Acculturative stress and psychotic-like experiences among Asian and Latino immigrants to the United States

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ABSTRACT

Previous studies have shown variation in the prevalence and incidence of psychosis across immigrant groups, but the underlying mechanisms are not fully understood. Stress related to acculturation may increase risk for psychosis among immigrant groups. In this study we examine the association between acculturative stress and psychotic-like experiences in a sample of Latino- and Asian-American immigrants to the United States in the National Latino and Asian American Study (n = 2434). Acculturative stress was associated with visual and auditory hallucinations among Asians, but only with hearing voices among Latinos. Increased risk for psychotic-like experiences among Latinos was primarily associated with younger age of immigration. Acculturative stress appears to be a promising candidate mechanism explaining the relationship between immigration and psychosis, particularly among Asian Americans. Ethnic differences may reflect variability between groups that integrate more readily into the host culture and those that are subject to greater discrimination and environmental adversity.

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1. Introduction

The association between immigration and psychosis has been firmly established through more than twenty international studies and two meta-analyses, with an estimated relative risk of 2.1 to 2.7 for first-generation immigrants relative to native-born populations (Cantor-Graae and Selten, 2005; Bourque et al., 2011). This appears to be driven by social factors rather than selective migration of people who have greater genetic risk (Selten et al., 2007). In this paper, we examine the association between acculturative stress and psychotic experiences in two first-generation immigrant groups.

1.1. Social determinants of psychosis among immigrants

Increased risk for psychosis among immigrants and ethnic minorities is associated with social adversity, perceived discrimination, and ethnic density within the host country (Morgan et al., 2010). Social adversity mediated differences in psychosis risk by ethnicity and immigration status in several case–control studies, whether defined as childhood separation from parents (Morgan et al., 2007) or cumulative social disadvantage across multiple domains, including education, employment, living environment, and social networks (Mallett et al., 2002; Hjern et al., 2004; Morgan et al., 2008a,b; Vanheusden et al., 2008). Ethnic minorities are also at increased risk for psychosis if exposed to racial attacks or employer racism (Karlsen and Nazroo, 2002) or societal-level discrimination (Veling et al., 2007), although not across all ethnic groups (Veling et al., 2008a). This is consistent with the ethnic density effect in immigrants, in which incidence of psychosis among immigrants declines when that particular immigrant group composes a larger segment of the host population (Boydell et al., 2001; Das-Munshi et al., 2012; Kirkbride et al., 2007; Schofield et al., 2011; Veling et al., 2008b). Given that the reviewed social determinants all constitute exposures that occur in the host country, younger age at immigration should be associated with greater duration of exposure and, consequently, increased risk for psychosis. This has been shown among non-western immigrants to The Netherlands, but not among western immigrants, who may be of higher SES and may assimilate more readily into the host culture (Veling et al., 2011).

1.2. Acculturative stress

Acculturation, an individual's cultural learning process that occurs while adapting to an alien culture (Rudmin, 2009), may contribute to risk for psychiatric problems as the individual struggles to integrate the values, behaviors, and social norms associated with the host culture

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while simultaneously maintaining the culture of origin (Berry, 1997). Acculturative stress refers to the tension or strain associated with the acquisition of a second-culture that may result in adverse physical or mental health effects (Rudmin, 2009). Acculturative stress has only minimally been studied in people with psychosis, with one case–control study finding that acculturation was correlated with global function, but not symptom severity, among immigrants with psychosis in Greece (Gonidakis et al., 2011).

1.3. Psychotic-like experiences

The psychosis phenotype has been conceptualized as a continuum, wherein symptoms occur across the population at both clinical and subclinical levels, varying in severity but sharing risk factors (van OS et al., 2009). Psychotic-like experiences (PLE) are associated with increased risk of later developing psychotic and, to a lesser extent, non-psychotic disorders (Werbeloff et al., 2012). PLE are considerably more prevalent than threshold psychotic disorders, and can be reliably assessed in general population studies (Kessler et al., 2005). As such, they provide a useful construct for assessing risk factors for psychosis using lay-administered population-level data sets. Immigration has been associated with increased risk for PLE (Linscott and van Os, 2010), specifically hallucinations (Vanheusden et al., 2008) and delusions (Janssen et al., 2003). To our knowledge, acculturative stress has not been studied with respect to PLE in a population-level sample.

