IMPORTANCE Community-based studies have linked psychotic experiences (PEs) with increased risks of suicidal thoughts and behaviors (STBs). However, it is not known if these associations vary across the life course or if mental disorders contribute to these associations.

OBJECTIVE To examine the temporal association between PEs and subsequent STBs across the life span as well as the influence of mental disorders (antecedent to the STBs) on these associations.

DESIGN, SETTING, AND PARTICIPANTS A total of 33,370 adult respondents across 19 countries from the World Health Organization World Mental Health Surveys were assessed for PEs, STBs (ie, ideation, plans, and attempts), and 21 DSM-IV mental disorders. Discrete-time survival analysis was used to investigate the associations of PEs with subsequent onset of STBs.

MAIN OUTCOMES AND MEASURES Prevalence and frequency of STBs with PEs, and odds ratios and 95% CIs.

RESULTS Of 33,370 included participants, among those with PEs (n = 2,488), the lifetime prevalence (SE) of suicidal ideation, plans, and attempts was 28.5% (1.3), 10.8% (0.7), and 10.2% (0.7), respectively. Respondents with 1 or more PEs had 2-fold increased odds of subsequent STBs after adjusting for antecedent or intervening mental disorders (suicidal ideation: odds ratio, 2.2; 95% CI, 1.8-2.6; suicide plans: odds ratio, 2.1; 95% CI, 1.7-2.6; and suicide attempts: odds ratio, 1.9; 95% CI, 1.5-2.5). There were significant dose-response relationships of number of PE types with subsequent STBs that persisted after adjustment for mental disorders. Although PEs were significant predictors of subsequent STB onset across all life stages, associations were strongest in individuals 12 years and younger. After adjustment for antecedent mental disorders, the overall population attributable risk proportions for lifetime suicidal ideation, plans, and attempts associated with temporally prior PEs were 5.3%, 5.7%, and 4.8%, respectively.

CONCLUSIONS AND RELEVANCE Psychotic experiences are associated with elevated odds of subsequent STBs across the life course that cannot be explained by antecedent mental disorders. These results highlight the importance of including information about PEs in screening instruments designed to predict STBs.
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Key Points

Question Are psychotic experiences associated with subsequent suicidal thoughts and behaviors (STBs), and do mental disorders (antecedent to the STBs) contribute to these associations?

Findings Based on 33,370 adult survey respondents drawn from 19 countries, those with psychotic experiences had 2-fold increased odds of subsequent STBs (after adjusting for mental disorders). Psychotic experiences were predictors of subsequent STB onset across all life stages; however, the strength of the association was strongest in individuals 12 years and younger.

Meaning Screening for psychotic experiences may assist in the prediction of subsequent STBs.

Method

Samples

The data were derived from 19 WHO World Mental Health (WMH) surveys, a coordinated set of community surveys administered in probability samples of adult respondents (18 years and older) in countries throughout the world (eTable 1 in the Supplement). The weighted (by sample size) average response rate across the 19 surveys was 72.3%, with the highest response rate in Iraq (95.2%) and the lowest in France (45.9%). Further information on details of the procedure and the assessment of mental disorders can be found in the eMethods in the Supplement. A human subjects review board or ethics committee approved the survey protocol in each country (eTable 2 in the Supplement), and all respondents gave informed consent; the mode of consent (written vs oral) varied by survey.

Measures

Psychotic Experiences

The Composite International Diagnostic Interview Psychosis Module included questions about 6 PE types—2 related to hallucinatory experiences and 4 related to delusional experiences. We excluded PEs experienced while dreaming, half-asleep, or under the influence of alcohol or drugs (eTable 3A and B in the Supplement). In this article, we present estimates of STBs for “Any PEs” only (ie, not individual types of PEs). In addition, we included 2 key PE variables: (1) number of PE types; and (2) an annualized frequency metric based on the frequency of PE episodes (ie, the count of PE occurrences per year). We derived the latter by dividing the total number of PE episodes by the time since onset of the first PE (age at interview minus age at onset plus 1 in order to avoid zero as a denominator). Age at onset of PEs was also assessed.

