Psychological Medicine (2014), **44**, 3503–3513. © Cambridge University Press 2014
doi:10.1017/S0033291714000944

ORIGINAL ARTICLE

Co-occurrence of psychotic experiences and common mental health conditions across four racially and ethnically diverse population samples

J. E. DeVylder[1]*, D. Burnette[1] and L. H. Yang[2]

[1] *Columbia University School of Social Work, New York, NY, USA*
[2] *Mailman School of Public Health, Columbia University, New York, NY, USA*

Background. Prior research with racially/ethnically homogeneous samples has demonstrated widespread co-occurrence of psychotic experiences (PEs) and common mental health conditions, particularly multi-morbidity, suggesting that psychosis may be related to the overall severity of psychiatric disorder rather than any specific subtype. In this study we aimed to examine whether PEs are associated with the presence of specific disorders or multi-morbidity of co-occurring disorders across four large racially/ethnically diverse samples of adults in the USA.

Method. Data were drawn from the National Comorbidity Survey Replication (NCS-R), the National Survey of American Life (NSAL) and separately from the Asian and Latino subsamples of the National Latino and Asian American Study (NLAAS). Logistic regression models were used to examine the relationship between PEs and individual subtypes of DSM-IV disorder, and to test for a linear dose–response relationship between the number of subtypes and PEs.

Results. Prevalence of PEs was moderately greater among individuals with each subtype of disorder in each data set [odds ratios (ORs) 1.8–3.8], although associations were only variably significant when controlling for clinical and demographic variables. However, the sum of disorder subtypes was related to odds for PEs in a linear dose–response fashion across all four samples.

Conclusions. PEs are related primarily to the extent or severity of psychiatric illness, as indicated by the presence of multiple psychiatric disorders, rather than to any particular subtype of disorder in these data. This relationship applies to the general population and across diverse racial/ethnic groups.

Received 24 November 2013; Revised 1 March 2014; Accepted 22 March 2014; First published online 24 April 2014

Key words: Anxiety, continuum, depression, epidemiology, ethnicity, psychosis, PTSD, race, schizophrenia, substance use.

Introduction

Psychosis is now widely believed to occur on a continuum, with an estimated 7.2% of the general population experiencing subthreshold psychotic experiences (PEs) at some point in their lifetimes (Linscott & van Os, 2013). Population-based studies of the co-occurrence of PEs and common mental health conditions have found widespread associations across a variety of diagnoses, including depressive, anxiety and substance use disorders. For example, the prevalence of PEs is reported to be greater in adults with major depressive disorder or any anxiety disorder in Europe (van Nierop *et al.* 2012; Wigman *et al.* 2012) and in Australia, with or without post-traumatic stress disorder (PTSD) (Varghese *et al.* 2011; Saha *et al.* 2012), which is no longer classified as an anxiety disorder (APA, 2013). PTSD itself has been associated prospectively with prior PEs (Fisher *et al.* 2013) and in cross-sectional data specifically with delusion-like experiences (Scott *et al.* 2007). This finding is consistent with other studies showing elevated prevalence of trauma exposure history among individuals reporting PEs (Johns *et al.* 2004; Lataster *et al.* 2006; Kelleher *et al.* 2008). PEs have similarly been associated with substance use disorders, including both alcohol and drug dependence, in England (Johns *et al.* 2004). Other studies have shown associations with drug use across a broad range of substances (opiate, cannabis, alcohol, tobacco; Degenhardt & Hall, 2001) and particularly cannabis use (Rössler *et al.* 2007).

* Address for correspondence: J. E. DeVylder, M.S., Columbia University School of Social Work, 1255 Amsterdam Avenue, 9th floor, New York, NY 10027, USA.
(Email: jed2147@columbia.edu)

PEs in the context of general psychopathology

One possible explanation for widespread associations between PEs and nearly all classes of psychopathology is that risk for psychosis may increase with greater illness severity, regardless of the particular type of illness. Overall severity of psychopathology may be indicated by quantifying the number of co-occurring disorders, or by measuring symptom severity within disorders or phenotypic dimensions. Several studies have found dose–response relationships between severity of co-occurring disorders and risk for PEs. Among children and adolescents in Ireland, risk for PEs was shown to increase linearly as the child met criteria for an increasing number of diagnosable conditions across four population-based data sets using different categories of disorder and means of assessment (Kelleher *et al.* 2012) and among a help-seeking clinical sample (Kelleher *et al.* 2013). Similarly, within a single disorder, risk for delusion-like experiences increases with increasing severity of major depression (Saha *et al.* 2012). These findings, coupled with the widespread associations of PEs with specific mental health conditions, suggest that the extent of psychopathology (i.e. the number of co-occurring diagnoses) may be equally important to, or more important than, the nature of psychopathology (i.e. the presence of particular diagnoses) in determining risk for PEs.

Racial/ethnic differences in co-occurrence of common disorders with psychosis

All of the above-mentioned studies of co-occurrence of PEs and general mental health conditions were conducted with samples entirely or almost entirely made up of white respondents. Threshold schizophrenia is known to occur in every country worldwide (Tandon *et al.* 2008), and the World Health Organization (WHO) World Health Survey (Nuevo *et al.* 2012) identified subthreshold PEs in all 52 countries studied. As such, the psychosis continuum is likely to be a universal phenomenon, conceivably with a similar clinical profile across disparate cultural and ethnic groups. However, studies have found PEs to be more prevalent among racial/ethnic minorities both in the UK (Johns *et al.* 2002, 2004; King *et al.* 2005; Morgan *et al.* 2009) and in the USA (Cohen & Marino, 2013), whereas risk for common mental health conditions does not seem to be greater among racial/ethnic minority groups (Kessler *et al.* 1994; Breslau *et al.* 2006). Given this discrepancy, co-occurrence of psychosis and common mental disorders may be less common among minority groups. Generalizability of findings of co-occurrence within and across racial/ethnic groups remains an important and, as yet, unanswered issue of considerable interest.

