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A survey of psychosis risk symptoms in Kenya

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Abstract

Defining the prepsychotic state in an effort to prevent illness progression and the development of disorders such as schizophrenia is a rapidly growing area of psychiatry. The presentation of psychotic symptoms can be influenced by culture; however, there has not been any previous assessment of psychosis risk symptoms in the continent of Africa. Our study aimed to measure the prevalence of psychosis risk in a community sample in Nairobi, Kenya, and to evaluate the effects of key demographic variables.

A culturally modified version of the 12-item PRIME-Screen (mPRIME) was self-administered by 2758 youth (aged 14-29 years) recruited through house-to-house visits in Nairobi, Kenya. The prevalence and severity of psychosis risk items from the mPRIME and the effects of sex and age on symptoms were evaluated. *k*-Means cluster analysis was used to identify symptom groups.

Depending on the mPRIME item, 1.8% to 19.5% of participants reported certainty of having had a psychosis risk symptom. Overall, 45.5% reported having had any psychosis risk symptom. Females had a significantly higher mean severity score on items evaluating persecutory ideation and auditory hallucinations. Symptom severity on 5 items showed a modest (R = 0.09-0.13) but significant correlation with age. Cluster analysis identified 4 groups of participants: normative (55%), high symptom (11%), intermediate symptom (19%), and grandiose symptom (15%).

Psychosis risk symptoms appear to be highly prevalent in Kenyan youth. Longitudinal studies are needed to determine the correlation of identified symptoms with transition to psychotic illness, as well as the associated functionality and distress, to develop appropriate intervention strategies.

1. Introduction

Schizophrenia and other psychotic disorders are among the most disabling psychiatric disorders, estimated to affect approximately 3% of the world's population [1]. Early detection of psychosis has been associated with less severe symptoms and fewer hospitalizations upon emergence of psychotic illness [2], which has a profound importance when considering strategies of efficient and cost-effective health care delivery [3]. Preventing the future development of a severe psychotic disorder is regarded as among the most effective ways to reduce this potentially devastating burden on the affected individual and family members [4]. In sub-Saharan Africa, where financial and health care resources for managing psychotic disorders are extremely limited, the need for effective preventive strategies before disorder onset is therefore fundamental [5].

The ultra-high-risk (UHR) criteria, a concept of early detection of help-seeking patients at short-term risk of psychosis, have become an increasing focus of current research [6]. Retrospective studies have confirmed an average prodromal period (ie, period before disorder onset) of 5 to 6 years [7], and the introduction of UHR criteria has significantly advanced the possibility of indicated prevention during this period [6]. The substantial body of UHR research has led some authors to create criteria for the identification of UHR individuals using structured interviews [8]. These schedules generally identify 3 groups of UHR: those at

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familial high risk, those with attenuated positive symptoms, and those with brief limited intermittent psychotic symptoms. Studies have indicated that 16% to 54% of the youth who meet the current UHR criteria develop a major psychotic disorder (eg, schizophrenia, schizoaffective disorder, and bipolar or unipolar depression with psychotic features) within 1 to 2.5 years [6,9,10].

The PRIME-Screen [11,12] is a self-reported instrument based on the Structured Interview for Psychosis-Risk Symptoms [8] and designed to enable rapid identification of those at risk for psychotic disorders. It consists of 12 items covering positive symptoms and uses a self-rated scoring system of between 0 (definitely disagree) and 6 (definitely agree), with a score of 3 indicating "not sure." Using limited samples of patients, a high sensitivity and a perfect specificity have been reported [11], although predictive validity has not been examined. General agreement on what constitutes the UHR state using the PRIME-Screen has not been established, although a score of 6 in at least 1 item is considered suggestive [11,12]. A modified version of the PRIME-Screen, which considered the duration of symptoms, showed a specificity and a sensitivity (against the Structured Interview for Psychosis-Risk Symptoms as a criterion standard) of 0.74 and 1.00, respectively, and a concordant validity of 0.43 [12]. A brief self-administered screen has a potential advantage in evaluating the prevalence of psychosis risk symptoms in large community settings where administration of a more extensive, time-consuming semistructured interview may not be feasible. Self-administration may also reduce inherent biases that may exist in researcher-assisted interviewing, particularly in cultures where certain questions may seem unfamiliar.

There have been no previous published reports evaluating prodromal or clinically high-risk individuals in the continent of Africa [5]. The limited data available from more developed countries may not be representative of Africa, as the presentation of schizophrenia and psychosis differs across cultures [13,14]. Epidemiologic studies in Africa suggest that there may be differences in the prevalence of psychotic illness across cultures [15], although there have been variable results across studies and surveyed populations within the continent. For example, the prevalence of schizophrenia in rural African communities has ranged between 4.3 and 60.0 per 1000 [16-18], which is lower than that typically reported in Western countries. However, such comparisons are limited by cultural differences in the worldview of concepts, which may influence the perception of psychotic illness [19] and, thus, the estimated prevalence.

Our primary aim was to evaluate the prevalence of various psychotic risk symptoms in a large community sample (n = 2758) in Nairobi, Kenya, using a culturally modified version of the PRIME. We explored the effect of gender on symptom manifestation, hypothesizing that symptoms will be more prevalent in males compared with females, consistent with previous studies showing higher rates of schizophrenia and psychotic experiences or an earlier age of onset in males [20]. Age effects on reporting psychosis risk were also evaluated, to gain insight into screening questions that may be more useful at various stages of development. Finally, we explored subject reports on the severity of specific psychosis risk symptoms to identify groups of subjects, using cluster analysis.

