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ORIGINAL PAPER

A comparison of the prevalence of psychiatric disorders in Puerto Rico with the United States and the Puerto Rican population of the United States

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Abstract

Purpose The manuscript compares the rates of psychiatric disorder among island Puerto Ricans, the US population and US Puerto Ricans in order to examine whether social support explains differences in psychiatric disorder among these three groups.

Methods Unadjusted and adjusted rates for sociodemographic factors and social support of main psychiatric disorders are compared among three population-based psychiatric epidemiology studies carried in Puerto Rico (PR) and the United States (US) as part of the NCS-R and NLAAS studies.

Results Comparison of adjusted rates showed island Puerto Ricans had similar overall rates of psychiatric disorder as those of the US, lower rates of anxiety disorders, but higher rates of substance use disorders. US Puerto Ricans had higher rates of adjusted anxiety and depression but not of overall psychiatric disorder, as compared to the island. When the rates of disorder were adjusted also for social support, the differences between these two groups disappeared.

Conclusions The findings suggest that social support is a variable worthy of further exploration for explaining differences in disorder prevalence particularly among Puerto Ricans depending on where they live.

Keywords Psychiatric epidemiology · Mental disorders · Population samples

Introduction

Puerto Rico is a small, densely populated Caribbean island (3.4 million inhabitants in 3435 square miles) that became a territory of the United States (US) after the Spanish American war of 1898. Since then, it has undergone dramatic change from a rural agricultural society to mostly urban (6% rural, 2014 Census) [1], industrial, and commercial one; however, its economic growth has been slow relative to the US. In 2016, Puerto Rico's estimated per capita gross domestic product (GDP) was $29,048, which was lower than both the overall US per capita GDP ($57,294) [2], and the US state with the lowest per capita GDP (i.e., Mississippi, $32,102) [3]. The island population is predominantly poor, (45.2% under the poverty level, US Census, 2014) [1] and suffers from other indications of social disruption such as high crime, unemployment, and divorce rates [4]. These chronic stressors have previously been linked to risk of psychopathology; thus, it might be expected that the island population would be at high risk for psychiatric disorders. Yet, results of the first psychiatric epidemiology study of adults in Puerto Rico [5] showed that 6-month prevalence rates of psychiatric disorder within this population were similar to rates observed in four US communities of the Catchment Area (ECA) Study [6].

Three decades after the Canino et al. study [5], there is still no clear explanation for why extreme economic and

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social adversity in Puerto Rico was not associated with higher rates of mental disorders. Many possible explanations have been discussed, including cultural protective factors such as familism, the role of subjective economic appraisal rather than absolute economic status [7, 8], and the possibility of some general response bias that diminished the true rates of psychiatric disorder in Puerto Rico [9, 10]. In addition to these possibilities, it remains to be determined whether any explanatory factors are protective for all Puerto Ricans—regardless of where they live—or specifically for those Puerto Ricans living in Puerto Rico.

One factor that has been proposed is the level of social support provided in Puerto Rican culture [11]. Social support has been posited as one of the most significant explanations for how certain cultural groups cope better with adversity than others [12]. The family is widely regarded as a social support resource for Latinos [13] but not necessarily for all racial/ethnic groups. If so, this difference may help explain why adversity and other stressors associated with living in Puerto Rico do not translate into higher rates of psychopathology for these individuals.

In the intervening years since those epidemiological studies were conducted, three additional psychiatric epidemiology studies have generated relevant psychiatric disorder prevalence data using similar sampling designs and measures. First, the National Comorbidity Study Revised (NCS-R) [14] examined a nationally representative sample of the overall US population. Second, the National Latino and Asian American Study (NLAAS) [15] obtained representative samples of Puerto Ricans, Mexicans, Cubans, and other Latinos living in the US. Finally, the Puerto Rico Mental Health and Anti-Addiction Services Administration (MHAASA) commissioned a new prevalence study of residents of Puerto Rico, before the devastating disruption of Hurricanes Irma and Maria in 2017. The results of this third survey have not yet been reported, and these data provide the basis for the current article.

Taken together, these epidemiological data allow three important questions to be addressed. First, do Island Puerto Ricans still demonstrate similar rates of psychopathology as the general US population—as they did decades ago? Second, do differences in disorder prevalence emerge between Puerto Ricans living in Puerto Rico and those self-identified Puerto Ricans who live in the mainland US? Third, do island Puerto Ricans, US-based Puerto Ricans, and the general US population experience significantly different levels of social support, a potentially important protective factor against psychopathology that was measured in all three surveys?

