Original Investigation

Psychotic Symptoms and Population Risk for Suicide Attempt
A Prospective Cohort Study

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IMPORTANCE Up to 1 million persons die by suicide annually. However, a lack of risk markers makes suicide risk assessment one of the most difficult areas of clinical practice.

OBJECTIVE To assess psychotic symptoms (attenuated or frank) as a clinical marker of risk for suicide attempt.

DESIGN, SETTING, AND PARTICIPANTS Prospective cohort study of 1112 school-based adolescents (aged 13-16 years), assessed at baseline and at 3 and 12 months for self-reported psychopathology, psychotic symptoms, and suicide attempts.

MAIN OUTCOMES AND MEASURES Suicide attempts at the 3- and 12-month follow-up and acute suicide attempts (defined as those occurring in the 2 weeks before an assessment).

RESULTS Of the total sample, 7% reported psychotic symptoms at baseline. Of that subsample, 7% reported a suicide attempt by the 3-month follow-up compared with 1% of the rest of the sample (odds ratio [OR], 10.01; 95% CI, 2.24-45.49), and 20% reported a suicide attempt by the 12-month follow-up compared with 2.5% of the rest of the sample (OR, 11.27; 95% CI, 4.44-28.62). Among adolescents with baseline psychopathology who reported psychotic symptoms, 14% reported a suicide attempt by 3 months (OR, 17.91; 95% CI, 3.61-88.82) and 34% reported a suicide attempt by 12 months (OR, 32.67; 95% CI, 10.42-102.41). Adolescents with psychopathology who reported psychotic symptoms had a nearly 70-fold increased odds of acute suicide attempts (OR, 67.50; 95% CI, 11.41-399.21). Differences were not explained by nonpsychotic psychiatric symptom burden, multimorbidity, or substance use. In a causative model, the population-attributable fraction of suicide attempts would be 56% to 75% for psychotic symptoms.

CONCLUSIONS AND RELEVANCE Adolescents with psychopathology who report psychotic symptoms are at clinical high risk for suicide attempts. More careful clinical assessment of psychotic symptoms (attenuated or frank) in mental health services and better understanding of their pathological significance are urgently needed.

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W orld Health Organization statistics place suicide among the leading causes of death worldwide.[1] Approximately half of patients who complete suicide have contact with primary care providers in the month before their death,[2] suggesting the possibility of prevention. However, suicide risk assessment is recognized to be one of the most difficult areas of clinical practice.[3,4] Although psychopathology, especially depression, is well established as a major risk factor for suicidal behavior,[5,6] its high prevalence in the population makes it difficult to identify a meaningful "at risk" group.[7] Further research to identify potential clinical markers of risk for suicidal behavior is sorely needed, especially in adolescents, an age group in whom the risk for suicide attempts peaks.[8-10]

A great deal of research has established that psychotic symptoms are far more prevalent in the population than actual psychotic disorder[11-14]; a meta-analysis[15] of community-based studies in adolescents (aged 13-18 years) demonstrated a median population prevalence of 7.5%. These symptoms may be frankly psychotic but more commonly occur in attenuated form; that is, experiences that are hallucinatory or delusional but in which reality testing remains intact. The most common symptom reported by young persons, for example, is hearing a voice speaking aloud in the absence of an external stimulus.[16] In contrast to the requirements for formal categorization as a true hallucination, however, reality testing is usually intact with this symptom. That is, as with a true hallucination, the individual perceives the sound of a voice in the absence of a stimulus; unlike with a true hallucination, however, he or she will usually accept, at least when directly challenged, that although the voice was perceived as external in origin, it may have arisen from his or her own mind.