2. Methods

2.1. Recruitment

Participants were recruited between August 9 and 26, 2010, through house-to-house visits in Kangemi, a slum neighborhood of the city of Nairobi, Kenya, located 6 miles from the city center. Conditions in Kangemi are very poor, and many of its residents lack access to basic services, including electricity and running water; however, most youth attend public schools and are proficient in reading and writing in English. There were 8 recruiters involved in the study. Recruiters were trained third- and fourth-year nursing students from the University of Nairobi. Written and signed consent was obtained from all participants, who were then asked to fill the questionnaire on their own, with staff available for questions if needed. There were 2800 individuals who were approached to participate in the study and 2758 who agreed to participate. The study was approved by Washington University Medical School's institutional review board, the Kenyan Medical Research Institute, and the Ministry of Education, Science, and Technology, Kenya.

2.2. Assessment

Participants were asked to complete the 12-item PRIME-Screen, which was slightly modified to be better understood by local Kenyan youth (mPRIME). Modifications were determined after a series of discussions by local Africa Mental Health Foundation (AMHF) researchers and Washington University researchers. Item modifications were relatively minor and involved minimal edits to the phrasing of some questions. In addition, item 9 of the original PRIME-Screen was deleted because it was felt that the statement "I think I might feel like my mind is playing tricks on me" would be difficult to understand in the local culture. We substituted this item with another: "Has your mental state or thinking worsened in the last year" to evaluate recent change in the subject's experiences. The PRIME-Screen is structured such that each item can be answered on a severity scale: 0, definitely disagree; 1, somewhat disagree; 2, slightly disagree; 3, do not know; 4, slightly agree; 5, somewhat agree; and 6, definitely agree. For purposes of evaluating items as continuous measures, "don't know" answers were excluded in subsequent analyses, and scales were condensed into 0- to 5-range scales.

2.3. Statistical analysis

General statistical analyses were done using SAS 9.1 (SAS Institute, Cary, NC). Sex differences in item prevalence severity were compared using the Student *t* test (2 tailed). Age effects on severity scores were evaluated using the Pearson correlation coefficient. Significant *P* values were set at .004 (0.05/12) to correct for multiple comparisons.

We used *k*-means iterative cluster analysis [21] to identify latent subgroups of subjects with related patterns of psychosis risk symptoms from items on the mPRIME. Sex was also included in the analysis as a covariate. Only participants who completed all items on the mPRIME, did not answer "I don't know" for any item and indicated that sex were included in the analysis (n = 908). *k*-Means iterative cluster analyses handle larger data sets more efficiently than do hierarchical agglomerative methods [21]. We used an algorithm in which each item is assigned to the cluster having the nearest centroid (mean). This nonhierarchical method initially takes the number of components of the population equal to the final required number of clusters. The final required number of clusters is chosen such that the points are mutually farthest apart. Next, it examines each component in the population and assigns it to one of the clusters depending on the minimum distance. The centroid's position is recalculated every time a component is added to the cluster, and this continues until all the components are grouped into the final required number of clusters. Because there are no completely satisfactory methods for determining the number of population clusters [22], we ran numerous analyses with various values of *k* (from $k = 2$ to $k = 10$), with the goal of finding clusters with high concentrations of subjects. A 4-cluster solution provided the most clarity with regard to the interpretability of the scores revealed on each item for the participants forming these clusters. A 4-cluster solution represented a relatively large change (29.9%) in the overall *R*-square from a 3-class solution, and the R^2 further increased by less than 20%, with additional numbers of clusters.

3. Results

3.1. Demographics

In total, 2758 individuals participated in the study. Participant ages ranged from 14 to 29 years, with a mean (SD) age of 18.5 (3.4) years and a median age of 18 years. There were 1628 (60.5%) males and 1064 (39.5%) females among the participants, with 66 participants not disclosing their sex.

3.2. Prevalence of psychosis risk symptoms

Of those surveyed, 1255 (45.5%) indicated certainty (ie, "definitely agree" on the mPRIME) on having had any psychosis risk symptom in their lifetime. Among the total population, the percentages stating "definitely agree" were 16.7% for 1 symptom, 11.0% for 2 symptoms, 8.2% for 3 symptoms, 5.0% for 4 symptoms, 2.4% for 5 symptoms, 1.4% for 6 symptoms, 0.5% for 7 symptoms, 0.1% for 8 symptoms, 0.1% for 9 symptoms, and 0.04% for 11 symptoms. Prevalence rates were 46.3% in males and 44.8% in females, and differences were not significant ($\chi^2 = 0.6$, $P = .4$). Excluding item 9 (ie, "Worsening in Last 12 Months") of the mPRIME did not significantly affect the prevalence of having any psychosis risk symptom (45.2%).

Table 1 lists the prevalence of the 6 severities of mPRIME psychosis risk items. Across all items, 3.7% ("Going Crazy") to 34.7% ("Supernatural/Special") of individuals reported having risk symptoms to any degree. However, only 1.8% to 19.5% reported the highest degree of certainty (ie, "definitely agree") to having experienced these symptoms. In contrast, 54.6% to 90.4% of individuals disagreed with having symptoms to any degree, and 37.7% to 83.8% "definitely disagreed" with having symptoms.

3.3. Sex effects

Sex differences in the prevalence of psychosis risk symptoms are depicted in Fig. 1. The mPRIME item with the largest sex prevalence difference was "(Super)natural/Special," with males reporting "definitely agree" 35.8% more than females (females, 16.1%; males, 21.8%). Answering "definitely agree" was also more prevalent in males compared with females in 9 other items by 8.7% to 27.0% ("Odd Things": females, 9.6%; males, 10.7%; "Predict Future": females, 8.7%; males, 11.0%; "Controlled Thoughts": females, 9.4%; males, 11.7%; "Superstitions": females, 8.9%; males, 10.3%, "Real vs. Imaginary": females, 10.7%; males, 11.7%; "Mind Reading": females, 9.7%; males, 11.6%; "Worsening in Last 12 Months": females, 3.2%; males, 4.0%; "Hearing Thoughts Out Loud": females, 6.8%; males, 7.0%; and "Going Mad": females, 1.7%; males, 1.9%). Females had a higher prevalence than did males in only 2 mPRIME items: "Planning to Hurt Me," by 26.9% (females, 11.2%; males, 8.2%), and "Hearing Voices/Sounds," by 18.8% (females, 7.6%; males, 6.1%).