1.4. Aims and hypotheses

This study examines the relationship between acculturative stress and PLE in a sample of first-generation Latino- and Asian-American immigrants in the United States (U.S.). Prior evidence suggests that social factors mediate the association between immigration and psychosis-risk, with acculturative stress as a promising yet under-studied candidate mechanism. We predicted that acculturative stress would be associated with greater risk for lifetime PLE and for specific symptoms (hallucinations and delusions) among Latino and Asian immigrants to the U.S., controlling for demographics and age of immigration.

2. Method

2.1. Participants

Data were drawn from the National Latino and Asian American Study (NLAAS; collected May 2002–November 2003), a national area probability sample of non-institutionalized adults (n = 4649) of Latino and Asian origin (Heeringa et al., 2004; Alegria et al., 2006). The NLAAS used a multi-stage probability design to draw samples of housing units and household members from primary sampling units (metropolitan statistical areas and county units) and secondary units (contiguous groupings of census blocks) with probability proportionate to size, with oversampling of census blocks with greater than 5% density of target ancestry groups. Secondary respondents were recruited from households that had one eligible member who already completed the interview.

Respondents were excluded if they were 65 years of age or older (n = 207) to rule out aging-related medical or neurological causes of PLE, consistent with prior studies (van Os et al., 2009). Participants were also excluded if they were not first-generation immigrants (n = 1996), or had missing data (n = 12). The final sample included 2434 participants, who significantly differed from those excluded in several ways: they were younger, 37.3 (SE = 0.4) versus 40.5 (SE = 0.8) years, $t_{(4647)} = 4.38$, $p < 0.001$, more likely to be Asian, 30.3% (SE = 2.3) versus 22.8% (SE = 2.3), $\chi^2_{(df = 1)} = 10.1$, $p = 0.001$, with lower prevalence of PLE, 10.7% (SE = 1.0) versus 7.0% (SE = 0.8), $\chi^2_{(df = 1)} = 6.7$, $p = 0.01$.

2.2. Measures

Lay interviewers were bilingual and trained to administer the survey through computer-assisted interviewing software. Interviews were conducted in-person unless a phone interview was requested or face-to-face interview was not possible. Instruments were available in English, Spanish, Mandarin, Cantonese, Tagalog, and Vietnamese. NLAAS data collection methods were previously described in greater detail (Alegria et al., 2006).

Demographic variables (age, sex, ethnicity, education, income, age at immigration, years in U.S.) were self-reported by respondents. Ethnicity was coded as eight nationalities from Latin American and Asian countries, which were consolidated into two yes/no ethnicity variables (Latino and Asian; Table 1) due to the low frequency of PLE among each nationality.

Lifetime prevalence of PLE was assessed using the WHO-CIDI 3.0 psychosis screen (Kessler and Üstün, 2004), previously used with Latino (Lewis-Fernández et al., 2009) and, to a lesser extent, Asian samples (Kessler et al., 2005) in the U.S., and internationally in more than 50 countries (Nuevo et al., 2012). Symptoms included visual hallucinations, hearing voices, and four variables that were collectively recoded as delusions (any present versus all absent) given their low frequency in this sample: 1) mind control experience, 2) mind taken over by strange forces, 3) communication attempts from strange forces, and 4) unjust plot to harm you that no one else believed. No results were significantly changed in a sensitivity analyses in which each delusion symptom was examined separately. Responses were not considered PLE if they occurred in the context of falling asleep, dreaming, or substance use.

Participants responded to nine dichotomous acculturative stress items, which were summed into a total score. These items were developed to assess the experiences of Latinos (Guarnaccia et al., 2007) but have also been used with Asians (Lueck and Wilson, 2010, 2011). The use of items specific to acculturation-related stress exposures alleviates some problems of prior acculturative stress measures, which overlapped conceptually with general psychological distress and depression (Rudmin, 2009). The reliability of the scale is adequate (Hair et al., 2009), Cronbach's alpha = 0.66, although greater in Latinos (alpha = 0.69) than in Asians (alpha = 0.59).