Aims and hypotheses

The current study used four population-level data sets, including one nationally representative survey and three surveys of distinct racial/ethnic groups, to examine the co-occurrence of mental health conditions and PEs in the general adult population of the USA. The primary hypothesis was that PEs would be highly prevalent across disorders and across surveys, and that the prevalence of these experiences would increase with higher levels of morbidity in a dose–response fashion. A strong dose–response relationship with multi-morbidity (i.e. the number of subtypes of a disorder) in the context of weak relationships with individual disorders would be consistent with the proposition that psychosis may derive from more extensive and severe psychopathology rather than from specific types of disorder (i.e. quantity rather than quality). Although the absolute rate of co-occurrence between PEs and common mental disorders was expected to be lower among racial/ethnic minority groups relative to the nationally representative sample, there was no clear *a priori* evidence or reason to expect that the nature of the relationship between psychosis and common mental disorders would vary across racial/ethnic groups. Despite expected racial/ethnic variation in prevalence rates of PEs, common mental disorders and their co-occurrence, we thus hypothesized a consistent overall pattern of findings across all surveys, in terms of whether PEs were associated primarily with particular diagnostic categories or the overall extent of multi-morbidity.

Method

Participants

The analyses presented here were conducted separately, with four samples drawn from three population-level surveys in the USA. The surveys used similar methodology and sampling design, and collectively comprise the Collaborative Psychiatric Epidemiology Surveys (CPES; Alegría *et al.* 2007*a*). The four samples are drawn from: (1) the National Comorbidity Survey Replication (NCS-R; Kessler *et al.* 2004; Alegría *et al.* 2007*b*), (2) the National Latino and Asian American Study (NLAAS; Alegría *et al.* 2004; Alegría & Takeuchi, 2007) and (3) the National Survey of American Life (NSAL; Jackson *et al.* 2004, 2007). All surveys used multi-stage sampling designs, drawing participants from households in the 48 contiguous states. The NCS-R is a nationally representative survey of 9282 individuals (predominantly Caucasian, reflecting the general population of the USA), of which a random subsample (n=2322) completed the psychosis screen. The NLAAS is a survey of Latino (n=2554)

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

and Asian Americans (n=2095), which was analyzed as two separate samples (divided by ethnicity) for this study. Finally, the NSAL is a nationally representative sample of African-American households (n=3570), with Afro-Caribbean (n=1621) and Caucasian (n=891) respondents drawn from the same source neighborhoods, although Caucasians were not assessed with the psychosis screen. Response rates for the NCS-R, NLAAS Latino sample, NLAAS Asian sample, and NSAL were 70.9, 75.5, 65.6 and 72.3% respectively, which are consistent with other large-scale psychiatric epidemiology studies. Because the focus of this study was subthreshold psychosis, participants were excluded if they had a lifetime psychotic disorder, conservatively defined as a self-reported lifetime diagnosis of schizophrenia or meeting WHO Composite International Diagnostic Interview (WHO-CIDI) criteria for lifetime bipolar disorder (regardless of the presence of psychosis). Participants with missing data for any of the variables of interest, including sociodemographic confounders, were also excluded. Respondents excluded due to missing demographic data (n=28) did not vary significantly from those included on age or prevalence of PEs in any data set, but were more likely to be female in the Latino sample [$\chi^2_{(df=1)}$=4.33, p=0.037]. Following exclusion, the sample sizes and percentages included for each survey were: NCS-R: n=2216 (95.4%); NLAAS Latino: n=2539 (99.4%); NLAAS Asian: n=2077 (99.1%); NSAL: n=4884 (94.1%).

Measures

Demographic variables (age, sex, race/ethnicity, foreign birth, education, employment status, and marital status) were self-reported by respondents. Lifetime PEs were assessed using the WHO-CIDI 3.0 psychosis screen, which included items assessing: (1) visual hallucinations, (2) auditory hallucinations, (3) thought insertion, (4) thought control, (5) telepathy and (6) delusions of persecution. PEs were excluded if the experience took place solely in the context of falling asleep, dreaming, or substance use.

Respondents were assessed for lifetime DSM-IV Axis I disorders using the WHO-CIDI, a widely used and reliable structured interview assessment for diagnosis (Wittchen, 1994; Haro *et al.* 2006). Participants were coded positive for affective disorders if they met criteria for major depressive disorder or dysthymia; for anxiety disorders if they met criteria for generalized anxiety disorder, agoraphobia with and without panic disorder, panic disorder or social phobia; for substance use disorders if they met criteria for abuse or dependence of alcohol or other substances; and individually for PTSD.

Analyses

All analyses were conducted using the complex sample features of SPSS version 21 (SPSS Inc., USA), and confirmed through independent analysis using Stata SE version 13 (Stata Corporation, USA). All statistical estimates were weighted using sampling weights for the corresponding survey to account for individual-level sampling factors including non-response and unequal probabilities of selection. Design-based analyses were used to estimate standard errors that accounted for the complex multistage clustered design of each survey, using the Taylor series linearization method. The analytic plan was conducted independently but following identical procedures for each of the four surveys (NCS-R, NLAAS Latino and Asian samples, NSAL). *Post-hoc* analyses tested for differences between the Afro-Caribbean and African-American subsamples of the NSAL in terms of associations of mental health conditions and PEs; all main results were in the same direction and of similar effect size magnitude. NSAL results are therefore presented as a single set of analyses.

Descriptive data for demographic variables and prevalence of PEs, by diagnosis, are reported across all four samples. Associations between PEs (dependent variable) and each diagnostic group (depressive, anxiety, substance use and PTSD) were tested using logistic regression, first without adjustment as separate bivariate analyses, and then together in a single model, with adjustment for potential demographic confounds (age, sex, foreign birth, marital status, employment status and education). Diagnostic categories were then summed to create a measure of multi-morbidity to test for a dose–response relationship between the number of disorder subtypes and risk for PEs. This was also tested using logistic regression (excluding variables indicating specific diagnoses), with adjustment for potential demographic confounds.

Statistical significance was assessed for all tests using Wald χ^2, with two-tailed α=0.05. Effect sizes were reported as unadjusted (bivariate analyses) or adjusted (multiple logistic regression analyses) odds ratios (ORs) with 95% confidence intervals (CIs).