We also evaluated the difference in mean severity scores (ranging from 0 to 5) between sexes on individual mPRIME items (Table 2). Significant mean (SD) score differences were only found for 2 items: "Planning to Hurt Me" (females, 1.2 [1.7]; males, 0.9 [1.5]; $P = .001$) and "Hearing Voices/Sounds" (females, 0.8 [1.5]; males, 0.5 [1.2]; $P = .0007$), both of which were higher in females compared with males.

3.4. Age effects

Age effects are shown in Table 2. Pearson correlational analysis on age against mPRIME item scores (range, 0-5) showed a significant positive relationship only for 5 items; however, *R* values were very modest. *R* values for these items were as follows: 0.12 for "Predict Future" ($P = .0002$),

Table 1
mPRIME psychotic risk symptom endorsement (n = 2758)

Experiences[a]				Total
	Definitely disagree	Somewhat disagree	Slightly disagree	Disagree
1. Odd or unusual things going on I can't explain	1222 (45.4)	294 (10.9)	171 (6.4)	1687 (62.7)
2. I may be able to predict future	1209 (44.4)	243 (8.9)	202 (7.4)	1654 (60.7)
3. Have felt something interrupting/controlling thoughts or actions	1029 (37.7)	346 (12.7)	245 (9.0)	1620 (59.3)
4. Experienced doing something differently due to superstitions	1345 (49.2)	242 (8.9)	206 (7.5)	1793 (65.6)
5. Get confused whether something is real or imaginary/dream	1184 (43.2)	221 (8.1)	186 (6.8)	1591 (58.1)
6. Might be possible others can read my mind, or I can read others'	1133 (41.5)	274 (10.0)	235 (8.6)	1642 (60.1)
7. Wonder if people are planning to hurt me	1185 (43.6)	249 (9.2)	194 (7.1)	1628 (60.0)
8. I have special or (super)natural gifts beyond my talents	1152 (42.1)	176 (6.4)	164 (6.0)	1492 (54.6)
9. My mental state has gotten worse in the last 12 mo[b]	1780 (65.2)	220 (8.1)	152 (5.6)	2152 (78.8)
10. Heard sounds of people when no one is near	1645 (60.1)	242 (8.8)	134 (4.9)	2021 (73.8)
11. Hear my own thoughts out loud	1578 (57.8)	215 (7.9)	163 (6.0)	1956 (71.7)
12. Been concerned that I may be going mad	2303 (83.8)	105 (3.8)	74 (2.7)	2482 (90.4)

Experiences[a]				Total
	Definitely agree	Somewhat agree	Slightly agree	Agree
1. Odd or unusual things going on I can't explain	275 (10.2)	110 (4.1)	264 (9.8)	649 (24.1)
2. I may be able to predict future	272 (10.0)	128 (4.7)	287 (10.5)	687 (25.2)
3. Have felt something interrupting/controlling thoughts or actions	292 (10.7)	184 (6.7)	311 (11.4)	787 (28.8)
4. Experienced doing something differently due to superstitions	267 (9.8)	119 (4.4)	252 (9.2)	638 (23.3)
5. Get confused whether something is real or imaginary/dream	307 (11.2)	159 (5.8)	309 (11.3)	775 (28.3)
6. Might be possible others can read my mind, or I can read others'	301 (11.0)	160 (5.9)	306 (11.2)	767 (28.1)
7. Wonder if people are planning to hurt me	254 (9.3)	121 (4.5)	238 (8.8)	613 (22.5)
8. I have special or (super)natural gifts beyond my talents	533 (19.5)	160 (5.9)	256 (9.4)	949 (34.7)
9. My mental state has gotten worse in the last 12 mo[b]	102 (3.7)	71 (2.6)	130 (4.8)	303 (11.1)
10. Heard sounds of people when no one is near	181 (6.6)	95 (3.5)	199 (7.3)	475 (17.4)
11. Hear my own thoughts out loud	187 (6.9)	109 (4.0)	196 (7.2)	492 (18.0)
12. Been concerned that I may be going mad	49 (1.8)	18 (0.7)	34 (1.2)	101 (3.7)

Values are given in raw numbers (percentages). Remaining percentages of subjects either answered "I don't know" or did not complete the item.

[a] Listed items from mPRIME are abbreviated to fit the table.

[b] The content of this item was changed from the original PRIME-Screen, which had in its place an item evaluating experiences involving "mind tricks."

