK, Borges G, Bromet EJ, Cha CB, Kessler RC, Lee S. Suicide and suicidal behavior. *Epidemiol Rev*. 2008;30:133-154.
  33. Powell J, Geddes J, Deeks J, Goldacre M, Hawton K. Suicide in psychiatric hospital in-patients: risk factors and their predictive power. *Br J Psychiatry*. 2000;176:266-272.
  34. Suominen K, Isometsä E, Suokas J, Haukka J, Achte K, Lönnqvist J. Completed suicide after a suicide attempt: a 37-year follow-up study. *Am J Psychiatry*. 2004;161(3):562-563.
  35. Yung AR, McGorry PD, McFarlane CA, Jackson HJ, Patton GC, Rakkar A. Monitoring and care of young people at incipient risk of psychosis. *Schizophr Bull*. 1996;22(2):283-303.
  36. Klosterkötter J, Schultze-Lutter F, Gross G, Huber G, Steinmeyer EM. Early self-experienced neuropsychological deficits and subsequent schizophrenic diseases: an 8-year average follow-up prospective study. *Acta Psychiatr Scand*. 1997;95(5):396-404.
  37. Frosh J. *The Psychotic Process*. New York, NY: International Universities Press; 1983.
  38. Dube SR, Anda RF, Felitti VJ, Chapman DP, Williamson DF, Giles WH. Childhood abuse, household dysfunction, and the risk of attempted suicide throughout the life span: findings from the Adverse Childhood Experiences Study. *JAMA*. 2001;286(24):3089-3096.
  39. Arseneault L, Cannon M, Fisher HL, Polanczyk G, Moffitt TE, Caspi A. Childhood trauma and children's emerging psychotic symptoms: a genetically sensitive longitudinal cohort study. *Am J Psychiatry*. 2011;168(1):65-72.
  40. Kelleher I, Harley M, Lynch F, Arseneault L, Fitzpatrick C, Cannon M. Associations between childhood trauma, bullying and psychotic symptoms among a school-based adolescent sample. *Br J Psychiatry*. 2008;193(5):378-382.
  41. Janssen I, Krabbendam L, Bak M, Hanssen M, Vollebergh W, de Graaf R, van Os J. Childhood abuse as a risk factor for psychotic experiences. *Acta Psychiatr Scand*. 2004;109(1):38-45.
  42. Jacobson S, Kelleher I, Harley M, Murtagh A, Clarke M, Blanchard M, Connolly C, O'Hanlon E, Garavan H, Cannon M. Structural and functional brain correlates of subclinical psychotic symptoms in 11-13 year old schoolchildren. *Neuroimage*. 2010;49(2):1875-1885.
  43. Blanchard MM, Jacobson S, Clarke MC, Connor D, Kelleher I, Garavan H, Harley M, Cannon M. Language, motor and speed of processing deficits in adolescents with subclinical psychotic symptoms. *Schizophr Res*. 2010;123(1):71-76.
  44. Laurens KR, Hodgins S, Mould GL, West SA, Schoenberg PL, Murray RM, Taylor EA. Error-related processing dysfunction in children aged 9 to 12 years presenting putative antecedents of schizophrenia. *Biol Psychiatry*. 2010;67(3):238-245.
  45. Koolschijn PC, van Haren NE, Lensvelt-Mulders GJ, Hulshoff Pol HE, Kahn RS. Brain volume abnormalities in major depressive disorder: a meta-analysis of magnetic resonance imaging studies. *Hum Brain Mapp*. 2009;30(11):3719-3735.
  46. Monkul ES, Hatch JP, Nicoletti MA, Spence S, Brambilla P, Lacerda AL, Sassi RB, Mallinger AG, Keshavan MS, Soares JC. Frontal-limbic brain structures in suicidal and non-suicidal female patients with major depressive disorder. *Mol Psychiatry*. 2007;12(4):360-366.
  47. Rössler W, Hengartner MP, Ajdacic-Gross V, Haker H, Gamma A, Angst J. Sub-clinical psychosis symptoms in young adults are risk factors for subsequent common mental disorders. *Schizophr Res*. 2011;131(1-3):18-23.
  48. Reinherz HZ, Tanner JL, Berger SR, Beardslee WR, Fitzmaurice GM. Adolescent suicidal ideation as predictive of psychopathology, suicidal behavior, and compromised functioning at age 30. *Am J Psychiatry*. 2006;163(7):1226-1232.
  49. Luoma JB, Martin CE, Pearson JL. Contact with mental health and primary care providers before suicide: a review of the evidence. *Am J Psychiatry*. 2002;159(6):909-916.