Results

Descriptive data for all demographic and clinical variables in each data set, which differed primarily in terms of racial/ethnic make-up, are presented in Table 1. PEs and DSM-IV diagnoses are both notably uncommon among the Asian-American sample compared to the others, possibly limiting statistical power in terms of significance testing in further analyses with this group. Prevalence of PEs was numerically

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

Table 1. *Descriptive data for all variables, divided by data set*

Variable	NCS-R (n=2216)	NLAAS (Asians) (n=2077)	NLAAS (Latinos) (n=2539)	NSAL (n=4884)
Continuous				
Mean age (years)	46.45	39.03	38.03	42.46
Categorical				
Sex				
Male	47.9 (1.5)	47.4 (1.1)	51.4 (1.4)	44.3 (0.8)
Female	52.1 (1.5)	52.6 (1.1)	48.6 (1.4)	55.7 (0.8)
Race/ethnicity				
White, non-Latino	73.0 (2.4)	–	–	–
Black, non-Latino	12.4 (1.5)	–	–	100.0 (0.0)
Latino	11.1 (1.7)	–	100.0 (0.0)	–
Asian	1.3 (0.3)	100.0 (0.0)	–	–
Other	2.2 (0.4)	–	–	–
Foreign-born				
Yes	6.8 (1.0)	76.1 (3.1)	57.3 (2.4)	6.8 (0.4)
No	93.2 (1.0)	23.9 (3.1)	42.7 (2.4)	93.2 (0.4)
Marital status				
Married	56.0 (1.6)	68.8 (1.6)	64.2 (1.4)	42.7 (1.0)
Never married	21.3 (1.4)	22.9 (1.2)	21.3 (1.2)	31.5 (1.2)
Previously married	22.7 (1.4)	8.3 (0.9)	14.5 (1.0)	25.8 (0.8)
Education				
High-school graduate or less	51.4 (1.7)	32.0 (2.0)	68.5 (1.5)	60.9 (1.6)
At least some college	48.6 (1.7)	68.0 (2.0)	31.5 (1.5)	39.1 (1.6)
Employment status				
Employed	62.1 (1.5)	64.0 (1.5)	63.2 (1.8)	67.8 (1.1)
Unemployed	6.3 (0.8)	6.2 (0.7)	7.5 (0.9)	10.0 (0.7)
Not in labor force	31.6 (1.4)	29.8 (1.5)	29.3 (2.0)	22.2 (0.9)
Diagnoses (lifetime)[a]				
Depressive disorder	14.6 (1.0)	9.2 (1.0)	14.3 (0.8)	10.8 (0.6)
Anxiety disorder	16.6 (0.9)	8.6 (0.9)	12.9 (0.9)	12.1 (0.6)
PTSD	5.5 (0.5)	1.9 (0.4)	4.5 (0.5)	8.6 (0.5)
Substance use disorder	12.8 (0.7)	3.8 (0.6)	11.1 (1.3)	10.8 (0.7)
None	66.3 (1.3)	83.0 (1.3)	70.7 (1.5)	70.4 (0.9)
Psychotic experiences				
Yes	8.6 (0.9)	6.2 (0.6)	9.6 (0.8)	11.1 (0.7)
No	91.4 (0.9)	93.8 (0.6)	90.4 (0.8)	88.9 (0.7)

NCS-R, National Comorbidity Survey Replication; NLAAS, National Latino and Asian American Study; NSAL, National Survey of American Life; PTSD, post-traumatic stress disorder.

Values for categorical variables given as weighted percentage (standard error).

[a] Diagnoses are not mutually exclusive.

greater in the context of every individual disorder and diagnostic subtype, across all data sets, with the exception of agoraphobia (without panic disorder) among the Asian sample (see online Supplementary Table S1). All remaining analyses used diagnostic subtypes (depressive, anxiety, PTSD, substance) rather than individual disorders. In unadjusted bivariate analyses, lifetime prevalence of PEs was significantly greater among respondents with each subtype of mental health condition (depressive, anxiety and substance use disorders, and PTSD diagnosis) compared to the remainder of the sample, across all four data sets (Table 2).

Relationships were then tested between each diagnostic category and PEs using a fully adjusted model, which controlled for demographic variables and also each remaining subtype of mental disorder. For instance, associations between PEs and depressive disorders controlled for the remaining disorders of anxiety, PTSD and substance use disorders, and so on for each

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

Table 2. *Unadjusted odds for psychotic experiences within each particular diagnostic category*

Diagnosis	Psychotic experiences OR (95% CI)	Statistics	
		$\chi^2_{(df=1)}$	p
NCS-R			
None	0.45 (0.29–0.70)	13.17	<0.001
Depressive	2.32 (1.54–3.47)	17.51	<0.001
Anxiety	2.17 (1.51–3.12)	18.57	<0.001
PTSD	2.51 (1.48–4.27)	12.27	<0.001
Substance	1.95 (1.27–2.99)	9.89	0.002
NLAAS (Asian)			
None	0.44 (0.26–0.75)	9.75	0.002
Depressive	1.77 (0.98–3.22)	3.73	0.053
Anxiety	2.40 (1.49–3.86)	13.82	<0.001
PTSD	3.73 (1.07–13.05)	4.48	0.034
Substance	3.16 (1.65–6.03)	12.81	<0.001
NLAAS (Latino)			
None	0.36 (0.23–0.55)	21.79	<0.001
Depressive	2.15 (1.53–3.02)	20.66	<0.001
Anxiety	1.98 (1.39–2.83)	15.09	<0.001
PTSD	2.84 (1.55–5.20)	11.85	0.001
Substance	2.64 (1.43–4.87)	10.01	0.002
NSAL			
None	0.38 (0.30–0.49)	65.05	<0.001
Depressive	2.47 (1.74–3.52)	26.24	<0.001
Anxiety	2.54 (1.96–3.29)	52.16	<0.001
PTSD	3.09 (2.28–4.19)	54.96	<0.001
Substance	2.02 (1.47–2.79)	54.96	<0.001

NCS-R, National Comorbidity Survey Replication; NLAAS, National Latino and Asian American Study; NSAL, National Survey of American Life; PTSD, post-traumatic stress disorder; OR, odds ratio; CI, confidence interval; df, degrees of freedom.

Each statistical test separately compares respondents with the particular diagnosis to the remainder of the sample, unadjusted for the presence of other clinical diagnoses.

disorder category. In the fully adjusted model, odds for PEs were still greater within each data set and each mental health condition, except for depressive disorders in the NLAAS Asian data set (Table 3). However, the effect sizes were reduced relative to those from the unadjusted analyses and many were no longer statistically significant.