Recent research findings, in both community-[17-20] and clinic-based studies,[21-23] suggest that these symptoms may be an underrecognized marker of risk for suicidal behavior. However, studies to date have lacked temporal information; no longitudinal studies, to our knowledge, have examined psychotic symptoms as a predictor of suicidal behavior over time. In the current study, we investigated whether psychotic symptoms, reported at baseline, would predict an increased incidence of suicide attempts at 3- and 12-month follow-up. Because recent research[24] has shown that most adolescents in the population who report psychotic symptoms have at least 1 nonpsychotic Axis 1 psychiatric disorder, we also investigated whether the co-occurrence of psychotic symptoms with psychopathology would predict an increased risk of suicide attempt, beyond that predicted by psychopathology alone. Specifically, we hypothesized that psychotic symptoms would be an important marker of clinical risk for future suicidal behavior and that such symptoms in adolescents with psychopathology would increase the risk of suicidal behavior beyond that associated with psychopathology alone.

Methods

Study Design

The Saving and Empowering Young Lives in Europe (SEYLE) study is a randomized clinical trial (registered in the German Clinical Trials Register, DRKS00000214) to assess prevention strategies for suicidal behavior across 11 countries.[25,26] In each study site, a catchment area was identified and a list of eligible schools was generated. Eligible schools were catego-

Table 1. Description of Measures

Variable	Instrument	Description of the Measure
Psychopathology	Strengths and Difficulties Questionnaire (SDQ)[27]	The emotional disorders section assesses for anxiety, depressive, and obsessive compulsive disorders (scores ≥7 suggest disorder); the conduct disorders section assesses for conduct and oppositional defiant disorders (scores ≥5 suggest disorder); and the hyperkinetic disorders section assesses for attention deficit/hyperactivity disorders (scores ≥7 suggest disorder). A "total difficulties" score is generated by summing the subscales for psychopathology; a score in the top 20% of the population norm indicates a high probability of psychopathology. The SDQ has been validated both in terms of its ability to distinguish between clinic and community samples[27] and as a tool to identify children with a psychiatric disorder in the general population.[28]
Psychotic symptoms	Adolescent Psychotic Symptoms Screener[16]	The question, "Have you ever heard voices or sounds that no one else can hear?" was specifically selected to assess for psychotic symptoms in our sample at all 3 time points. This item has been shown to have good positive and negative predictive value for clinically verifiable psychotic symptoms (both frank and attenuated psychotic symptoms but with the latter being predominant)[16]; in a community survey of adolescents, the item identified not only adolescents with auditory hallucinations but also those with psychotic symptoms in general (frank and attenuated hallucinations and delusions) (positive predictive value, 100%; negative predictive value, 88%).[16]
Suicidal behavior	Paykel Suicide Scale[29]	Suicidal thoughts and behavior were assessed by using this scale at all 3 time points.[29] Assessment included (1) suicidal ideation ("During the past 2 weeks, have you thought about taking your own life, even if you would not really do it?"); (2) serious suicidal thoughts or suicide plans ("During the past 2 weeks, have you reached the point where you seriously considered taking your life, or perhaps made plans how you would go about doing it?"); and (3) suicide attempts ("Have you ever made an attempt to take your own life?"). When a suicide attempt was reported, participants were also asked whether the attempt had occurred within the preceding 2 weeks (defined as an acute suicide attempt) or earlier.

rized by size as either small (number of pupils no more than the median for all schools in the study catchment area or region) or large (more pupils than the median). In each school selected, we surveyed every class (regardless of size) in which at least 50% of the pupils were aged 14 years. This age group was selected because of its risk propensity for suicidal behavior. Questions on psychotic symptoms were included in the study protocol for the Irish center only; therefore, the current analyses were based just on the Irish site. Seventeen randomly selected schools in Counties Cork and Kerry, Ireland, took part in the study, with testing occurring at baseline and follow-up assessments at 3 and 12 months. See **Table 1** for exposure and outcome measures.

The study was approved ethically by the European Commission. Ethical approval was also obtained in each participating country, including from the clinical research ethics committee of the Cork Teaching Hospitals in Ireland. An independent ethical advisor supervised the implementation of the ongoing project to ensure maximum protection of vulnerable individuals. A specific procedure to evaluate and provide immediate assistance in emergency cases was compulsory at all study centers. Emergency cases were identified by means of 2 specific questions: a response of sometimes, often, very often, or always to Paykel question 4 ("Have you ever reached the point where you seriously considered taking your life, or perhaps made plans how you would go about doing it?") and/or a response of yes to Paykel question 5 ("Have you ever made an attempt to take your own life?").[29] In identified emergency cases, pupils were immediately referred for clinical evaluation to health care services.