2.3. Analyses

All analyses were conducted using the complex sample features of SPSS version 20 (IBM Corp., 2012). Statistical estimates were weighted to account for individual-level sampling factors including non-response and unequal probabilities of selection, as well as post-stratification, to ensure that the sample was representative based on the 2001 census estimates. Separate sample weights specific to Asian and Latino subsamples were used. Design-based analyses were used to estimate standard errors that accounted for the complex multistage clustered design of the NLAAS sample. Demographic variables, acculturative stress items,

Table 1
Nation of origin for Latino and Asian respondents.

	Unweighted n (%)	Weighted % (SE)
Asian (total)	1226 (50.4)	30.3 (2.3)
Vietnamese	347 (14.3)	4.6 (0.8)
Chinese	337 (13.8)	8.6 (1.1)
Filipino	288 (11.8)	6.4 (0.9)
Other	315 (10.4)	10.7 (1.3)
Latino (total)	1208 (49.6)	69.7 (2.3)
Mexican	394 (16.2)	39.6 (3.9)
Cuban	315 (12.9)	3.6 (0.4)
Puerto Rican	140 (5.8)	4.3 (0.5)
Other	359 (14.7)	22.2 (2.1)

Note: All analyses utilized weighted estimates of the total Latino and Asian groups.

and PLE were compared between ethnic groups using the Wald chi-square tests.

We used logistic regression models to examine the associations between acculturative stress and PLE, adjusted for demographic variables and stratified by ethnicity. Acculturative stress was recorded as a categorical variable to facilitate calculation of adjusted odds ratios and to eliminate problems related to the non-normal (positively skewed) distribution of acculturative stress scores. Adjusted odds ratios were calculated for all predictors. Acculturative stress was tested for dose–response relationships using the χ^2 analysis of linear trends. Associations were considered significant at two-tailed alpha = 0.05.

3. Results

3.1. Demographics and clinical variables

Compared to Latino respondents, Asian respondents were older, predominantly female, of higher income and education, and older at time of immigration (Table 2). Approximately 7% of the sample reported PLE over the course of their lifetime, which primarily consisted of visual or auditory hallucinations (Table 3).

3.2. Acculturative stress

The most commonly endorsed items for both Asians and Latinos pertained to limitations in contact with family and friends and difficulty with interaction due to language barriers, whereas few experienced stress related to fear of deportation or the involvement of government immigration agencies, particularly among Asian-Americans (Table 3). Acculturative stress total score was greater among Latinos than among Asians (2.6 (SD = 0.1) versus 1.8 (SD = 1.1), $f_{(1,69)}$ = 40.1, p < .001).

3.3. Logistic regression analyses

When examining the Asian group, acculturative stress was significantly associated with the presence of any PLE, as well as visual hallucinations and hearing voices specifically, in a significant dose–response fashion, such that risk for PLE increased linearly with an increasing

Table 2
Demographics of the sample.

	Asian n = 1226	Latino n = 1208	Wald χ^2, p
Age			24.8, <0.001
18–29	23.2 (1.8)	31.0 (1.4)	12.7, <0.001
30–39	29.0 (1.8)	33.3 (1.7)	3.0, 0.081
40–49	25.4 (1.9)	20.0 (1.5)	4.3, 0.039
50–64	22.4 (1.8)	15.7 (1.1)	13.0, <0.001
Sex			7.3, 0.007
Male	46.8 (1.7)	54.3 (2.1)	–
Female	53.2 (1.7)	45.7 (2.1)	–
Income			113.7, <0.001
<26,000	16.7 (1.6)	44.0 (2.7)	88.8, <0.001
26,000–64,999	31.5 (2.2)	37.4 (1.9)	4.1, 0.043
>65,000	48.1 (2.4)	16.4 (1.8)	86.8, <0.001
Education			184.1, <0.001
<12 years	14.7 (1.7)	53.3 (2.0)	181.5, <0.001
12 years	15.9 (1.4)	21.0 (1.4)	6.5, 0.011
13–15 years	24.5 (2.0)	16.6 (1.6)	11.7, 0.001
>16 years	44.9 (2.5)	9.1 (1.3)	117.3, <0.001
Age at immigration			48.4, <0.001
<12 years	15.9 (2.1)	20.3 (1.5)	2.2, 0.138
13–17 years	7.4 (0.9)	20.3 (1.5)	48.0, <0.001
18–64 years	76.7 (2.4)	59.4 (2.1)	19.9, <0.001
Years in United States			0.6, 0.724
<10 years	35.7 (2.9)	34.4 (2.7)	0.1, 0.763
11–20 years	34.7 (1.9)	33.8 (1.9)	0.1, 0.745
>20 years	29.6 (2.2)	31.7 (1.7)	0.5, 0.488