Specifically, adjusted associations were only significant with depressive disorders in the NCS-R, NLAAS Latino and NSAL samples, with anxiety disorders in the NCS-R and NSAL samples, with PTSD in the NSAL sample, and with substance use disorders in the NCS-R, NLAAS Latino and NSAL samples. Sociodemographic associations with PEs also varied across the data sets, with respondents reporting PEs more likely to be female in the NCS-R only, more likely to be never married in the NLAAS Latino only, previously married in the NSAL, and unemployed in the NLAAS Asian and NSAL, and more likely to be out of the labor force in the NSAL but less likely in the NLAAS Asian sample. Mental disorders were common among respondents with PEs, although with notably lower rates of co-occurrence among the ethnic minority samples across disorder categories (except PTSD in the NSAL and substance use among NLAAS Latinos), particularly among Asian-Americans (Table 4). There was a significant linear relationship between the number of mental health conditions and psychosis risk across all four data sets (Table 5).

Discussion

Main findings

There is increasing evidence that subthreshold PEs occur frequently in the general population, particularly among individuals with one or more diagnosable disorders (Johns *et al.* 2004; Scott *et al.* 2007; Varghese *et al.* 2011; Kelleher *et al.* 2012; Saha *et al.* 2012; van Nierop *et al.* 2012; Wigman *et al.* 2012). In these analyses, there were widespread moderate associations with PEs across all types of psychopathology, replicated in four data sets including a nationally representative sample and three samples within specific racial/ethnic groups. These associations were consistently weakened and only variably significant, although still in the predicted direction, when controlling for sociodemographic confounders and, perhaps more importantly, the remaining subtypes of disorder. However, the relationship between the extent of multi-morbidity (i.e. the number of subtypes of diagnosable disorders) was robust to controls for sociodemographic factors, exhibiting a strong linear relationship across all four data sets, suggesting that PEs may specifically be related to the quantity (number of co-occurring disorders) rather than the quality (specific diagnoses) of co-occurring mental health conditions. Although the prevalence of common mental disorders among individuals with PEs was generally lower in the racial/ethnic minority samples, the overall pattern of a linear association with multi-morbidity was consistent across groups, thus suggesting universality in the relationship of prevalence of common mental disorders with PEs within the USA.

Is psychosis risk related to the quality or the degree of psychopathology?

The prevalence of PEs was elevated in the context of every individual diagnosis and diagnostic category

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

Table 3. *Final adjusted model of the association between each diagnostic category and psychotic experiences, within each data set*

	NCS-R	NLAAS (Asian)	NLAAS (Latino)	NSAL
Clinical variables				
None (ref.)	–	–	–	–
Depressive	**1.70 (1.15–2.53)**	0.98 (0.45–2.17)	**1.62 (1.16–2.27)**	**1.71 (1.14–2.56)**
Anxiety	**1.56 (1.08–2.26)**	1.53 (0.77–3.02)	1.35 (0.89–2.05)	**1.76 (1.31–2.36)**
PTSD	1.46 (0.82–2.60)	2.41 (0.55–10.55)	1.77 (0.93–3.38)	**2.15 (1.58–2.93)**
Substance	**1.85 (1.15–2.96)**	1.95 (0.90–4.21)	**2.14 (1.19–3.87)**	**1.44 (1.05–1.98)**
Confounder variables				
Age	0.99 (0.98–1.01)	1.00 (0.98–1.02)	1.01 (1.00–1.02)	1.00 (0.99–1.01)
Sex (ref. male)	**1.84 (1.22–2.78)**	0.82 (0.54–1.26)	1.06 (0.82–1.37)	0.99 (0.78–1.26)
Foreign-born (ref. no)	1.18 (0.66–2.12)	0.73 (0.46–1.16)	0.82 (0.53–1.26)	0.81 (0.54–1.21)
Marital (ref. married)	–	–	–	–
Never married	1.36 (0.78–2.35)	1.50 (0.83–2.70)	**1.84 (1.33–2.55)**	1.21 (0.90–1.64)
Previously married	1.35 (0.77–2.37)	1.57 (0.72–3.44)	1.14 (0.82–1.57)	**1.53 (1.05–2.23)**
Education (ref. no college)	0.80 (0.55–1.16)	1.46 (0.98–2.18)	1.48 (0.91–2.39)	1.03 (0.77–1.39)
Employment (ref. employed)	–	–	–	–
Unemployed	1.15 (0.51–2.59)	**2.61 (1.15–5.88)**	1.09 (0.53–2.23)	**1.47 (1.04–2.06)**
Not in labor force	1.22 (0.79–1.88)	**0.54 (0.33–0.90)**	1.02 (0.70–1.49)	**1.64 (1.18–2.27)**

NCS-R, National Comorbidity Survey Replication; NLAAS, National Latino and Asian American Study; NSAL, National Survey of American Life; PTSD, post-traumatic stress disorder; OR, odds ratio; CI, confidence interval; Ref., reference.

Values presented as OR (95% CI), with each OR adjusted for the remaining clinical conditions and for sociodemographic factors. Significant associations are presented in bold.

Table 4. *Prevalence of disorders among respondents with psychotic experiences*

	NCS–R	NLAAS (Asians)	NLAAS (Latinos)	NSAL
None	48.8 (5.3)	69.7 (5.9)	49.0 (5.6)	50.7 (2.6)
Depressive	26.4 (3.9)	14.6 (3.7)	24.7 (2.6)	20.7 (2.7)
Anxiety	28.4 (3.0)	17.3 (3.7)	21.3 (3.0)	23.2 (1.9)
PTSD	11.5 (2.3)	5.9 (3.1)	10.2 (2.1)	19.4 (2.0)
Substance	21.1 (3.5)	10.0 (2.9)	22.5 (6.0)	18.1 (2.1)

NCS-R, National Comorbidity Survey Replication; NLAAS, National Latino and Asian American Study; NSAL, National Survey of American Life; PTSD, post-traumatic stress disorder.