Suicidality

Lifetime STBs were assessed using the Composite International Diagnostic Interview Suicidality Module.17 Separate questions were asked about the lifetime occurrence of suicidal ideation (“Have you ever seriously thought about committing suicide?”), suicide plans (“Have you ever made a plan for committing suicide?”), and suicide attempt (“Have you ever

Prior studies suggest that psychotic experiences (PEs) are associated with an elevated risk of suicidal thoughts and behaviors (STBs). A 2016 meta-analysis by Honings et al1 based on 21 studies reported a 3-fold increased risk of STBs in people with PEs (odds ratio [OR], 3.2; 95% CI, 2.3-4.4). Other studies have documented a significant dose-response relationship between the number of PEs and increased odds of STBs.2-5 Worryingly, prospective studies of school-aged children have reported strong associations between PEs and suicide attempts, with children with PEs having an approximately 11-fold increased odds of suicide attempts during the following 12 months (OR, 11.3; 95% CI, 4.4-28.6) compared with those without PEs.6

Despite the growing body of evidence linking the presence of PEs with STBs, several research questions warrant closer attention. First, there is considerable variation in effect size estimates for these associations across studies, likely owing to differences in methods and analysis.1,7,8 Thus, it would be informative to examine these associations across different sites using similar methods. Second, prior studies have documented that most common mental disorders are associated with increased odds of both PEs9 and STBs.10-12 However, it is unclear whether the presence of mental disorders explains the associations of PEs with subsequent STBs.13 Third, although it has generally been assumed that mental disorders could increase the risk of each of 3 main STB outcomes (ie, ideation, plans, and attempts), recent studies have shown that only a subset of those with ideation also have suicide plans and attempts.14-16 We examine the role of PEs with respect to the odds of transitioning between ideation, plans, and attempts. Fourth, there is evidence to suggest that the association between PEs and STBs may be stronger in samples based on children6 compared with estimates based on adult samples.1 Thus, it would be of interest to examine if the strength of the association between PEs and STBs differed across age groups within one study. If children and/or adolescents with PEs are differentially prone to STBs compared with older age groups, then this could have important clinical implications for screening in pediatric and adolescent settings.5 Fifth, there is considerable uncertainty about the population attributable risk proportions (PARPs) for STBs that are associated with PEs. For example, DeVylder et al16 reported that about 29% of suicide attempts were attributable to PEs among US adults. Kelleher et al6 have found that 56% to 75% of suicide attempts among adolescents aged 13 to 16 years were attributable to PEs (however, these estimates were imprecise; OR, 67.50; 95% CI, 11.41-399.21). Accurate and age-range specific estimates of these PARPs are important for policy-making and prevention purposes.

Specifically, we aimed to examine the association between PEs (and related PE type and frequency metrics) and subsequent STBs across the life span and the influence of mental disorders on these associations. We also examined the associations between PEs, suicide plans and attempts among individuals with suicidal ideation, and the PARPs of various STBs.
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Table 1. Lifetime Prevalence of Suicidal Ideation, Plans, and Attempts