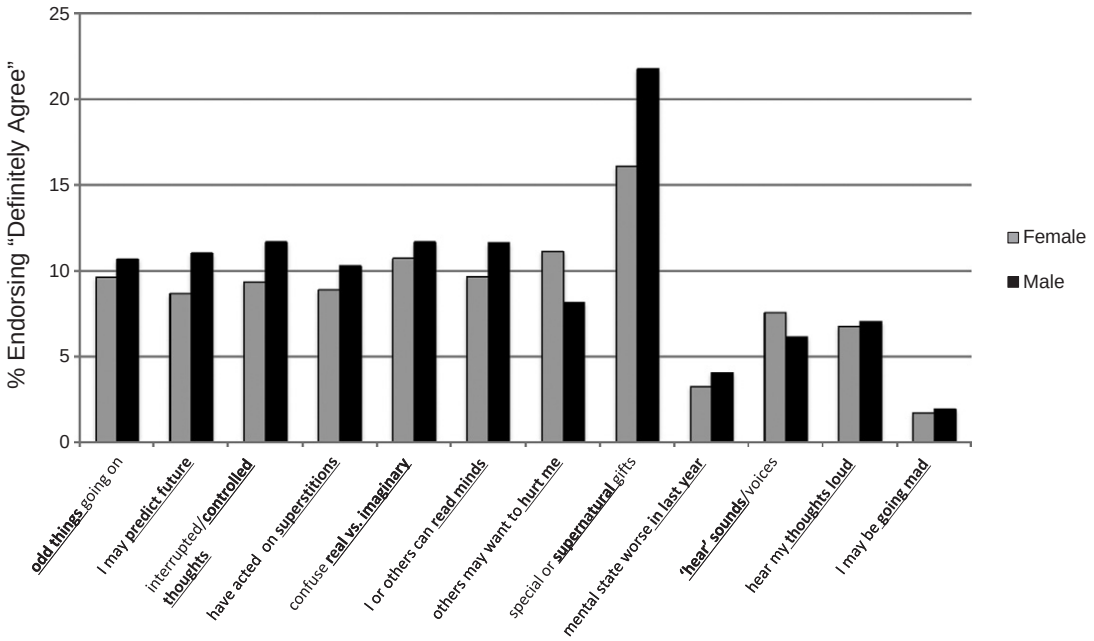

Fig. 1. Sex differences in the prevalence of psychosis risk symptom in Nairobi. The mPRIME was used to evaluate psychosis risk symptoms, shown on the *x*-axis. The *y*-axis indicates the percentage of individuals who answered "definitely agree" on an mPRIME item. Exact values are shown in the "Results" section.

Table 2
Effects of sex and age on mPRIME item severity

Experiences	Sex, mean severity score				Age, Pearson correlation coefficient	
	Female	Male	F	*P*	*R*	*P*
1. Odd or unusual things going on I can't explain	0.9 (1.5)	1.1 (1.7)	1.7	.19	0.07	.036*
2. I may be able to predict future	0.9 (1.5)	1.1 (1.7)	2.8	.09	0.12	.0002**
3. Have felt something interrupting/controlling thoughts or actions	1.2 (1.6)	1.3 (1.7)	0.6	.42	0.09	.009*
4. Experienced doing something differently due to superstitions	1.1 (1.7)	0.9 (1.6)	2.3	.13	0.13	<.0001**
5. Get confused whether something is real or imaginary/dream	1.2 (1.6)	1.1 (1.7)	0.5	.48	0.11	.0006**
6. Might be possible others can read my mind, or I can read others'	1.3 (1.8)	1.2 (1.7)	0.1	.72	0.12	.0002**
7. Wonder if people planning to hurt me	1.2 (1.7)	0.9 (1.5)	10.4	.001**	0.03	.39
8. I have special or (super)natural gifts beyond my talents	1.2 (1.8)	1.4 (2.0)	2.5	.11	0.02	.57
9. My mental state has gotten worse in the last 12 mo	0.5 (1.2)	0.4 (1.0)	4.7	.03*	0.04	.20
10. Heard sounds of people when no one is near	0.8 (1.5)	0.5 (1.2)	11.6	.0007**	−0.05	.16
11. Hear my own thoughts out loud	0.7 (1.4)	0.6 (1.4)	0.9	.35	0.02	.52
12. Been concerned that I may be going mad	0.2 (0.8)	0.2 (0.8)	0.3	.56	0.05	.16

Answers given for mPRIME items were numerically scored at 0 to 5 severity, with 0 indicating definitely disagree and 5 indicating definitely agree. Results for sex are reported as means (SD). Results for age are reported as the Pearson correlation coefficient.

* $P < .05$ (uncorrected for multiple comparisons).

** $P < .004$ (corrected for multiple comparisons).

0.09 for "Controlling Thoughts" ($P = .009$), 0.13 for "Superstitions" ($P \leq .0001$), 0.11 for "Real vs. Imaginary" ($P = .0006$), and 0.12 for "Mind Reading" ($P = .0002$).

Correlational analysis done separately in males also showed a significant effect for "Predict Future" ($R = 0.09$, $P = .001$), 0.09 for "Controlling Thoughts" ($R = 12$, $P = .004$), 0.13 for "Superstitions" ($R = 0.18$, $P \leq .0001$), 0.11 for "Real vs. Imaginary" ($R = 0.15$, $P = .0003$), and 0.12 for "Mind Reading" ($R = 0.15$, $P = .0002$), but not for other items. Age effects in females did not show a significant correlation in any mPRIME item, after controlling for multiple comparisons. However, there was a trend level effect for "Hearing Voices" in females ($R = -0.13$, $P = .02$).

3.5. Cluster analysis of psychosis risk symptoms

k-Means cluster analyses of the 908 subjects who completed all mPRIME items, with a severity score, generated 4 clusters ($k = 4$). The sample used for cluster analysis and the total sample (n = 2758) did not significantly differ in sex ($\chi^2 = 1.7$, $P = .2$). The mean age of cluster-analyzed subjects was only minimally higher (18.8 years) than that of the total sample (18.5 years; $P = .03$). The 4 clusters were as follows: (1) a normative group (NG; 55%), with scores approaching 0 in all items; (2) a high-symptom group (HG1; 11.1%), with mean scores higher than 2.5 in most items; (3) an intermediate-symptom group (IG; 18.6%), with mean scores lower than 2.5 in all items; and (4) a grandiose-symptom group (GG; 15.2%), with intermediate mean scores lower than 2.0 in all items except on that inquiring about being exceptionally "(Super)natural/Special," where the mean score was 4.3.