Values given as percentage (standard error).

examined, across all samples, with a single exception (agoraphobia without panic disorder among Asian-Americans). Several studies have now tested for associations between PEs and specific psychiatric diagnoses, generally finding significantly greater prevalence of PEs among those with the disorder in question compared to those without the disorder, regardless of the disorder (i.e. depressive, anxiety and substance use disorders, and PTSD; Johns *et al.* 2004; Scott *et al.* 2007; Varghese *et al.* 2011; Saha *et al.* 2012; van Nierop *et al.* 2012; Wigman *et al.* 2012). In a recent study by Fisher *et al.* (2013), childhood PEs were prospectively associated with schizophrenia and PTSD in adulthood, but not significantly associated with persistent anxiety or depressive disorders or substance dependence, although nearly all individuals with childhood PEs later met criteria for at least one of these diagnoses.

Overall, therefore, the literature points to widespread associations between PEs and psychopathology in general, with few examples of null associations. Given that the data presented here also demonstrate consistent associations with every disorder subtype (in bivariate analysis), it would be parsimonious to conclude that the odds of PEs are increased in the context of psychopathology in general, rather than in any particular subtype of mental health condition. Such non-specific co-occurrence has similarly been found among people with schizophrenia, a population with an elevated prevalence of co-morbidity across the entire spectrum of mental health conditions (Buckley *et al.* 2009), and among individuals with a family history of schizophrenia, who are similarly at elevated risk for a broad range of psychiatric disorders (Dean *et al.* 2010; DeVylder & Lukens, 2013).

Although psychosis may not be related to the type of co-occurring psychopathology, it may be related to the severity of co-occurring psychopathology, as indicated

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

Table 5. *Logistic regression tests for dose–response relationships between increasing numbers of diagnoses and odds of psychotic experiences (PEs)*

No. of diagnoses	Prevalence of PEs % (S.E.)	Odds of PEs OR (95% CI)	Statistics
NCS-R			$\chi^2_{(df=3)}=39.01$, $p<0.001$
0	6.4 (1.2)	–	–
1	10.4 (1.6)	1.70 (1.01–2.87)	–
2	15.5 (2.1)	2.62 (1.58–4.33)	–
⩾3	25.0 (4.6)	5.04 (2.91–8.73)	–
Linear trend			$\chi^2_{(df=1)}=38.85$, $p<0.001$
NLAAS Asian			$\chi^2_{(df=3)}=8.27$, $p=0.041$
0	5.2 (0.7)	–	–
1	8.7 (2.2)	1.53 (0.76–3.08)	–
2	17.2 (5.1)	2.62 (1.10–6.23)	–
⩾3	16.9 (5.8)	2.46 (0.89–6.86)	–
Linear trend			$\chi^2_{(df=1)}=4.28$, $p=0.039$
NLAAS Latino			$\chi^2_{(df=3)}=32.14$, $p<0.001$
0	6.7 (0.5)	–	–
1	14.9 (2.9)	2.30 (1.36–3.90)	–
2	20.5 (3.8)	3.59 (2.23–5.77)	–
⩾3	18.7 (5.2)	3.09 (1.47–6.47)	–
Linear trend			$\chi^2_{(df=1)}=10.05$, $p=0.002$
NSAL			$\chi^2_{(df=3)}=97.58$, $p<0.001$
0	8.0 (0.5)	–	–
1	15.0 (2.0)	1.93 (1.39–2.66)	–
2	21.6 (2.8)	3.05 (2.10–4.44)	–
⩾3	37.0 (5.7)	6.13 (3.87–9.69)	–
Linear trend		–	$\chi^2_{(df=1)}=64.25$, $p<0.001$

NCS-R, National Comorbidity Survey Replication; NLAAS, National Latino and Asian American Study; NSAL, National Survey of American Life; S.E., standard error; df, degrees of freedom.

All analyses were fully adjusted for all potential sociodemographic confounders.

by the number of co-occurring disorders. Such an explanation is consistent with the linear dose–response relationship identified here across all four data sets, in accordance with past studies showing that odds for PEs increased with more extensive multi-morbidity in adolescents (Kelleher *et al.* 2012, 2013) and with greater severity within a single diagnosis (Saha *et al.* 2012). This finding supports a construct of sub-threshold psychosis as an independent syndrome or dimension of psychopathology, the risk for which is increased with greater co-morbidity but which is not bound to a single disorder. Notably, this association is robust across racial/ethnic groups.

Mechanisms of multi-morbidity

There are numerous potential explanations for the co-occurrence of psychosis with common mental health disorders, none of which could be distinguished based on the presented data but all of which should be explored in future studies. Recent evidence has shown that diagnostically disparate mental health conditions (i.e. schizophrenia, autism, attention-deficit hyperactivity disorder, bipolar disorder and major depressive disorder) share genetic risk loci (Cross-Disorder Group of the Psychiatric Genomics Consortium, 2013), confirming through genetic analysis previous conclusions from research with twins (Kendler *et al.* 2003) and in family history studies with population-level samples (Dean *et al.* 2010; DeVylder & Lukens, 2013). As such, inherited genes may exert pleiotropic effects such that a common set of 'risk' genes may lead to different and seemingly disparate phenotypic expressions (Weiser *et al.* 2005), which may then be more or less consistent with particular diagnostic criteria.

Psychosis and common mental health conditions also share environmental risk factors. For example, childhood trauma may lead to PTSD (e.g. Cloitre *et al.* 2009), but is also more prevalent among people

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

with depressive and anxiety disorders (Douglas *et al.* 2010; Hovens *et al.* 2010) and substance abuse disorders (Wilsnack *et al.* 1997; Medrano *et al.* 1999; Ducci *et al.* 2009; Douglas *et al.* 2010), and notably among people with PEs (Galletly *et al.* 2011; Mackie *et al.* 2011; Soosay *et al.* 2012). Similar non-specific associations are found with social support, employment status, socio-economic status and other known risk factors for PEs (Linscott & van Os, 2013). Psychosis and common mental disorders also share putative neural substrates, including dysfunction in the hippocampus, hypothalamic–pituitary–adrenal axis, prefrontal cortex or dopaminergic system, which may mediate the relationship between genetic and environmental risk factors and symptom presentation.

Although it is parsimonious to assume that multimorbidity is caused by shared risk factors, it is possible that it is caused by shared risk factors in addition to interactive effects between diagnoses (or dimensions of symptoms). A pilot analysis of the temporal order of diagnoses and PEs in this sample, based on retrospective estimates of age of onset, did not seem to be reliable or consistent across data sets (data not shown), leaving this an open question that would be better answered using prospective cohort data.