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Ideation</th>
<th>Plans</th>
<th>Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No./Total No. (%)</td>
<td>SE</td>
<td>No./Total No. (%)</td>
</tr>
<tr>
<td>STB prevalence</td>
<td>5106/33370 (9.2)</td>
<td>0.2</td>
<td>2000/33370 (3.1)</td>
</tr>
<tr>
<td>PE status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No PE</td>
<td>4165/30882 (8.0)</td>
<td>0.2</td>
<td>1583/30882 (2.6)</td>
</tr>
<tr>
<td>Any PE</td>
<td>941/2488 (38.5)</td>
<td>1.3</td>
<td>417/2488 (10.8)</td>
</tr>
<tr>
<td>No. of PE types (in those with PEs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exactly 1 PE type</td>
<td>571/1706 (32.8)</td>
<td>1.4</td>
<td>236/1706 (8.6)</td>
</tr>
<tr>
<td>Exactly 2 PE types</td>
<td>247/566 (35.4)</td>
<td>3.4</td>
<td>111/566 (12.8)</td>
</tr>
<tr>
<td>≥3 PE types</td>
<td>123/216 (57.5)</td>
<td>4.9</td>
<td>70/216 (28.8)</td>
</tr>
<tr>
<td>PE annualized frequency metric (in those with PEs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤0.3 Episodes/y</td>
<td>425/1259 (32.7)</td>
<td>1.9</td>
<td>183/1259 (9.6)</td>
</tr>
<tr>
<td>&gt;0.3 Episodes/y</td>
<td>516/1229 (39.7)</td>
<td>1.8</td>
<td>234/1229 (12.2)</td>
</tr>
</tbody>
</table>

Abbreviations: PE, psychotic experience; STB, suicidal thoughts and behaviors.
* Numerators refer to the number of individuals with each suicidal outcome. Denominators refer to the number of individuals in the total sample or in the sample of those with/without PEs. Estimates are based on weighted data.

The predictive associations of temporally prior PEs with each STB outcome were estimated using discrete-time survival models, with person-year as the unit of analysis. A person-year data set was constructed, where each year in the life of each respondent (up to and including the age of STB onset or age at interview, whichever came first) was treated as a separate observational record, with the year of STB onset coded as 1 and earlier years coded as 0. Psychotic experiences were coded as 1 a year after the first PE onset to ensure that a PE occurring in the same year as STBs did not count as a predictor. We first estimated models of PE and subsequent STBs adjusting for respondent’s age at time of interview, sex, person-year dummies, and country. In addition, we built models adjusted for age at time of interview, sex, person-year dummies, country, and 21 antecedent mental disorders (ie, mental disorders that had onsets prior to the STBs) to examine the influence of mental disorders on the association between PEs and STBs. The joint significance test and test for linear trend were computed. We also conducted a post hoc analysis stratified by mental illness (yes/no) in examining whether the association between PEs and STBs was observed in both the groups. Next, we reestimated the associations between PEs and subsequent STBs after stratifying the sample into 4 life course stages: childhood (12 years and younger), adolescence (aged 13-19 years), young adulthood (aged 20-29 years), and later adulthood (30 years and older). This allowed us to examine whether the associations varied across the life course and the strength of association (in early vs later years of life), given previous findings of large effect sizes among adolescents (ORs >10).6-18 Finally, PARPS were calculated by converting the ORs obtained from the survival models as approximation of relative risk based on the assumption that the survival coefficients represented causal effects.19

As the WMH data are both clustered and weighted, the design-based Taylor series linearization implemented in SUDAAN software (RTI International) was used to estimate the SEs and evaluate the statistical significance of the coefficients. Survival coefficients and their SEs were exponentiated to generate ORs and 95% CIs. All statistical tests (Wald χ² based on discrete-time survival models) were evaluated using 2-sided tests. Statistical significance was set at P<.05.

Results

Prevalence of STBs
The lifetime prevalence (SE) of suicidal ideation, plans, and attempts in all respondents was 9.2% (0.2), 3.1% (0.1), and 2.8% (0.1), respectively (Table 1). Among 5106 individuals with suicidal ideation, 2000 (33.6%; SE, 0.9) reported a suicide plan. Among the subset of 2000 individuals with suicidal ideation with a plan, the prevalence of suicide attempts was 55.5% (SE, 1.5). Among the subset of 3106 individuals with suicidal ideation without a plan, the prevalence of suicide attempts was 17.0% (SE, 0.9). (The proportions for the nested suicide outcomes reflect different denominators; eTable 4 in the Supplement.) The lifetime prevalence of STBs was substantially higher among those with PEs compared with those without PEs (Table 1). Specifically, among respondents with PEs, the prevalence (SE) of suicidal ideation, plans, and attempts was 28.5% (1.3), 10.8% (0.7), and 10.2% (0.7), respectively, compared with 8.0% (0.2), 2.6% (0.1), and 2.3% (0.1) for respondents without PEs.
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Original Investigation Research