Note: Values indicate % (SE).

Table 3
Frequency of endorsement of acculturative stress items and psychotic-like experiences.

	Asian	Latino	Wald χ^2, p
Acculturative stress items			
Limited contact with family and friends	37.2 (2.5)	50.0 (2.4)	11.3, 0.001
Interaction hard due to difficulty with English language	30.7 (2.4)	43.9 (1.9)	21.8, <0.001
Difficult to find work due to Latino/Asian descent	24.7 (1.8)	32.6 (1.8)	10.9, 0.001
Do not have the same respect in US as in country of origin	23.6 (1.7)	31.3 (1.2)	12.6, <0.001
Questioned about legal status	19.2 (1.8)	32.5 (2.0)	25.3, <0.001
Treated badly due to poor/accented English	26.7 (2.0)	23.5 (1.7)	1.7, 0.199
Felt guilty about leaving family/friends in country of origin	18.8 (1.4)	17.3 (1.1)	0.8, 0.373
Think might be deported if go to social/ government agency	1.9 (0.7)	19.0 (2.1)	36.7, <0.001
Avoid health service due to INS	0.6 (0.3)	12.1 (1.4)	26.8, <0.001
Psychotic-like experiences			
Any psychotic-like experience	5.3 (0.8)	7.7 (1.1)	3.4, 0.064
Visual hallucinations	3.7 (0.8)	5.4 (0.8)	1.8, 0.175
Hearing voices	2.5 (0.6)	4.0 (0.6)	3.4, 0.065
Delusions	0.9 (0.3)	1.7 (0.6)	1.7, 0.194

Note: Values represent % (SE) endorsing each item. The number (%) of respondents endorsing 0, 1, 2, and 3+ acculturative stress items was 322 (26.3), 326 (26.6), 198 (16.2), and 380 (31.0) among Asians, respectively, and 233 (19.3), 264 (21.9), 217 (18.0), and 494 (40.9) among Latinos.

number of endorsed acculturative stress items (Table 4). Associations with either class of hallucinations were not meaningfully changed when excluding individuals endorsing both subtypes. Acculturative stress was not associated with delusions. Among the Latino group, acculturative stress was associated with hearing voices, again in a significant linear dose–response fashion, but not with any other subtype of PLE (Table 5). However, there appeared to be a close relationship between age of immigration and PLE among Latinos, with childhood immigration (prior to age 12) significantly associated with the presence of any PLE and visual and auditory hallucinations, specifically.

Logistic regression models were also tested with the exclusion of age, age at immigration, and years in U.S. variables, to ensure that results were not influenced by potential collinearity among these predictors. No results were meaningfully changed.

4. Discussion

4.1. Main findings

To our knowledge, this is the first study to examine risk for psychosis among Asian and Latino immigrants to the U.S., and the first study to report an association between acculturative stress and PLE among a national community sample of first-generation immigrants. Asian respondents who endorsed increasing numbers of acculturative stress items were at progressively greater risk for PLE (particularly visual and auditory hallucinations, but not delusions) in a dose–response fashion. In contrast, acculturative stress was only related to risk for hearing voices among Latinos, even though Latinos experienced significantly greater acculturative stress and prevalence of PLE. Varying findings for visual hallucinations may reflect cross-cultural differences in the relationship between acculturative stress and PLE, or may indicate phenomenological differences in experiences being endorsed in response to the visual hallucinations item across the two groups. The only prior study to examine acculturation and psychosis among immigrants found an effect on global function but not symptom severity (Gonidakis et al., 2011); however, their findings were based on a sample of people with psychotic disorders (primarily schizophrenia) and focused on symptom severity rather than symptom occurrence. Further, they may have captured the effects of acculturation as a broad construct, thereby potentially confounding stress with other aspects of acculturation (Rudmin, 2009).