Fig. 2 depicts and Table 3 lists the mean (SD) mPRIME item severity scores (ranging from 0 to 5) of the participants in each of the 4 clusters. Participants in the HG were, on average, approximately 2 years older (mean age, 20.4 years) than those in the NG, IG, or GG. There was a statistically similar predominance of males in every group, which approximated the sex distribution of the original 2758-subject sample. Participants in each group had relatively low mean scores on the "Worsening in Last 12 Months" item (NG, 0.2; HG, 1.2; IG, 0.7; and GG, 0.5). The mean scores for endorsing feelings of "Going Mad" were very low in all groups; the highest score was in HG (mean score, 1.9). Other mean scores in HG were 2.5 or higher, with the exception of the items "Hearing Voices/Sounds" and "Hearing Thoughts Loud," which were lower.

4. Discussion

Our studies showed a relatively high (45.5%) adolescent and young adult lifetime prevalence of symptoms suggesting psychosis risk in a region within Nairobi, Kenya. The most commonly reported symptom (34.7%) involved feelings of having special gifts beyond one's natural ability. Other symptoms reported, of decreasing prevalence, were interrupted or controlled thinking, difficulty identifying reality, thoughts of mind reading, thoughts of predicting the future, feeling that odd things are going on, superstition, persecutory ideation, and auditory hallucinations. A previous community survey of Mexican adolescents using the PRIME-Screen reported psychosis risk rates of only 18.4%, lower than that found in our study [23]. In Australia and Britain, community surveys evaluating "psychotic-like experiences" using alternative screening tools have reported prevalence estimates between 5% and 12% [24-27]. However, higher rates of prodromal symptoms have also been reported. For example, in a survey of US college students, 43% of students reported as having 8 or more positive symptoms on a prodromal

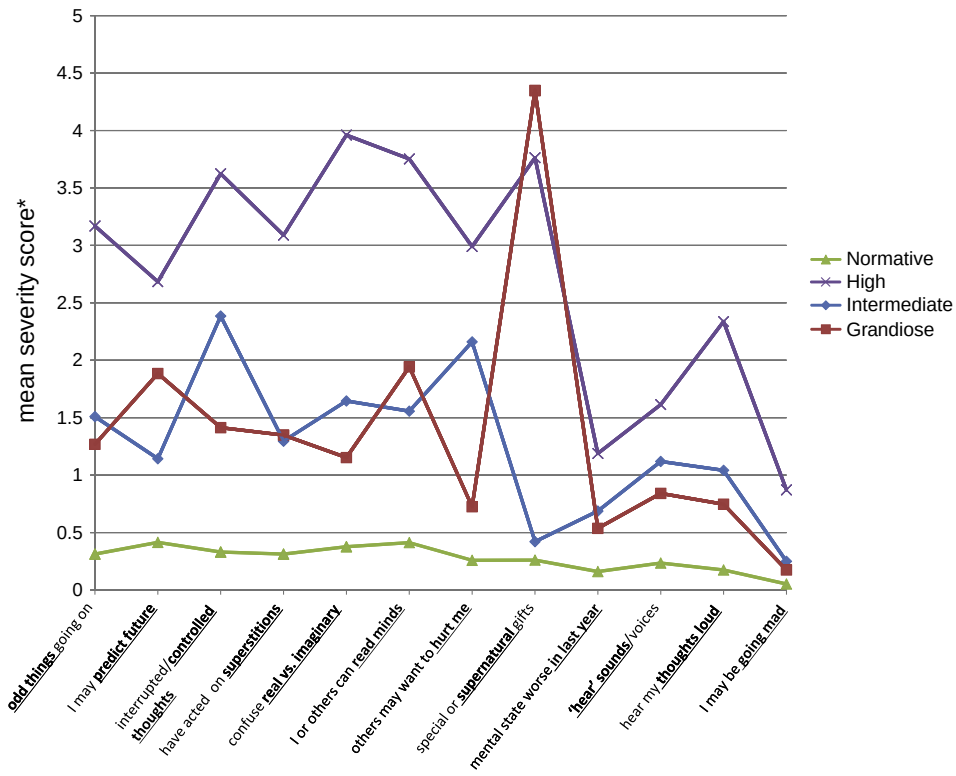

Fig. 2. Cluster analysis of psychosis risk questionnaire reports. *k*-Means cluster analysis was used on results from the mPRIME item severity scores, with sex included in the analysis. In total, 908 participants were included in the analysis, which required completion of all items, without answering "don't know" on any item. Severity scores on each item were renumbered such that 0 indicates definitely disagree; 1, somewhat disagree; 2, slightly disagree; 3, slightly agree; 4, somewhat agree; and 5, definitely agree.

Table 3
Characteristics of 4 groups of youth derived from cluster analysis of subject responses on mPRIME (n = 908)

Features	Normative	High symptom	Intermediate symptom	Grandiose symptom	F/χ^2	*P*
No. (%)	500 (55.0)	101 (11.1)	169 (18.6)	138 (15.2)	–	–
Age (y)	18.7 (3.4)	20.4 (3.3)	18.8 (3.4)	18.1 (3.5)	9.0	<.0001
Sex, n (%)					4.7	.2
Female	177 (35.4)	36 (35.6)	75 (44.4)	49 (35.5)		
Male	323 (64.6)	65 (64.4)	94 (55.6)	89 (64.5)		
mPRIME items						
1. Odd things	0.3 (1.8)	3.2 (1.8)	1.6 (1.9)	1.3 (1.8)	147.6	<.0001
2. Predict future	0.4 (0.9)	2.7 (2.1)	1.1 (1.6)	1.9 (2.1)	91.5	<.0001
3. Controlled thoughts	0.3 (0.6)	3.6 (1.5)	2.4 (1.7)	1.4 (1.8)	272.1	<.0001
4. Superstitions	0.3 (0.8)	3.1 (1.9)	1.3 (1.8)	1.3 (1.8)	126.0	<.0001
5. Real vs imaginary	0.4 (0.9)	4.0 (1.4)	1.5 (1.8)	1.2 (1.6)	228.8	<.0001
6. Mind reading	0.4 (0.9)	3.8 (1.7)	1.6 (1.6)	1.9 (2.0)	193.2	<.0001
7. Hurt me	0.3 (0.6)	3.0 (2.0)	2.2 (1.8)	0.7 (1.3)	197.2	<.0001
8. Supernatural	0.3 (0.7)	3.8 (1.7)	0.4 (0.9)	4.3 (0.9)	1057.8	<.0001
9. Last 12 mo	0.2 (0.5)	1.2 (1.8)	0.7 (1.4)	0.5 (1.3)	32.0	<.0001
10. Hear sounds	0.2 (0.7)	1.6 (2.0)	1.1 (1.6)	0.8 (1.5)	48.4	<.0001
11. Thoughts loud	0.2 (0.5)	2.3 (2.1)	1.0 (1.5)	0.7 (1.6)	97.5	<.0001
12. Going mad	0.1 (0.3)	0.9 (1.6)	0.2 (0.8)	0.2 (0.7)	34.5	<.0001