Psychosis and common disorders across racial/ethnic groups

The four data sets examined in this study were drawn from the same source country using similar methods, with race/ethnicity as the primary factor distinguishing the samples. No single prior study has attempted to replicate findings with PEs across racial/ethnic groups. In this analysis, prevalence rates of PEs were higher among the racial/ethnic minority samples (except for Asian-Americans) but lower for common mental disorders, in concurrence with prior research (Kessler *et al.* 1994; Johns *et al.* 2002, 2004; King *et al.* 2005; Breslau *et al.* 2006; Morgan *et al.* 2009; Cohen & Marino, 2013). However, findings regarding the relationship between common disorders and psychosis were consistent across data sets, particularly in that PEs were associated with (1) all classes of psychopathology in bivariate analyses and (2) multi-morbidity in a linear dose–response fashion, across all four samples. Our findings thus argue for the universality of the relationship between multi-morbidity of common mental disorders and the prevalence of PEs, at least across racial/ethnic groups in the USA.

Strengths, limitations and conclusions

The primary strength of this study is the use of four large general population data sets with varying racial/ethnic composition, allowing multiple replications and cross-cultural validation within a single study. Furthermore, diagnoses and the presence of PEs were determined using the WHO-CIDI, widely considered a valid measure for use in general population survey samples. However, despite validation with clinical interviews (Haro *et al.* 2006), which themselves may be fallible, the assessment of psychiatric diagnoses and psychosis using lay-interviews may be subject to misclassification. Epidemiologists have argued intermittently for the use of psychometric or dimensional measures of psychopathology rather than categorical diagnoses (e.g. Dohrenwend, 1990), which may produce more valid measures when administered by lay-interviewers, and indeed would have been consistent with the assumption, inherent in studying subthreshold psychosis, that psychopathology is continuously distributed in the population. Controversy over the validity of single diagnoses in lay-administered surveys is offset by the use of subgroups of disorders rather than individual diagnoses. However, lifetime diagnoses may be nonetheless underestimated because of extensive recall periods (Takayanagi *et al.* 2014), but were chosen over 12-month diagnoses to increase statistical power for looking at rare constructs (i.e. PEs and multi-morbidity of several diagnoses), consistent with prior studies of multi-morbidity and psychosis (Kelleher *et al.* 2012, 2013) and studies of multimorbidity in these data (e.g. Ruscio *et al.* 2010). Conversely, lifetime measures are limiting in that they allow examination of co-occurrence within individuals but not necessarily within overlapping time periods for those individuals. The use of clinical samples with greater prevalence of both PEs and disorders (relative to the general population) may provide sufficient statistical power to examine co-occurrence of psychosis and multi-morbidity within a specified time-frame (e.g. 12-month prevalence). Future studies should therefore replicate general population findings in clinical samples to improve temporal resolution and understand the significance of co-occurrence among help-seeking individuals. A further potential limitation is that PTSD and anxiety disorders are separated based on DSM-5 guidelines, although the diagnoses in the surveys used DSM-IV criteria. However, separating PTSD and anxiety disorders seemed necessary because of prior evidence that PTSD may be particularly closely related to PEs (Fisher *et al.* 2013). Overall, concerns over measurement are partially allayed by the study design, which allowed up to four replications of any significant findings; measurement limitations, which would generally introduce random error, are unlikely to sufficiently explain several replications of a statistical association.

Survey response rates were in the typical range for national surveys, notably lowest in the NLAAS Asian data set (65.6%) and highest in the NLAAS Latino

https://doi.org/10.1017/S0033291714000944 Published online by Cambridge University Press

data set (75.5%). Higher rates of psychopathology have been found among survey non-responders (Kessler *et al.* 1994), which would potentially lead to underestimation of prevalence rates of psychiatric diagnoses and PEs proportionate to the response rate, although response rates may have less of an effect on prevalence rates than previously assumed and typically do not notably influence the relative associations between clinical variables (Galea & Tracy, 2007).

Finally, PE prevalence rates could not be compared statistically across racial/ethnic groups because of the use of separate data sets. Specifically, because the psychosis screen was given to a random subsample of the NCS-R, to the entire sample of the NLAAS and systematically only to non-white respondents in the NSAL, comparisons between data sets and between racial/ethnic groups using the combined data set (CPES) would be improperly weighted and therefore of questionable validity (DeVylder, 2014). Despite this limitation, our prevalence rates are consistent with previous reports using the combined CPES data set showing significant racial/ethnic prevalence differences (Cohen & Marino, 2013, 2014).

Given the replication of findings across four large data sets, this study provides strong evidence that PEs are associated with multi-morbidity of common mental health conditions, both in the general population of the USA and within specific racial/ethnic categories. Further prospective research would be useful in disentangling the causal relationship between PEs and co-occurring disorders.

Supplementary material

For supplementary material accompanying this paper, please visit http://dx.doi.org/10.1017/S0033291714000944.

Acknowledgments

We thank F. Chen, B. Link and E. Lukens for helpful comments on an earlier version of this manuscript, and H. Oh for independent verification of statistical analyses. We also thank the investigators responsible for the CPES for making their data publicly available to the research community.

Declaration of Interest

None.

References

Alegría M, Jackson JS, Kessler RC, Takeuchi D (2007*a*). *Collaborative Psychiatric Epidemiology Surveys (CPES), 2001–2003 [United States] ICPSR20240-v5*. Inter-university Consortium for Political and Social Research: Ann Arbor, MI.

Alegría M, Jackson JS, Kessler RC, Takeuchi D (2007*b*). National Comorbidity Survey Replication (NCS-R). In *Collaborative Psychiatric Epidemiology Surveys (CPES), 2001–2003 [United States]. ICPSR20240-v5*. Inter-university Consortium for Political and Social Research: Ann Arbor, MI.

Alegría M, Takeuchi D (2007). National Latino and Asian American Study (NLAAS). In *Collaborative Psychiatric Epidemiology Surveys (CPES), 2001–2003 [United States] ICPSR20240-v5* (PIs: M. Alegría, J. S. Jackson, R. C. Kessler and D. Takeuchi). Inter-university Consortium for Political and Social Research: Ann Arbor, MI.