Table 4
Multiple logistic regression models of psychotic-like experiences among Asian respondents.

	Total PLE		Visual hallucinations		Hearing voices		Delusions	
	Wald χ^2, p	OR (95% CI)	Wald χ^2, p	OR (95% CI)	Wald χ^2, p	OR (95% CI)	Wald χ^2, p	OR (95% CI)
Acculturative stress								
0	–	1.0	–	1.0	–	1.0	–	1.0
1	3.0, 0.084	2.8 (0.8–9.4)	1.6, 0.203	3.3 (0.5–21.5)	**5.4, 0.021**	13.6 (1.4–132.3)	0.1, 0.795	1.3 (0.2–8.8)
2	**8.7, 0.003**	4.9 (1.7–14.6)	**4.6, 0.032**	4.3 (1.1–16.9)	**11.9, 0.001**	66.9 (5.7–785.8)	0.0, 0.969	1.0 (0.1–10.6)
3 +	**8.9, 0.003**	7.2 (1.9–27.2)	**7.7, 0.006**	9.9 (1.9–53.2)	**9.3, 0.002**	38.4 (3.4–428.4)	1.3, 0.258	2.5 (0.5–12.7)
Linear trend	**11.3, 0.001**		**10.0, 0.002**		**11.3, 0.001**		0.9, 0.349	
Age								
18–29	–	1.0	–	1.0	–	1.0	–	1.0
30–39	1.5, 0.218	0.6 (0.3–1.3)	1.6, 0.211	0.5 (0.2–1.5)	**4.6, 0.033**	0.4 (0.2–0.9)	0.6, 0.431	2.7 (0.2–33.9)
40–49	2.7, 0.102	0.4 (0.1–1.2)	1.4, 0.236	0.4 (0.1–1.9)	**11.7, 0.001**	0.0 (0.0–0.3)	0.1, 0.819	1.4 (0.1–31.9)
50–64	1.5, 0.214	0.5 (0.1–1.6)	0.7, 0.329	0.5 (0.1–2.8)	**12.0, 0.001**	0.0 (0.0–0.3)	0.3, 0.604	1.9 (0.2–23.2)
Female	5.7, 0.017	0.5 (0.3–0.9)	9.4, 0.002	0.3 (0.2–0.7)	1.6, 0.202	0.6 (0.2–1.4)	1.7, 0.195	2.2 (0.6–7.7)
Income								
<26,000	–	1.0	–	1.0	–	1.0	–	1.0
26,000 - 64,999	0.1, 0.748	1.2 (0.4–3.3)	0.0, 0.914	0.9 (0.2–3.6)	1.5, 0.214	2.0 (0.6–6.2)	0.1, 0.768	1.3 (0.2–10.5)
>65,000	0.9, 0.343	0.6 (0.2–1.9)	2.7, 0.104	0.3 (0.1–1.3)	0.0, 0.982	1.0 (0.3–3.8)	0.0, 0.999	1.0 (0.1–7.5)
Education								
<12 years	–	1.0	–	1.0	–	1.0	–	1.0
12 years	2.0, 0.163	0.4 (0.1–1.5)	2.1, 0.143	0.2 (0.0–1.8)	0.3, 0.568	0.6 (0.1–3.3)	0.0, 0.856	0.8 (0.0–16.5)
13–15 years	0.6, 0.434	1.5 (0.5–4.0)	0.0, 0.983	1.0 (0.3–2.9)	0.1, 0.702	1.3 (0.3–4.7)	0.6, 0.444	2.7 (0.2–38.6)
>16 years	0.0, 0.943	1.0 (0.3–3.0)	0.1, 0.731	0.8 (0.2–3.0)	2.2, 0.135	0.4 (0.1–1.4)	0.5, 0.494	2.4 (0.2–32.2)
Age at immigration								
<12 years	0.1, 0.772	0.8 (0.2–3.0)	0.1, 0.806	0.8 (0.1–5.4)	1.0, 0.312	0.6 (0.2–1.8)	–	–
13–17 years	**4.3, 0.037**	0.3 (0.1–1.0)	**4.0, 0.047**	**0.3 (0.1–1.0)**	2.1, 0.143	0.4 (0.1–1.4)	–	–
18–64 years	–	1.0	–	1.0	–	1.0	–	–
Years in USA								
<10 years	–	1.0	–	1.0	–	1.0	–	1.0
11–20 years	2.5, 0.117	2.5 (0.8–8.3)	2.7, 0.098	3.3 (0.8–13.8)	**3.9, 0.047**	**6.0 (1.0–37.5)**	0.8, 0.373	2.4 (0.3–17.6)
>20 years	2.9, 0.089	2.9 (0.8–10.4)	**4.4, 0.036**	5.2 (1.1–25.1)	1.7, 0.193	4.3 (0.4–41.7)	1.1, 0.300	2.9 (0.4–24.3)