Values are given in means (SD) unless stated otherwise. χ^2 Analysis was used to compare frequencies. Analysis of variance was used to compare means. *k*-Means cluster analysis was used to generate clusters. Scores of the mPRIME items are derived from the answers on a 0- to 5-severity scale, with a score of 0 being definitely disagree and 5 being definitely agree. (Individuals who answered "don't know" on any item or did not indicate their sex were not included in the cluster analysis.)

questionnaire [28], whereas 10% to 50% of high school students have reported prodromal symptoms by other authors [29,30]. Discrepancies across studies may reflect differences in the number and types of questions on the screening tools used but may also indicate that psychotic symptoms vary across population groups, with the poorest socioeconomic regions in Kenya having particularly high rates. This would be consistent with the relationship of psychosis with high environmental stress. In our study, 3.7% of those surveyed stated that they may be "going mad," which may indicate that these participants may have more severe symptoms or have an already existing psychotic disorder—considering that this is only slightly above the estimated community rates of psychotic disorders [1]. Thoughts of going crazy may, however, underestimate the severity of illness due to poor insight [31] or may indicate the presence of other underlying conditions that are associated with significant anxiety symptoms [32]. We also found that 11.1% of the population stated that their symptoms might have worsened within the last year, a number that may estimate the incidence rate of psychosis risk symptoms. However, it is unclear if worsening was caused by psychosis risk symptoms or by other unrelated conditions such as depression, anxiety, or other environmental stressors, as these were not specifically investigated.

Females were found to be more likely to report persecutory ideation and auditory hallucinations compared with males. This difference was observed both by measuring mean severity scores and by measuring the prevalence rates of definitive symptoms. A higher rate of auditory and visual hallucinations in females is consistent with that previously reported by other authors [27,33]. Although these researchers found a higher prevalence of persecutory delusions in males [27], unlike our findings, an association of victimization (including, for example, bullying, violence, and sexual assault) with both hallucinations [27,34] and persecutory delusions [27] has been noted. Thus, it is plausible that higher rates of hallucinations and persecutory ideation in our female participants may reflect a greater history of physical or psychological trauma compared with males. Our studies also found that male participants were somewhat more likely to report certainty in having special or supernatural self-attributions, interrupted or controlled thinking, difficulty identifying reality, thoughts of mind reading, superstitious behaviors, thoughts of predicting the future, or feelings of oddness. However, males did not show a significant difference in mean severity scores compared with females, although there was a trend in that direction for some symptoms.

We found a statistically significant effect of increasing age on increased endorsement of superstitious behavior, thoughts of predicting the future, thoughts of mind reading, difficulty identifying reality, and interrupted thinking. These correlations were, however, very modest, with R values from 0.09 to 0.13. Analysis done separately by sex indicated that these correlations were present in males but not in females, suggesting that the noted risk symptoms are slightly more commonly reported with increased age in males. Although the reasons for this are not clear from these data, it is plausible that the noted symptoms are more likely to occur later in development. Alternatively, the possibility that certain questionnaire items are easier to comprehend at older ages because of their content or the way they are phrased cannot be overlooked, as probing for a particular symptom using differently worded text has shown differing prevalence rates [27].

We used cluster analysis to identify subject groups that have common patterns of observable symptoms based on severity scores of mPRIME items. We identified, in addition to an NG, 3 groups of individuals with some degree of psychosis risk traits. The HG comprised 11.1% of the analyzed population and was characterized by a relatively high severity of all psychosis risk symptoms. Mean scores for auditory hallucinatory experiences were observably lower than those for other psychotic risk symptoms. It is of interest that, on average, the HG consisted of somewhat older participants (20.4 years) compared with other groups, which more closely reflects the 15- to 35-year age range associated with psychotic disorder onset [35]. Considering the multiple psychotic experiences of relatively high severity in this group, it appears probable that it partly comprises community participants with existing psychotic disorders, estimated at approximately 3% of the population [1]. This group would most likely also be at the greatest psychosis risk, as higher risk scores predict the development of future psychotic illness [36]. An IG of higher prevalence was also found using cluster analysis. It is unclear whether a lower score severity may impart any risk for the future development of psychotic illness. This group could represent an unrelated normal variant, considering that psychotic experiences are often reported in healthy individuals or may be mischaracterized [37]. In the GG, the most characteristic symptoms reported were high scores on feeling extremely special. Our study, however, did not evaluate whether these individuals may have an underlying pathology with grandiose symptoms such as mania or hypomania, as bipolar spectrum disorders are relatively prevalent in the community [38]. However, grandiosity and egocentrism are not uncommon in adolescence and can be often misjudged as pathologic [39]. In either case, our findings suggest that questions of grandiosity may be less specific for evaluating psychosis risk. The symptom clusters found in our study share some similarities with that reported by Rocchi et al [40], where latent class analysis was applied to a delusion inventory. Although only delusional symptoms were analyzed, these authors identified 4 classes, including a prominent grandiosity/hypomania class. Two other studies using other psychosis risk questionnaires have reported 4 alternative classes, including an intermediate, a positive psychosis, and either a paranoid or a hallucinatory class [41,42]. Together, these findings suggest that resulting

clusters are dependent on the number and type of symptoms included in the analysis.