Alegría M, Takeuchi D, Canino G, Duan N, Shrout P, Meng XL, Vega W, Zane N, Vila D, Woo M, Vera M, Guarnaccia P, Aguilar-Gaxiola S, Sue S, Excobar J, Lin KM, Gong F (2004). Considering context, place and culture: the National Latino and Asian American Study. *International Journal of Methods in Psychiatric Research* **13**, 208–220.

APA (2013). *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. DSM-5*. American Psychiatric Publishing: Arlington, VA.

Breslau J, Aguilar-Gaxiola S, Kendler KS, Su M, Williams D, Kessler KC (2006). Specifying race-ethnic differences in risk for psychiatric disorder in a USA national sample. *Psychological Medicine* **36**, 57–68.

Buckley PF, Miller BJ, Lehrer DS, Castle DJ (2009). Psychiatric comorbidities and schizophrenia. *Schizophrenia Bulletin* **35**, 383–402.

Cloitre M, Stolbach BC, Herman JL, Kolk BVD, Pynoos R, Wang J, Petkova E (2009). A developmental approach to complex PTSD: childhood and adult cumulative trauma as predictors of symptom complexity. *Journal of Traumatic Stress* **22**, 399–408.

Cohen CI, Marino L (2013). Racial and ethnic differences in the prevalence of psychotic symptoms in the general population. *Psychiatric Services* **64**, 1103–1109.

Cohen CI, Marino L (2014). Prevalence of psychotic symptoms: in reply. *Psychiatric Services* **65**, 270–271.

Cross-Disorder Group of the Psychiatric Genomics Consortium (2013). Genetic relationship between five psychiatric disorders estimated from genome-wide SNPs. *Nature Genetics* **45**, 984–994.

Dean K, Stevens H, Mortensen PB, Murray RM, Walsh E, Pedersen CB (2010). Full spectrum of psychiatric outcomes among offspring with parental history of mental disorder. *Archives of General Psychiatry* **67**, 822–829.

Degenhardt L, Hall W (2001). The association between psychosis and problematical drug use among Australian adults: findings from the National Survey of Mental Health and Well-Being. *Psychological Medicine* **31**, 659–668.

DeVylder JE (2014). Prevalence of psychotic symptoms. *Psychiatric Services* **65**, 270.

DeVylder JE, Lukens EP (2013). Family history of schizophrenia as a risk factor for axis I psychiatric conditions. *Journal of Psychiatric Research* **47**, 181–187.

Dohrenwend BP (1990). The problem of validity in field studies of psychological disorders revisited. *Psychological Medicine* **20**, 195–208.

Douglas KR, Chan G, Gelernter J, Arias AJ, Anton RF, Weiss RD, Brady K, Poling J, Farrer L, Kranzler HR (2010). Adverse childhood events as risk factors for substance dependence: partial mediation by mood and anxiety disorders. *Addictive Behaviors* **35**, 7–13.

Ducci F, Roy A, Shen PH, Yuan Q, Yuan NP, Hodgkinson CA, Goldman LR, Goldman D (2009). Association of substance use disorders with childhood trauma but not African genetic heritage in an African American cohort. *American Journal of Psychiatry* **166**, 1031–1040.

Fisher HL, Caspi A, Poulton R, Meier MH, Houts R, Harrington H, Arseneault L, Moffitt TE (2013). Specificity of childhood psychotic symptoms for predicting schizophrenia by 38 years of age: a birth cohort study. *Psychological Medicine* **43**, 2077–2086.

Galea S, Tracy M (2007). Participation rates in epidemiologic studies. *Annals of Epidemiology* **17**, 643–653.

Galletly C, Van Hooff M, McFarlane A (2011). Psychotic symptoms in young adults exposed to childhood trauma – a 20 year follow-up study. *Schizophrenia Research* **127**, 76–82.

Haro JM, Arbabzadeh-Bouchez S, Brugha TS, De Girolamo G, Guyer ME, Jin R, Lepine JP, Mazzi F, Reneses B, Vilagut G, Sampson NA, Kessler RC (2006). Concordance of the Composite International Diagnostic Interview Version 3.0 (CIDI 3.0) with standardized clinical assessments in the WHO World Mental Health surveys. *International Journal of Methods in Psychiatric Research* **15**, 167–180.

Hovens JGFM, Wiersma JE, Giltay EJ, Van Oppen P, Spinhoven P, Penninx BWJH, Zitman FG (2010). Childhood life events and childhood trauma in adult patients with depressive, anxiety and comorbid disorders vs. controls. *Acta Psychiatrica Scandinavica*, **122**, 66–74.

Jackson JS, Caldwell CH, Chatters LM, Neighbors HW, Nesse R, Taylor RJ, Trierweiler SJ, Williams DR (2007). National Survey of American Life (NSAL). In *Collaborative Psychiatric Epidemiology Surveys* (*CPES*), *2001–2003 [United States] ICPSR20240-v5* (PIs: M. Alegría, J. S. Jackson, R. C. Kessler and D. Takeuchi). Inter-university Consortium for Political and Social Research: Ann Arbor, MI.

Jackson JS, Torres M, Caldwell CH, Neighbors HW, Nesse RM, Taylor RJ, Trierweiler SJ, Williams DR (2004). The National Survey of American Life: a study of racial, ethnic and cultural influences on mental disorders and mental health. *International Journal of Methods in Psychiatric Research* **13**, 196–207.

Johns LC, Cannon M, Singleton N, Murray RM, Farrell M, Brugha T, Bebbington P, Jenkins R, Meltzer H (2004). Prevalence and correlates of self-reported psychotic symptoms in the British population. *British Journal of Psychiatry* **185**, 298–305.

Johns LC, Nazroo JY, Bebbington P, Kuipers E (2002). Occurrence of hallucinatory experiences in a community sample and ethnic variations. *British Journal of Psychiatry* **180**, 174–178.

Kelleher I, Devlin N, Wigman JT, Kehoe A, Murtagh A, Fitzpatrick C, Cannon M. (2013). Psychotic experiences in a mental health clinic sample: implications for suicidality, multimorbidity and functioning. *Psychological Medicine*. Published online: 12 September 2013. doi: 10.1017. S0033291713002122.

Kelleher I, Harley M, Lynch F, Arseneault L, Fitzpatrick C, Cannon M (2008). Associations between childhood trauma, bullying and psychotic symptoms among a school-based adolescent sample. *British Journal of Psychiatry* **193**, 378–382.