Statistical Analysis

Scores for psychopathology ("total difficulties") were calculated for the Strengths and Difficulties Questionnaire (SDQ) and divided into quintiles so that, in line with guidelines, the top quintile (ie, the top 20% of total difficulties scores) was classified as our psychopathology subsample (full scoring guidelines available online[30]). Using χ^2 tests, we assessed for significant differences in attrition in participants who reported psychotic symptoms at baseline and the effects of a number of sociodemographic variables on suicide risk, including age, sex, country of birth, and household status. We used analysis of variance to assess for significant differences in attrition at 3- and 12-month follow-up based on baseline SDQ scores for psychopathology. We used logistic regression to investigate the relationship between psychotic symptoms at baseline and suicidal behavior at 3- and 12-month follow-up, reporting odds ratios (ORs) and 95% CIs.

We then looked specifically at the psychopathology subsample, stratified into 2 groups: adolescents who also reported psychotic symptoms and those who did not. We used logistic regression to assess the relationship between psychopathology at baseline, with or without psychotic symptoms, and suicide attempts reported at 3- and 12-month follow-up. We also used logistic regression to assess the risk for suicide attempt between 3- and 12-month follow-up for participants who reported psychotic symptoms at both the baseline and 3-month assessments. To assess the relationship between psy-

chotic symptoms and acute suicide attempts (attempts occurring within the 2 weeks before an assessment point), we used a random effects model to cluster for repeated measures. We used logistic regression to investigate differences in risk for acute suicide attempts between participants with psychopathology who also reported psychotic symptoms and those who did not. Still considering acute suicide attempts, we then calculated the population-attributable fraction for psychotic symptoms in both the total population sample and the subsample with psychopathology.

Persons with mental disorders who report psychotic symptoms or suicidal behavior may have more severe psychopathology in terms of burden of symptoms than those with the same mental disorders who do not report psychotic symptoms or suicidal behavior. We therefore conducted additional stratified analyses, looking at study participants with psychopathology in the emotional, conduct, and hyperkinetic disorder subscales of the SDQ. We used logistic regression to determine whether participants with SDQ-rated emotional disorders who reported psychotic symptoms or suicide attempts had higher emotional symptom scores (ie, increased symptom burden) than those with SDQ-rated emotional disorders who did not report psychotic symptoms or suicide attempts. Similarly, we investigated whether participants with SDQ-rated conduct or hyperkinetic disorders who reported psychotic symptoms or suicide attempts had higher conduct or hyperkinetic symptom scores than those with SDQ-rated conduct or hyperkinetic disorders who did not report psychotic symptoms or suicide attempts.

We then conducted a multivariate analysis of the relationship between symptom burden and suicidal acts, controlling for the presence of psychotic symptoms. Furthermore, because psychotic symptoms[24] and suicidal behavior[31,32] have been associated with multimorbidity (ie, the presence of multiple concurrent psychiatric disorders), we also investigated the relationship between multimorbidity and both psychotic symptoms and suicide attempts. To test for a statistically significant increase (or decrease) in the prevalence of psychotic symptoms and suicidal acts across increasing levels of multimorbid psychopathology, we stratified the sample by the number of SDQ-rated disorder domains (ie, psychopathology in ≥1 disorder domain of the SDQ [emotional, conduct, or hyperkinetic]) and used the Stata software (StataCorp) command *nptrend* (an extension of the Wilcoxon rank sum test that performs a nonparametric test for trend across ordered groups) to determine whether the prevalence of psychotic symptoms and suicidal acts increased linearly with increasing levels of multimorbidity.

We also calculated the ORs for psychotic symptoms and suicide attempts in participants at each of these 3 levels of multimorbidity, comparing these groups with participants who did not demonstrate psychopathology in any of the 3 disorder domains. We then conducted a multivariate analysis of the relationship between multimorbidity and suicide attempts, controlling for the presence of psychotic symptoms. One of us (I.K.) performed analyses using Stata software, version 11. Analyses were adjusted for age and a number of sociodemographic variables, including household type (ie, living with mother

and/or father) and country of birth of participant, mother, and father. Analyses were also adjusted for substance use, based on a yes answer to the question, "Have you ever used hash or marijuana?"