Note: Bold font indicates significance, p < 0.05.

4.2. Acculturative stress and specific psychotic-like symptoms

The association between acculturative stress and hallucinations but not delusions was unexpected based on the prior literature, which has primarily focused on risk for psychotic disorders rather than specific symptoms (Cantor-Graae and Selten, 2005; Morgan et al., 2010; Bourque et al., 2011). Vanheusden et al. (2008) previously showed a positive relationship between immigration and self-reported

Table 5
Multiple logistic regression models of psychotic-like experiences among Latino respondents.

	Total PLE		Visual hallucinations		Hearing voices		Delusions	
	Wald χ^2, p	OR (95% CI)	Wald χ^2, p	OR (95% CI)	Wald χ^2, p	OR (95% CI)	Wald χ^2, p	OR (95% CI)
Acculturative stress								
0	–	1.0	–	1.0	–	1.0	–	1.0
1	0.0, 0.890	0.9 (0.4–2.1)	0.5, 0.476	0.7 (0.3–1.8)	3.5, 0.060	2.7 (0.9–9.5)	2.6, 0.106	0.2 (0.0–1.4)
2	1.5, 0.215	1.4 (0.8–2.4)	0.3, 0.580	1.2 (0.7–2.1)	**5.5, 0.019**	3.7 (1.2–11.6)	1.0, 0.309	0.5 (0.2–1.8)
3 +	0.0, 0.864	1.1 (0.5–2.5)	0.5, 0.468	0.7 (0.2–2.0)	**17.6, <0.001**	7.3 (2.8–19.0)	0.5, 0.466	0.7 (0.3–1.7)
Linear trend	0.3, 0.588		0.2, 0.641		**18.0, <0.001**		0.0, 0.999	
Age								
18–29	–		–	1.0	–	1.0	–	1.0
30–39	0.0, 0.990	1.0 (0.4–2.5)	**4.3, 0.038**	**2.3 (1.0–5.0)**	0.3, 0.602	0.6 (0.1–3.9)	**10.9, 0.001**	0.0 (0.0–0.2)
40–49	3.1, 0.077	1.0 2.6 (0.9–7.5)	**9.8, 0.002**	**4.9 (1.8–13.5)**	0.7, 0.387	2.0 (0.4–9.9)	0.4, 0.538	1.5 (0.4–5.5)
50–64	3.3, 0.071	2.5 (0.9–7.1)	**12.2, <0.001**	**6.2 (2.2–17.6)**	0.2, 0.667	1.5 (0.2–11.3)	0.1, 0.741	0.7 (0.1–5.5)
Female	1.2, 0.266	1.3 (0.8–2.3)	1.2, 0.264	1.4 (0.8–2.4)	0.8, 0.363	1.6 (0.6–4.1)	0.5, 0.459	0.5 (0.1–2.8)
Income								
<26,000	1.1, 0.292	1.0	–	1.0	–	1.0	–	1.0
26,000 - 64,999	0.8, 0.370	0.8 (0.5–1.3)	0.6, 0.450	0.8 (0.4–1.4)	0.0, 0.880	0.9 (0.4–2.4)	2.0, 0.156	0.3 (0.1–1.6)
>65,000		0.7 (0.3–1.5)	0.0, 0.948	1.0 (0.4–2.4)	0.1, 0.721	1.3 (0.3–4.7)	0.1, 0.781	0.8 (0.1–4.2)