Kelleher I, Keeley H, Corcoran P, Lynch F, Fitzpatrick C, Devlin N, Molloy C, Roddy S, Clarke MC, Harley M, Arseneault L, Wasserman C, Carli V, Sarchiapone M, Hoven C, Wasserman D, Cannon M (2012). Clinicopathological significance of psychotic experiences in non-psychotic young people: evidence from four population-based studies. *British Journal of Psychiatry* **201**, 26–32.

Kendler KS, Prescott CA, Myers J, Neale MC (2003). The structure of genetic and environmental risk factors for common psychiatric and substance use disorders in men and women. *Archives of General Psychiatry* **60**, 929–937.

Kessler RC, Berglund P, Chiu WT, Demler O, Heeringa S, Hiripi E, Jin R, Pennell BE, Walters EE, Zaslavsky A, Zheng H (2004). The US National Comorbidity Survey Replication (NCS-R): design and field procedures. *International Journal of Methods in Psychiatric Research* **13**, 69–92.

Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, Wittchen H-U, Kendler KS (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey. *Archives of General Psychiatry* **51**, 8–19.

King M, Nazroo J, Weich S, McKenzie K, Bhui K, Karlsen S, Stansfeld S, Tyrer P, Blanchard M, Lloyd K, McManus S, Sproston K, Erens B (2005). Psychotic symptoms in the general population of England. *Social Psychiatry and Psychiatric Epidemiology* **40**, 375–381.

Lataster T, van Os J, Drukker M, Henquet C, Feron F, Gunther N, Myin-Germeys I (2006). Childhood victimisation and developmental expression of non-clinical delusional ideation and hallucinatory experiences. *Social Psychiatry and Psychiatric Epidemiology* **41**, 423–428.

Linscott RJ, van Os J (2013). An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: on the pathway from proneness to persistence to dimensional expression across mental disorders. *Psychological Medicine* **43**, 1133–1149.

Mackie CJ, Castellanos-Ryan N, Conrod PJ (2011). Developmental trajectories of psychotic-like experiences across adolescence: impact of victimization and substance use. *Psychological Medicine* **41**, 47–58.

Medrano MA, Zule WA, Hatch J, Desmond DP (1999). Prevalence of childhood trauma in a community sample of substance-abusing women. *American Journal of Drug and Alcohol Abuse* **25**, 449–462.

Morgan C, Fisher H, Hutchinson G, Kirkbride J, Craig TK, Morgan K, Dazzan P, Boydell J, Doody GA, Jones PB,

Murray RM, Leff J, Fearon P (2009). Ethnicity, social disadvantage and psychotic-like experiences in a healthy population based sample. *Acta Psychiatrica Scandinavica* **119**, 226–235.

Nuevo R, Chatterji S, Verdes E, Naidoo N, Arango C, Ayuso-Mateos JL (2012). The continuum of psychotic symptoms in the general population: a cross-national study. *Schizophrenia Bulletin* **38**, 475–485.

Rössler W, Riecher-Rössler A, Angst J, Murray R, Gamma A, Eich D, van Os J, Gross VA (2007). Psychotic experiences in the general population: a twenty-year prospective community study. *Schizophrenia Research* **92**, 1–14.

Ruscio AM, Stein DJ, Chiu WT, Kessler RC (2010). The epidemiology of obsessive-compulsive disorder in the National Comorbidity Survey Replication. *Molecular Psychiatry* **15**, 53–63.

Saha S, Scott J, Varghese D, McGrath J (2012). Anxiety and depressive disorders are associated with delusional-like experiences: a replication study based on a National Survey of Mental Health and Wellbeing. *BMJ Open* **2**, e001001.

Scott J, Chant D, Andrews G, Martin G, McGrath J (2007). Association between trauma exposure and delusional experiences in a large community-based sample. *British Journal of Psychiatry* **190**, 339–343.

Soosay I, Silove D, Bateman-Steel C, Steel Z, Bebbington P, Jones PB, Chey T, Ivancic L, Marnane C (2012). Trauma exposure, PTSD and psychotic-like symptoms in post-conflict Timor Leste: an epidemiological survey. *BMC Psychiatry* **12**, 229.

Takayanagi Y, Spira AP, Roth KB, Gallo JJ, Eaton WW, Mojtabai R (2014). Accuracy of reports of lifetime mental and physical disorders: results from the Baltimore Epidemiology Catchment Area Study. *Journal of the American Medical Association. Psychiatry* **71**, 273–280.

Tandon R, Keshavan MS, Nasrallah HA (2008). Schizophrenia, 'just the facts' what we know in 2008. 2. Epidemiology and etiology. *Schizophrenia Research* **102**, 1–18.

van Nierop M, van Os J, Gunther N, Myin-Germeys I, de Graaf R, ten Have M, van Dorsselaer S, Bak M, van Winkel R (2012). Phenotypically continuous with clinical psychosis, discontinuous in need for care: evidence for an extended psychosis phenotype. *Schizophrenia Bulletin* **38**, 231–238.

Varghese D, Scott J, Welham J, Bor W, Najman J, O'Callaghan M, Williams G, McGrath J (2011). Psychotic-like experiences in major depression and anxiety disorders: a population-based survey in young adults. *Schizophrenia Bulletin* **37**, 389–393.

Weiser M, van Os J, Davidson M (2005). Time for a shift in focus in schizophrenia: from narrow phenotypes to broad endophenotypes. *British Journal of Psychiatry* **187**, 203–205.

Wigman JT, van Nierop M, Vollebergh WA, Lieb R, Beesdo-Baum K, Wittchen HU, van Os J (2012). Evidence that psychotic symptoms are prevalent in disorders of anxiety and depression, impacting on illness onset, risk, and severity – implications for diagnosis and ultra-high risk research. *Schizophrenia Bulletin* **38**, 247–257.

Wilsnack SC, Vogeltanz ND, Klassen AD, Harris TR (1997). Childhood sexual abuse and women's substance abuse: national survey findings. *Journal of Studies on Alcohol and Drugs* **58**, 264–271.

Wittchen HU (1994). Reliability and validity studies of the WHO-Composite International Diagnostic Interview (CIDI): a critical review. *Journal of Psychiatric Research* **28**, 57–84.