Results

Participation and Emergency Referrals

In total, 1602 consent forms were distributed, and 69% (1112 participants) took part in the first wave of the study. Of baseline participants, 90% (n = 1006) completed the 3-month follow-up, and 88% (n = 973) the 12-month follow-up. At baseline assessment, 83 participants received emergency referrals to local mental health services as a result of endorsing Paykel Suicide Scale question 4 and/or 5. There were 53 and 43 emergency referrals at the 3- and 12-month follow-up, respectively.

Baseline psychotic symptoms had no significant effect on attrition at 3 (χ^2 = 0.003; P = .96) or 12 months (χ^2 = 0.88; P = .35). Furthermore, total baseline score for psychopathology had no effect on participation among participants who demonstrated psychopathology at the baseline SDQ at 3 (F = 0.14; P = .71) or 12 months (F = 0.05; P = .82) (see **Table 2**).

Table 2. Demographic Characteristics in 1112 Participants

Demographic Characteristic	Participants, No. (%)
Age, y	
13	409 (37)
14	598 (54)
15	55 (5)
16	29 (3)
Female sex	496 (45)
Country of birth	
Participant born in Ireland	907 (82)
Mother born in Ireland	857 (77)
Father born in Ireland	874 (79)
Household type	
Living with both parents	914 (82)
Living with mother only	142 (13)
Living with father only	23 (2)
Other	33 (3)

for demographic details). There was no difference in risk for suicide attempt between male and female participants (χ^2 = 0.07; P = .79). However, a number of other demographic variables were predictive of suicide attempt, including older age (χ^2 = 19.01; P < .01), not living with mother (χ^2 = 56.13; P < .01), not living with father (χ^2 = 6.33; P = .01), not born in Ireland (χ^2 = 6.94; P < .01), mother not born in Ireland (χ^2 = 12.92; P < .01), and father not born in Ireland (χ^2 = 12.63; P = .01). Analyses were adjusted for these potential demographic confounders. Forty-six participants reported a history of using cannabis at baseline assessment, and this variable was also adjusted for in the analyses.

Psychotic Symptoms at Baseline and Suicide Attempt at Follow-up

Seventy-seven participants (7%) of the sample reported psychotic symptoms at baseline. The ORs and 95% CIs for the relationship between baseline psychotic symptoms and responses to questions 3 and 4 of the Paykel Suicide Scale (referring to suicidal ideation and suicide plans) at 3- and 12-month follow-up are shown in eTables 1 and 2 in the Supplement. There were 96 reports of suicide attempts over the 3 assessment points of the study, involving 45 participants (4%). Fourteen acute suicide attempts were reported (ie, suicide attempts within the 2 weeks before a study assessment point). There were no completed suicides during the study. Of all participants with psychotic symptoms at baseline, 7% (n = 4) reported a suicide attempt by 3-month follow-up compared with 1% (n = 12) of the rest of the population (OR, 10.01; 95% CI, 2.24-45.49), and 20% (n = 9) reported a suicide attempt by 12-month follow-up compared with 2.5% (n = 23) of the rest of the population (OR, 11.27; 95% CI, 4.44-28.62) (**Table 3**).

Psychotic Symptoms at Baseline and Suicide Attempts at Follow-up Stratified by Psychopathology

Of the subsample with psychopathology, 23% (n = 43) reported psychotic symptoms compared with less than 4% (n = 34) of the rest of the sample (OR, 8.13; 95% CI, 4.98-13.26). The risk for suicide attempt varied significantly according to the presence of psychotic symptoms. Of the participants with psychopathology at baseline who did not report psychotic symptoms, 3.5% (n = 4) reported a suicide attempt by 3-month follow-up and 13% (n = 15) a suicide attempt by 12-month follow-