A major limitation to our prevalence rate findings from the mPRIME is that it may overestimate the true risk for developing a psychotic disorder. However, establishing psychosis risk using more extensive "gold standard" interviews is also not highly specific, with only a fraction of individuals eventually transitioning to a psychotic disorder [6,10]. Improved estimation of conversion risk would be expected to require severity evaluation using an index of functionality and symptom duration or frequency, which was not contained within the mPRIME. Including the duration criteria only during screening, as other authors have done previously [12], may improve the accuracy of predicting a psychotic disorder but could also result in the underestimation of clinically significant cases where impairment or distress is present for shorter periods. An additional limitation of our study is that results are based on self-report and may not precisely reflect symptoms experienced by individuals. Although every effort was made to modify the questionnaire to be easily understood in the Kenyan youth culture, the possibility remains that some items were difficult to comprehend, particularly by younger individuals or those who may have a degree of cognitive impairment in the community. Questionnaire items were also not fully completed by all study participants, which may have influenced our findings by excluding individuals who are cognitively impaired or may be distractible due to psychopathology. Thus, prevalence rates reported may underestimate the actual rates in the community. Because our study was cross-sectional, it is difficult to predict whether positive symptoms reported indicate the true risk for a psychotic disorder, a risk for other psychiatric conditions (such as anxiety or affective disorders), or no risk at all, as follow-up studies were not done. Other potential causes of reported symptoms were also not evaluated but may include substance abuse, infective or toxic states, malnutrition, vitamin deficiency, or epilepsy, which are relatively common in Africa [43]. Such etiologies, although significant, may not necessarily indicate a risk for primary psychotic conditions like schizophrenia or affective psychoses.

Our study provides insight into potential psychotic risk symptoms in Africa, where this has not previously been evaluated. In addition to imparting likelihood for developing more severe illness, psychosis risk symptoms observed in our study can, by themselves, be disabling. Thus, our studies may imply a larger burden of disease on individuals, families, and the society at large than would be attributable to a diagnosable mental illness. Longitudinal studies are required to evaluate the rate of transition to psychotic illness over various intervals and how this is influenced by participants' reports on the mPRIME. This would entail assessment of psychiatric diagnoses in participants as well as other diagnostic confounders. It will also be necessary to determine the level of functionality and distress experienced by those reporting symptoms on the questionnaire to develop suitable intervention strategies.

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References

[1] Perala J, Suvisaari J, Saarni SI, Kuoppasalmi K, Isometsa E, Pirkola S, et al. Lifetime prevalence of psychotic and bipolar I disorders in a general population. Arch Gen Psychiatry 2007;64(1):19-28.
[2] Larsen TK, Melle I, Friis S, Joa I, Johannessen JO, Opjordsmoen S, et al. One-year effect of changing duration of untreated psychosis in a single catchment area. Br J Psychiatry Suppl 2007;51:s128-32.
[3] Stain HJ, Clark S, O'Donnell M, Schall U. Young rural people at risk for schizophrenia: time for mental health services to translate research evidence into best practice of care. Aust N Z J Psychiatry 2010;44 (10):872-82.
[4] World_Health_Organization. Prevention of mental disorders: effective interventions and policy options. Geneva, Switzerland: World Health Organization; 2004.
[5] Ndetei DM. Early intervention in psychosis: concepts, evidence and perspectives. World Psychiatry 2008;7(3):164-5 PMCID: 2559925.
[6] Yung AR, Phillips LJ, Yuen HP, McGorry PD. Risk factors for psychosis in an ultra high-risk group: psychopathology and clinical features. Schizophr Res 2004;67(2-3):131-42.
[7] Yung AR, McGorry PD. The prodromal phase of first-episode psychosis: past and current conceptualizations. Schizophr Bull 1996;22(2):353-70.
[8] Miller TJ, McGlashan TH, Rosen JL, Cadenhead K, Cannon T, Ventura J, et al. Prodromal assessment with the structured interview for prodromal syndromes and the scale of prodromal symptoms: predictive validity, interrater reliability, and training to reliability. Schizophr Bull 2003;29(4):703-15.
[9] Woods SW, Addington J, Cadenhead KS, Cannon TD, Cornblatt BA, Heinssen R, et al. Validity of the prodromal risk syndrome for first psychosis: findings from the North American Prodrome Longitudinal Study. Schizophr Bull 2009;35(5):894-908 [PMCID: 2728816].
[10] Ruhrmann S, Schultze-Lutter F, Salokangas RK, Heinimaa M, Linszen D, Dingemans P, et al. Prediction of psychosis in adolescents and young adults at high risk: results from the prospective European prediction of psychosis study. Arch Gen Psychiatry 2010;67 (3):241-51.
[11] Miller TJ, Cicchetti D, Markovich D, McGlashan TH, Woods SW. The SIPS screen: a brief self-report screen to detect the schizophrenia prodrome. Schizophr Res 2004;70(suppl1):78.
[12] Kobayashi H, Nemoto T, Koshikawa H, Osono Y, Yamazawa R, Murakami M, et al. A self-reported instrument for prodromal symptoms of psychosis: testing the clinical validity of the PRIME Screen–Revised (PS-R) in a Japanese population. Schizophr Res 2008;106(2-3):356-62.
[13] Sartorius N, Gulbinat W, Harrison G, Laska E, Siegel C. Long-term follow-up of schizophrenia in 16 countries. A description of the International Study of Schizophrenia by the World Health Organization. Soc Psychiatry Psychiatr Epidemiol 1996;31:249-58.
[14] Susser E, Wanderling J. Epidemiology of nonaffective acute remitting psychosis vs schizophrenia. Sex and sociocultural setting. Arch Gen Psychiatry 1994;51(4):294-301.
[15] Torrey EF. The epidemiology of paranoid schizophrenia. Schizophr Bull 1981;7(4):588-93.