Education								
<12 years	–	1.0	–	1.0	–	1.0	–	1.0
12 years	1.7, 0.195	1.5 (0.8–2.7)	0.0, 0.940	1.0 (0.4–2.5)	0.4, 0.515	1.4 (0.5–3.9)	3.2, 0.075	4.4 (0.8–23.0)
13–15 years	**7.1, 0.008**	1.9 (1.2–3.2)	0.4, 0.537	1.2 (0.6–2.6)	2.8, 0.092	3.0 (0.8–11.2)	**6.3, 0.012**	3.5 (1.3–9.6)
>16 years	2.4, 0.124	1.8 (0.8–4.1)	0.4, 0.511	0.7 (0.3–1.9)	1.2, 0.280	2.6 (0.4–15.4)	0.6, 0.445	2.5 (0.2–26.3)
Age at immigration								
<12 years	**9.6, 0.002**	**4.0 (1.6–9.7)**	**32.4, <0.001**	**7.7 (3.8–16.0)**	**4.4, 0.035**	**3.1 (1.1–9.4)**	0.0, 0.859	0.9 (0.3–3.1)
13–17 years	1.7, 0.190	2.0 (0.7–6.1)	3.7, 0.055	2.4 (1.0–6.1)	0.5, 0.472	1.5 (0.5–4.8)	0.5, 0.496	0.5 (0.1–3.8)
18–64 years	–	1.0	–	1.0	–	1.0	–	1.0
Years in USA								
<10 years	–	1.0	–	1.0	–	1.0	–	1.0
11–20 years	0.0, 0.865	1.0 (0.6–1.8)	0.0, 0.995	1.0 (0.5–2.1)	0.3, 0.599	1.4 (0.4–4.3)	3.7, 0.053	3.7 (0.9–14.1)
>20 years	**4.8, 0.029**	**0.4 (0.2–0.9)**	**12.1, 0.001**	**0.2 (0.1–0.5)**	2.2, 0.137	0.5 (0.2–1.3)	0.0, 0.996	1.0 (0.2–4.5)

Note: Bold font indicates significance, p < 0.05.

hallucinations among non-western immigrants to The Netherlands, although they did not distinguish between visual and auditory hallucinations. Berg et al. (2011) found increased positive symptom severity among immigrants (primarily African or Asian) in Norway, but did not distinguish between subtypes of positive symptoms. Other studies have found greater severity of delusions and hallucinations at initial intake among Moroccan immigrants in the Netherlands (Veling et al., 2007) or depressive symptoms among Turkish immigrants in Germany (Haasen et al., 2001) but not hallucinations exclusively. Findings across studies may vary for reasons related to measurement, sample ascertainment, and differences between particular immigrant groups and host nations. There also may have been insufficient power to detect an association with delusions in our study, given their low prevalence relative to hallucinations in this sample.