Table 3. Psychopathology With or Without Psychotic Symptoms and Risk for Suicide Attempts at 3 and 12 Months

Sample	Participants, No.	Suicide Attempt Reported at 3 mo		Suicide Attempt Reported at 12 mo	
		Participants, %	OR (95% CI)[a]	Participants, %	OR (95% CI)[a]
Total sample	1112	2	NA	4	NA
Total reporting psychotic symptoms at baseline	77	7	10.01 (2.24-45.49)	20	11.27 (4.44-28.62)
Psychopathology subsample[b]					
No psychotic symptoms at baseline	146	3	0.58 (0.06-5.62)	13	4.62 (1.94-10.99)
Psychotic symptoms at baseline	47	14	17.91 (3.61-88.82)	34	32.67 (10.42-102.41)

Abbreviations: NA, not applicable; OR, odds ratio.

[a] Analyses were adjusted for age, substance use, household type, and country of birth of participant, mother, and father.

[b] Psychopathology was identified with the Strengths and Difficulties Questionnaire.

up. Of those with psychopathology at baseline who reported psychotic symptoms, 14% (n = 4) reported a suicide attempt by 3 months and more than one-third (34%; n = 11) by 12 months (Table 3). Twelve percent of the sample (132 participants) demonstrated psychopathology on the SDQ at baseline and 3-month follow-up. Within this group, 11% (n = 15) reported psychotic symptoms at both baseline and 3-month follow-up. Data were available for 9 of these 15 participants at 1-year follow up; 56% of them (n = 5) reported a suicide attempt between 3- and 12-month follow-up, representing a more than 60-fold increased odds of suicide attempt compared with the rest of the population (OR, 64.23; 95% CI, 10.25-402.57). When this subgroup was compared directly with participants who also demonstrated psychopathology at both baseline and 3-month follow-up but did not report psychotic symptoms, psychotic symptoms at both baseline and 3-month follow-up were predictive of a 15-fold increased odds of suicide attempt between 3- and 12-month follow-up (OR, 15.00; 95% CI, 1.67-135.07).

Psychotic Symptoms and Acute Suicide Attempts
Although the presence of psychopathology without psychotic symptoms at baseline predicted suicide attempts over time, albeit to a lesser degree than psychopathology with psychotic symptoms, some participants who were not experiencing psychotic symptoms at the time of the assessment may have experienced such symptoms closer to the time of their suicide attempt. A solution to this methodological problem is to investigate only suicide attempts that occurred close to the time of the psychotic symptom assessment. To do this, we considered suicide attempts occurring within the 2 weeks before an assessment point (acute suicide attempts). Participants with psychopathology who did not report psychotic symptoms did not have significantly increased odds of acute suicide attempts (OR, 1.09; 95% CI, 0.15-8.06) compared with the rest of the population. Those with psychopathology who did experience psychotic symptoms, on the other hand, had a nearly 70-fold increased odds of acute suicide attempts (OR, 67.50; 95% CI, 11.41-399.21). In absolute terms, individuals with psychotic symptoms made up less than a quarter of the total group with psychopathology but accounted for nearly 80% of the acute suicide attempts in this group. Assuming a causative relationship for suicide attempts, the population-attributable fraction for psychotic symptoms would be 56% in the whole sample and 75% in the subsample with psychopathology.

Symptom Burden and Multimorbidity
Among adolescents with psychopathology, those who reported psychotic symptoms had significantly higher symptom scores on the SDQ than those who did not report such symptoms for both emotional disorders (mean [SD] symptom score for participants with psychotic symptoms, 5.8 [2.6]; no psychotic symptoms, 4.8 [2.1]; OR, 1.21; 95% CI, 1.09-1.33) and conduct disorders (psychotic symptoms, 4.6 [2.0]; no psychotic symptoms, 3.9 [1.7]; OR, 1.24; 95% CI, 1.10-1.40) but not hyperkinetic disorders (psychotic symptoms, 6.5 [2.1]; no psychotic symptoms, 6.4 [1.9]; OR, 1.02; 95% CI, 0.91-1.14).