[16] Ben-Tovim DI, Cushnie JM. The prevalence of schizophrenia in a remote area of Botswana. Br J Psychiatry 1986;148:576-80.
[17] Kebede D, Alem A, Shibre T, Negash A, Fekadu A, Fekadu D, et al. Onset and clinical course of schizophrenia in Butajira-Ethiopia—a community-based study. Soc Psychiatry Psychiatr Epidemiol 2003;38 (11):625-31.
[18] Tafari S, Aboud FE, Larson CP. Determinants of mental illness in a rural Ethiopian adult population. Soc Sci Med 1991;32(2):197-201.
[19] Maslowski J, Jansen van Rensburg D, Mthoko N. A polydiagnostic approach to the differences in the symptoms of schizophrenia in different cultural and ethnic populations. Acta Psychiatr Scand 1998;98(1):41-6.
[20] Hambrecht M, Maurer K, Hafner H, Sartorius N. Transnational stability of gender differences in schizophrenia? An analysis based on the WHO study on determinants of outcome of severe mental disorders. Eur Arch Psychiatry Clin Neurosci 1992;242(1):6-12.
[21] Everitt BS. Cluster analysis. London: Edward Arnold; 1993.
[22] Everitt BS. Unresolved problems in cluster analysis. Biometrics 1979;35:169-81.
[23] Fresan A, Apiquian R, Ulloa RE, Nicolini H. Reliability study of the translation into Spanish of the PRIME Screen Questionnaire for Prodromic Symtoms. Actas Esp Psiquiatr 2007;35(6):368-71.
[24] Saha S, GS J, Varghese D, McGrath JJ. The association between general psychological distress and delusional-like experiences: a large population-based study. Schizophr Res 2011.
[25] Scott J, Chant D, Andrews G, McGrath J. Psychotic-like experiences in the general community: the correlates of CIDI psychosis screen items in an Australian sample. Psychol Med 2006;36(2):231-8.
[26] 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):179-85.
[27] Johns LC, Cannon M, Singleton N, Murray RM, Farrell M, Brugha T, et al. Prevalence and correlates of self-reported psychotic symptoms in the British population. Br J Psychiatry 2004;185:298-305.
[28] Loewy RL, Johnson JK, Cannon TD. Self-report of attenuated psychotic experiences in a college population. Schizophr Res 2007;93(1-3):144-51 [PMCID: 2063995].
[29] McGorry PD, McFarlane C, Patton GC, Bell R, Hibbert ME, Jackson HJ, et al. The prevalence of prodromal features of schizophrenia in adolescence: a preliminary survey. Acta Psychiatr Scand 1995;92 (4):241-9.
[30] Nishida A, Tanii H, Nishimura Y, Kajiki N, Inoue K, Okada M, et al. Associations between psychotic-like experiences and mental health status and other psychopathologies among Japanese early teens. Schizophr Res 2008;99(1-3):125-33.
[31] Drake RJ. Insight into illness: impact on diagnosis and outcome of nonaffective psychosis. Curr Psychiatry Rep 2008;10(3):210-6.
[32] Chen J, Tsuchiya M, Kawakami N, Furukawa TA. Non-fearful vs. fearful panic attacks: a general population study from the National Comorbidity Survey. J Affect Disord 2009;112(1-3):273-8.
[33] Tien AY. Distributions of hallucinations in the population. Soc Psychiatry Psychiatr Epidemiol 1991;26(6):287-92.
[34] Romme MA, Escher AD. Hearing voices. Schizophr Bull 1989;15 (2):209-16.
[35] Hafner H, an der Heiden W. Epidemiology of schizophrenia. Can J Psychiatry 1997;42(2):139-51.
[36] McGlashan T, Walsh B, Woods S. The psychosis-risk syndrome: handbook for diagnosis and follow-up. 1st ed. USA: Oxford University Press; 2010.
[37] Pierre JM. Hallucinations in nonpsychotic disorders: toward a differential diagnosis of “hearing voices.”. Harv Rev Psychiatry 2010;18(1):22-35.
[38] Merikangas KR, Akiskal HS, Angst J, Greenberg PE, Hirschfeld RM, Petukhova M, et al. Lifetime and 12-month prevalence of bipolar spectrum disorder in the National Comorbidity Survey replication. Arch Gen Psychiatry 2007;64(5):543-52 [PMCID: 1931566].
[39] Harrop C, Trower P. Why does schizophrenia develop at late adolescence? Clin Psychol Rev 2001;21(2):241-65.
[40] Rocchi MB, Sisti D, Manca S, Siddi S, Mura T, Preti A. Latent class analysis of delusion-proneness: exploring the latent structure of the Peters et al. delusions inventory. J Nerv Ment Dis 2008;196 (8):620-9.
[41] Shevlin M, Murphy J, Dorahy MJ, Adamson G. The distribution of positive psychosis-like symptoms in the population: a latent class analysis of the National Comorbidity Survey. Schizophr Res 2007;89 (1-3):101-9.
[42] Murphy J, Shevlin M, Adamson G. A latent class analysis of positive psychosis symptoms based on the British Psychiatric Morbidity Survey. Pers Individ Differ 2007;42:1491-502.
[43] Guinness EA. Brief reactive psychosis and the major functional psychoses: descriptive case studies in Africa. Br J Psychiatry Suppl 1992(16):24-41.