Table 2. Associations Between Lifetime PEs and Subsequent Onset of Suicidal Ideation, Plans, and Attempts, With and Without Adjustment for Antecedent Mental Disorders

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic Demographic Adjustment*</td>
</tr>
<tr>
<td></td>
<td>Plans</td>
</tr>
<tr>
<td></td>
<td>Attempts</td>
</tr>
<tr>
<td>Any PE</td>
<td>3.0 (2.6-3.6)c</td>
</tr>
<tr>
<td>No. of PE types</td>
<td></td>
</tr>
<tr>
<td>Exactly 1 PE type</td>
<td>2.5 (2.0-3.1)c</td>
</tr>
<tr>
<td>Exactly 2 PE types</td>
<td>3.7 (2.7-4.9)c</td>
</tr>
<tr>
<td>≥3 PE types</td>
<td>7.1 (4.9-10.3)c</td>
</tr>
<tr>
<td>Joint significance of the PE type measures</td>
<td></td>
</tr>
<tr>
<td>χ²</td>
<td>256.2</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Difference in the ORs of the PE type measures</td>
<td></td>
</tr>
<tr>
<td>χ²</td>
<td>24.3</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Test for linear trend</td>
<td></td>
</tr>
<tr>
<td>χ²</td>
<td>15.0</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PE frequency metric</td>
<td></td>
</tr>
<tr>
<td>&gt;0.3 Episodes/y</td>
<td>3.5 (2.8-4.3)c</td>
</tr>
</tbody>
</table>

Abbreviations: OR, odds ratio; PE, psychotic experience; STB, suicidal thoughts and behaviors.

* Psychotic experience (any PE, number of PE type, and frequency metric) was used as a predictor of STB outcomes in separate discrete-time survival models. These models control for age cohorts, sex, person-year dummies, and country.

When we restricted the analysis to the subset with suicidal ideation, the associations of any PEs with suicide plans and suicide attempts were not significant, indicating that PEs are associated with increased odds of suicidal ideation but not with an increased odds of planning or attempting suicide among those reporting suicide ideation (eTable 5 in the Supplement). As a post hoc analysis, we also repeated the analysis stratified by mental disorders (yes/no). While the 95% CIs were wider in the subgroup with no mental disorders, the general pattern of findings persisted (eTable 6 in the Supplement).

Associations Between Lifetime PEs and Subsequent Onset of STBs Across 4 Life Course Stages

Table 3 shows the associations between PEs and subsequent onset of STBs in 4 life course stages. In the basic demographic adjustment models, we found strong and significant associations between occurrence of PEs and subsequent onset of STBs in all 4 life course stages (childhood, adolescence, early adulthood, and later adulthood). The effect sizes were significantly higher in childhood compared with other age groups (ideation: χ² = 14.7; P < .001; plans: χ² = 17.6; P < .001; and attempts: χ² = 8.8; P = .003). The ORs for suicidal ideation, plans, and attempts in childhood were 4.0 (95% CI, 2.3-6.8), 7.8 (95% CI, 3.4-17.9), and 5.4 (95% CI, 2.6-11.3), respectively. When adjusted for antecedent mental disorders, the pattern of associations remained significant though the effect sizes were attenuated.
PARPs Between PEs and STBs
The overall PARPs for suicidal ideation, plans, and attempts ranged between 8.4% and 11.0% (Table 4) in the basic demographic adjustment models. After adjustments for antecedent mental disorders, the overall PARPs were smaller, ranging from 4.8% to 5.7%. When examined across the life course, compared with older age groups, children 12 years and younger consistently had the highest PARPs (9.0%, 20.0%, and 11.1% for suicidal ideation, plans, and attempts, respectively) after adjustment for antecedent mental disorders.