Similarly, compared with participants with psychopathology but no history of suicide attempt, those with psychopathology who reported a suicide attempt had significantly higher symptom scores for both emotional disorders (mean [SD] symptom score for participants with a past suicide attempt, 5.7 [2.4]; no past suicide attempt, 4.9 [2.2]; OR, 1.17, 95% CI, 1.04-1.32) and conduct disorders (past suicide attempt, 4.5 [2.1]; no past suicide attempt, 4.0 [1.8]; OR, 1.17, 95% CI, 1.02-1.35) but not hyperkinetic disorders (past suicide attempt, 6.7 [2.1]; no past suicide attempt, 6.4 [1.9]; OR, 1.11; 95% CI, 0.97-1.27). When we constructed a multivariate model to control for the effect of psychotic symptoms, symptom burden was no longer significantly associated with suicide attempts for emotional disorders (OR, 1.11; 95% CI, 0.99-1.25) or conduct disorders (OR, 1.11; 95% CI, 0.96-1.29). There was little if any reciprocal change, however, in the strength of the relationship between psychotic symptoms and suicide attempts (unadjusted OR subsample with psychopathology, 4.74; 95% CI, 2.76-8.13) when we adjusted for emotional (OR, 4.36; 95% CI, 2.51-7.58) or conduct (OR, 4.43; 95% CI, 2.54-7.70) symptom scores.

Participants with psychopathology who reported psychotic symptoms were also significantly more likely to have multimorbidity across the emotional, conduct, and/or hyperkinetic domains of the SDQ than those who did not report psychotic symptoms (OR, 1.89; 95% CI, 1.41-2.47). Similarly, participants with psychopathology who had a history of attempting suicide were significantly more likely to have multimorbidity across the 3 SDQ disorder domains (OR, 1.50; 95% CI, 1.10-2.04) than those who did not have such a history (Table 4). When we constructed a multivariate model to control for the effect of psychotic symptoms, multimorbidity was no longer significantly associated with suicide attempt (OR, 1.26; 95% CI, 0.92-1.75). When we adjusted for multimorbidity, however, there was little if any reciprocal change in the strength of the relationship between psychotic symptoms and suicide attempt (unadjusted vs adjusted OR for the subsample with psychopathology, 4.74 [95% CI, 2.76-8.13] vs 4.33 [2.48-7.56]).

Discussion

In a longitudinal study of adolescents in the general population, we have shown that psychotic symptoms are a clinical marker of high risk for suicide attempt. This was especially true in adolescents with psychopathology who reported psychotic symptoms. Within 1 year of the baseline assessment, 34% of these adolescents had reported at least 1 suicide attempt. This compares with 4% of the total general population and 13% of participants with psychopathology who did not report psychotic symptoms at baseline. The latter group did not have a significantly increased risk of suicide attempt at 3-month follow-up but did have an increased risk at 1 year (albeit to a lesser degree than those with psychopathology who did report psychotic symptoms).

It is possible, however, that although these participants did not report psychotic symptoms at the baseline assessment, they

Table 4. Risk for Suicide Attempt and Psychotic Symptoms, Stratified by Multimorbidity Across Disorder Domains of the SDQ

SDQ Disorder Domains[a]	Prevalence of Suicide Attempt, No. (%)[b]	OR (95% CI)[c]	Prevalence of Psychotic Symptoms, No. (%)[b]	OR (95% CI)[c]
0 Domains	39 (1.6)	1 [Reference]	74 (3.0)	1 [Reference]
1 Domain	26 (6.4)	7.24 (2.87-18.24)	51 (12.7)	6.48 (3.50-11.97)
2 Domains	22 (16.4)	15.09 (4.55-50.00)	37 (27.8)	27.63 (11.44-66.75)
3 Domains	8 (30.8)	30.50 (2.96-314.85)	11 (44.0)	88.09 (16.18-479.55)

Abbreviations: OR, odds ratio; SDQ, Strengths and Difficulties Questionnaire.

[a] The 3 psychopathology domains of the SDQ include the emotional disorders section, assessing for anxiety, depressive, and obsessive compulsive disorders; the conduct disorders section, assessing for conduct and oppositional defiant disorders; and the hyperkinetic disorders section, assessing for attention deficit/hyperactivity disorders.