4.3. Acculturative stress as a mechanism of risk

Several studies have prospectively demonstrated associations between daily stress and increased psychotic-like symptom severity (DeVylder et al., 2013; Tessner et al., 2011) among help-seeking youth at clinical risk for psychosis. Acculturative stress may likewise consist primarily of the experience of persistent minor hassles. Increased sensitivity to ongoing stressors associated with adjustment and integration to a new culture, and the inability to effectively cope with these ongoing stressors, may contribute to the association between psychosis and immigration. However, it is likely that acculturative stress is just one of multiple mechanisms mediating the relationship between immigration and psychosis, which may also include perceived discrimination (Karlsen and Nazroo, 2002; Veling et al., 2007) and ethnic density (Boydell et al., 2001; Das-Munshi et al., 2012; Kirkbride et al., 2007; Schofield et al., 2011; Veling et al., 2008b), which were not examined in our models. Notably, acculturative stress is a mechanism that is potentially modifiable through individual- and family-level intervention, unlike ethnic density or societal discrimination. For example, interventions have been proposed to combat the stress of acculturation through individual and family support groups and bicultural skill trainings (Bacallao and Smokowski, 2005; Smokowski and Bacallao, 2009). Interventions for immigrants experiencing acculturative stress may have promise in reducing the risk for psychosis, particularly among Asian-Americans.

4.4. Age of immigration

Among Latino respondents, younger age of immigration was associated with increased risk for any PLE and specifically for visual and auditory hallucinations. Younger age at the time of immigration has previously been associated with increased risk of psychosis among non-western immigrants to The Netherlands (Veling et al., 2011). Interestingly, the same study found no effect of age of immigration among Western immigrants, consistent with a prior study that found no association between immigration from predominantly western nations to Denmark and psychosis (Cantor-Graae et al., 2003). One possible explanation is that western immigrants to The Netherlands and Asian immigrants to the U.S. more closely resemble the dominant ethnic group in terms of SES, allowing for easier assimilation into the host culture, leaving those that experience a more stressful acculturation process at an increased risk for psychosis. Conversely, risk for PLE in Latinos in the US (and likewise in non-western immigrants to The Netherlands) may be related to environmental factors, particularly those that occur or begin during childhood (e.g. perceived discrimination, childhood separation from parents), with risk increasing as duration of exposure increases.

4.5. Limitations and future directions

This study has several potential limitations. First, we could not control directly for overall acculturation, although acculturation is likely to overlap with years in the host country, which was included in our models. Second, we were not able to include a non-immigrant control group since the acculturative stress scale was only assessed among first-generation immigrants. Also, individual acculturative stress items that probed guilt and feelings of persecution may have some conceptual overlap with psychotic-like experiences, but these were the least commonly endorsed items in our sample and thus less likely to have substantially influenced our main findings. The association between acculturative stress and hearing voices in Latinos may be confounded by legal status, which was not assessed in this survey. We also may have obscured important differences between individual nationalities given that ethnicities were collapsed into two broad categories to increase statistical power. Statistical power may have also limited our ability to detect associations with delusions, which were of much lower prevalence compared to hallucinations. The modest internal consistency of our acculturative stress measure also may have introduced random error and therefore biased our findings towards the null, possibly preventing detection of potential associations between acculturative stress and delusions.

There were insufficient data on age of immigration or age of onset for particular PLE to determine their temporal order in our cross-sectional data, allowing for the possibility of reverse causality. Acculturation may be more stressful for those with psychiatric symptoms, as previously suggested regarding depression and anxiety (Rudmin, 2009). This interpretation is less consistent with the substantial body of literature including several prospective studies linking immigration to psychosis (Bourque et al., 2011), although none of these studies included measures of acculturative stress, necessitating replication of our results in a prospective design to clarify the causal direction of this relationship.

The NLAAS over-sampled areas census tracts with high ethnic density of Latinos or Asians, which has been associated with reduced risk for psychosis (Veling et al., 2008b). It would be of interest in future studies to examine whether acculturative stress mediates the association between ethnic density and psychosis by sampling from a broader range of communities.

This is the first study to our knowledge to examine acculturative stress as a risk factor for psychosis, and to examine PLE among Asian and Latino immigrants in the US. Our findings suggest that acculturative stress is associated specifically with hallucinatory symptoms among immigrants to the United States, particularly those from Asian countries. Phenomenological analyses of PLE across cultures may help us to better understand how acculturative stress may relate to PLE, and the nature of PLE when occurring in this context. Future studies should continue to explore the heightened prevalence of psychosis commonly found among immigrant groups, not only in terms of varying mechanisms of risk between different nationalities, but also variations in how these risk factors influence specific psychotic symptoms.

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