Discussion
The results reported here are based on, to our knowledge, the largest and most detailed study of PEs and STBs reported to date. We found that community respondents who reported PEs had 2-fold increased odds of subsequent suicidal ideation, plans, and attempts after adjustment for antecedent mental disorders. These estimates are broadly consistent with several longitudinal studies\(^1\,5\) and slightly lower than the pooled estimate from a 2016 meta-analysis.\(^1\) We also found a dose-response relationship between (1) higher numbers of PE types (in keeping with previous literature)\(^2,5\) and (2) higher annualized PE frequency with subsequent STBs. Additionally, these results shed new light on 4 issues. First, the association between PEs and STBs persisted after adjustment for antecedent mental disorders. Second, among the subset of respondents reporting suicidal ideation, PEs did not contribute significantly to increased odds of subsequent suicide plans or attempts. Third, the association between PEs and STBs was most prominent in children 12 years and younger. Fourth, PEs accounted for an appreciable proportion of STBs (9%-20%) during childhood, even when adjusted for antecedent mental disorders. We discuss each of these in turn.

First, although the association between PEs and STBs was attenuated after adjustment for 21 antecedent mental disorders, appreciable ORs (at least 2-fold) were still found between PEs and STBs. These findings are consistent with previous studies\(^1,3,22\) and lend weight to the hypothesis that the experience of PEs, even in the absence of mental disorders, may be sufficient to influence the subsequent onset of STBs. This is an important finding from a clinical point of view because it suggests that PEs may be a predictor of subsequent STBs even in individuals who do not meet criteria for mental disorders. In keeping with a 2017 commentary,\(^22\) we do not propose that the presence of isolated
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We found that PEs were independently associated with subsequent STBs regardless of antecedent mental disorders. There were significant dose-dependent relationships between both number of PE types and annualized frequency of PEs with subsequent STBs. The association was found at all ages, with a stronger effect at younger ages, and were associated with appreciable PARPs. From a public health perspective, we speculate that the inclusion of PE items in routine screening tools could improve the prediction of suicide risk. Our study lends additional weight to the call for the routine inclusion of PE items when assessing STBs in both research and clinical settings.
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Group Information: The World Health Organization World Mental Health Survey collaborators are Sergio Aguilar-Gaxiola, MD, PhD (Center for Reducing Health Disparities, University of California-Davis Health System, Sacramento); Ali Al-Hamzawi, MD (College of Medicine, Al-Qadisiya University, Diwaniya Governorate, Iraq); Mohammed Salih Al-Kaisy, MD (Ibn Seena Teaching Hospital, Alkhdira, Baghdad, Iraq); Jordi Alonso, MD, PhD (Health Services Research Unit, Hospital del Mar Medical Research Institute, Barcelona, Spain); Laura Helena Andrade, MD, PhD (Section of Clinical Research, Carattere Scientifico–St John of God Clinical Center, Murcianode Investigación Biosanitaria–Arrixaca, Subdirección General de Planificación, Innovación y Calidad, Instituto Murciano de Investigación Biosanitaria–Arrixaca); Centro de Investigación Biomédica en Red de Epidemiología y Salud Pública-Murcia, Murcia, Spain); Beth-Ellen Pernell, MA (Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor); Marina Piazza, MPH, ScD (National Institute of Mental Health, Bethesda, Maryland, USA); Carlos de la Fuente, MD, PhD (Centre of Monitoring and Analyses of Population and Social Development, Budapest, Hungary); Alex Colman, PhD (Health and Social Care Research and Evaluation Centre, Cardiff, Wales, UK); Lorenzo Belvisi, PhD (Research Unit on Multiaxial Classification of Mental Disorders, University of Florence, Florence, Italy), and Ahmad Al-Mohri, MD, PhD (Department of Psychiatry, University of Medicine and Dentistry of New Jersey, Newark, New Jersey, USA).

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