[b] Because this is a repeated-measures analysis, the denominators for the

percentages in this table represent the numbers of participants at baseline and at 3- and 12-month follow-up summed (ie, participants were assessed 3 times).

[c] Analyses were adjusted for age, substance use, household type, and country of birth of participant, mother, and father. A linear trend was demonstrated for both suicide attempts ($Z = 10.95$; $P < .001$) and psychotic symptoms ($Z = 19.31$; $P < .001$).

may have subsequently experienced such symptoms around the time of their suicide attempt. To address this issue, we conducted additional analyses limited to participants who had attempted suicide close to the time of psychotic symptom assessment—specifically, within the 2 weeks before symptom assessment (defined as acute suicide attempts). The prevalence of acute suicide attempts did not differ significantly between the general population (without psychopathology) and adolescents with psychopathology who did not report psychotic symptoms. Those who did report psychotic symptoms, however, had a nearly 70-fold increased odds of acute suicide attempts. Furthermore, the association between psychotic symptoms and suicide attempt was not explained by either nonpsychotic psychiatric symptom burden or multimorbidity. In fact, although these variables have been shown elsewhere to be important risk factors for suicidal behavior[31,32]—findings that we replicated in univariate analyses—neither variable was statistically associated with suicide attempt once the effect of psychotic symptoms was included in the multivariate analysis.

Davies et al[7] highlighted the importance of suicide risk assessment and intervention in genuinely high-risk groups. However, they also pointed out that the high prevalence of psychopathology in the population coupled with the relatively low prevalence of suicidal acts and the lack of clinically useful markers of risk for suicidal behavior in persons with psychopathology offered "little encouragement" in terms of suicide prevention. In this context, the findings of the current study point to psychotic symptoms as a valuable means of identifying individuals who are clinically at highest risk for suicidal behavior. In absolute terms, among the total subsample of adolescents with psychopathology, nearly 80% of all acute suicide attempts occurred in participants with psychotic symptoms, even though they accounted for less than a quarter of the total subsample. This highlights the importance of assessing psychotic symptoms in individuals with suspected psychopathology and the need to recognize suicide risk when these symptoms are present. It is also important to recognize that most such symptoms do not present as true hallucinations; that is, they may occur with intact reality testing and thus may be attenuated rather than frankly psychotic.

The level of risk for suicide attempt predicted by psychotic symptoms in the current study is higher than that predicted by many other prominent risk syndromes in medicine. Research has found, for example, that within 12 months, up to 15% of persons with mild cognitive impairment progress to dementia[33] and up to 10% of those with prediabetes progress to diabetes.[34] Research in persons with "at-risk mental states"—a group considered at clinical high risk for psychotic disorder[35-38]—has found that 22% develop a psychotic illness within 12 months.[39] With a 34% prevalence of suicide attempts at 12 months, the findings of the current study suggest that adolescents with psychopathology who report psychotic symptoms (attenuated or frank) should be considered at clinical high risk for suicide attempt.

The reasons why psychotic symptoms so strongly predict suicidal behavior are not readily clear. Although our multivariate analyses found that symptom burden and multimorbidity were no longer significantly associated with suicide attempt once we adjusted for psychotic symptoms, it is possible that, although psychotic symptoms are a marker of risk for suicidal behavior, nonpsychotic psychiatric symptom burden and multimorbidity may be partial mechanisms that underlie this relationship. Thus, psychotic symptoms may be a marker of increasing severity of psychopathology, including increased nonpsychotic psychiatric symptom burden and multimorbidity, that indexes risk for suicidal behavior. However, given the findings of our multivariate analyses, these variables can be, at best, only partial explanations for the relationship between psychotic symptoms and suicidal behavior. A number of other possible mechanisms may contribute to the relationship. Some research, for example, has suggested that individuals who experience psychotic symptoms have increased sensitivity to stress, in terms of affective reactions to life events,[40] as well as poorer coping skills,[41] which may contribute to a greater risk of suicidal behavior when faced with acute life stressors. Other potential mechanisms may be shared risk factors for suicidal behavior and psychotic symptoms, including childhood traumatic experiences, such as physical and sexual abuse.[26,42-59]

Magnetic resonance imaging research has shown volumetric differences in the cingulum and orbitofrontal cortex in community-based adolescents with psychotic symptoms,[60] 2

centers that have been shown to be important in stress regulation[61] and have been highlighted as areas of interest in imaging studies of suicidal patients.[62] In genetic research, Alemany et al[63] demonstrated an interaction between childhood trauma and the brain-derived neurotrophic factor Val66Met polymorphism in predicting psychotic symptoms in the population, which also has been implicated in research on suicidal behavior.[64] Interesting overlaps in neuropsychological findings are also emerging. A meta-analysis of studies of neurocognitive performance in persons who have attempted suicide found that deficits in processing speed are the most replicated.[65] Similarly, research in community samples of adolescents with psychotic symptoms has shown processing speed deficits to be the most prominent.[66,67]

The longitudinal nature of this study allowed us to assess, for the first time, whether psychotic symptoms predict suicidal behavior. Furthermore, the population approach allows us to generalize our findings to the community. The fact that our research was carried out in an adolescent sample is also an advantage since risk for suicide attempts peaks at this age, although further research on other age groups will be important. Follow-up participation was good, 90% at 3 months and 88% at 12 months. Although we assessed a relatively large number of adolescents at multiple time points, the number of acute suicide attempts was relatively low because suicide attempts are uncommon. Thus, CIs were wide, particularly for acute suicide attempts, and this was a limitation of our study. However, even the lower end of the CI was strikingly high (OR, >11), demonstrating that this finding is robust.

There is debate about the relative strengths and weaknesses of self-report surveys compared with face-to-face assessments for psychopathology and psychotic symptoms. Although a face-to-face assessment offers valuable qualitative information, the resources required mean that far fewer assessments can be conducted compared with self-report research. Furthermore, self-report studies are a valuable approach to limit interviewer or information bias (whereby an interviewer may, for example, spend more time assessing psychotic symptoms in someone who has reported suicidal behavior, potentially biasing the results). In relation to the specific measures adopted in the study, the SDQ is one of the most widely used self-report

measures for psychopathology in children and adolescents and has been validated both in terms of its ability to distinguish between clinic and community samples[27] and as a tool to identify children with psychopathology in the general population.[28] Similarly, our choice of self-report question for psychotic symptoms was based on research showing good positive and negative predictive value for psychotic symptoms (both attenuated and frank) compared with in-depth clinical interview assessment of psychotic symptoms.[16]

Nonetheless, further in-depth assessment of psychotic symptoms, including different types of hallucinations, delusions, and negative symptoms of psychosis, will be valuable. Although the burden of nonpsychotic psychopathology and multimorbidity were no longer significant predictors of suicide attempt once we adjusted for psychotic symptoms, there was still a small (nonsignificant) trend for these variables to predict suicide attempt. Analyses of a larger sample may find an independent effect of these variables on suicide risk in addition to the risk we found to be mediated through their relationship with psychotic symptoms.

In conclusion, in a population sample of adolescents (aged 13-16 years), the presence of psychotic symptoms predicted a very high risk of suicide attempts during the following 12 months. Among adolescents with psychopathology, those who reported psychotic symptoms had a nearly 70-fold increased odds of acute suicide attempts compared with the rest of the population, but this risk was not significantly increased in those who did not report psychotic symptoms. An important clinical implication of these findings is the need for a new clinical focus on careful assessment of psychotic symptoms (both attenuated and frank) in patients with nonpsychotic disorders; this should be considered a key element of suicide risk assessment. An important research implication is that all future studies on suicidal behavior should incorporate a measure of psychotic symptoms. Although the results of the current study are applicable to the general adolescent population, further research is needed among older age groups. Further community and clinical research on suicidal behavior and psychotic symptoms will be valuable, including research on underlying mechanisms that might explain this relationship and research that provides targets for intervention.

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