These questions will be considered in the context of findings that have already been reported using the NSC-R and NLAAS. Alegría and colleagues [16] reported that, after adjusting for age, gender, and socioeconomic status (education and income), US-residing Puerto Ricans had higher disorder rates compared to all other Latino groups (i.e., Mexicans, Cubans, other Latinos), but not compared to non-Latino Whites surveyed in the NCS-R [16]. Furthermore, US-residing Puerto Ricans did not demonstrate the prevalence pattern known as the "immigrant paradox," a phrase referring to the tendency for immigrants to demonstrate lower rates of psychopathology than the US-born offspring of immigrants, despite the substantial stressors immigrants typically experience during relocation [17]. Using data from the NESARC survey [18] Breslau and colleagues [19] reported similar findings; there was no association between US-nativity and risk of mood and anxiety disorders among Puerto Ricans. In addition, Puerto Rican adolescents living in the South Bronx section of New York have been found to have similar levels of antisocial symptoms compared to adolescents living in Puerto Rico [20]. Alegría and colleagues [15] speculated that similarity between Puerto Rican migrants and US-born Puerto Ricans may reflect the fact that Puerto Rico has been under the influence of the US culture for more than a century and has adopted many aspects of US culture and lifestyle. The frequent circular migration from the island to the US of about a quarter of the Puerto Rican population may also be related to the lack of differences in risk for psychiatric disorders between US Puerto Rican migrants and those born in the US [21]. However, whether cultural similarities, such as those related to social support, exist and whether they contribute to similar rates of psychiatric disorder in the US and Puerto Rico has not been empirically examined.

We have noted that Puerto Ricans living on the island are exposed to chronic stressors related to poverty, crime, and absence of hope for economic improvement [4]. Some individuals may migrate to the US to escape these stressors and achieve greater economic stability [22]; however, relocation may be accompanied by new stressors, including discrimination and disruption in social and family networks which have been linked to poorer mental health among US Puerto Ricans [23, 24]. Given that Puerto Ricans are US citizens and can travel between the US and Puerto Rico without difficulty, it is unlikely that select migration (i.e., only individuals without disorder can undergo migration) applies to Puerto Ricans as it might to migrants from other nations. In addition, data suggest that Puerto Ricans who migrate to the US are not dramatically different from island Puerto Ricans with regards to socioeconomic or occupational status [4]. Taken together, these factors may contribute to the lack of an "immigrant paradox" pattern of disorder prevalence within this population.

In summary, we take advantage of the MHAASA survey to revisit the 1987 finding that Puerto Ricans were not at increased risk for mental disorder despite exposure to island wide socioeconomic stress. We focus on three classes of psychopathology that are often associated with

chronic stress exposure: (1) mood disorders, (2) anxiety disorders and (3) substance use disorders. We explicitly compare the MHAASA prevalence rates to those found in the US mainland during the NCS-R survey and to prevalence rates among US-residing Puerto Ricans, as documented in the NLAAS survey. We formally examine the hypothesis that Puerto Ricans enjoy additional protective effects of social support relative to non-Puerto Rican US residents.

The survey of island Puerto Ricans was carried out a year before Hurricane Maria hit the island in September 2017. Therefore, the 12-month rates presented in this report will also provide an important baseline to assess changes in rates of psychiatric disorder that follow this historic natural disaster.

Methods

Samples and sampling design

The MHAASA survey

This survey was a psychiatric epidemiology study of a representative sample of Puerto Rico residents, carried out from 2014 to 2016. Eligibility was based on age (18–64 years) and self-identification as Puerto Rican. A total of 3062 interviews were completed from 3656 eligible subjects, for a response rate of 83.8%. Respondents were sampled from eight health regions defined by the Puerto Rico Health Insurance Administration, using 2010 Census Block Groups as the primary sampling units. Using a multistage cluster sampling procedure, 340 primary sampling units (PSUs) were selected, with probability proportional to size (i.e., number of adults in the target age group) and health region. Each PSU contained a minimum of 200 occupied housing units (OHUs) and an average of 20–40 OHUs were selected per Block Group.

National comorbidity replication study of US population (NCS-R)

The NCS-R ($N=4983$) was a national household survey of mental health in the US that was carried out from 2001 to 2003 [14]. Data were collected using face-to-face interviews with participants from randomly selected households drawn from population-based probability samples with a response rate of 70.9%. Further details of the survey methodology are reported elsewhere [25, 26] and summarized, along with sample sizes and response rates in Kessler et al. [14].

National Latino and Asian American study (NLAAS)

Developed in conjunction with the NCS-R as part of the Collaborative Psychiatric Epidemiology Surveys, the NLAAS was a national probability survey of mental health among Latinos and Asian Americans in the United States [15]. The survey was based on multi-stage clustered area probability household samples selected using the sampling frames and sample selection procedures that are common to the University of Michigan Survey Research Center's (SRC) National Sample design [27, 28], but with unique features to optimize the representation of Latinos and Asian Americans in the US. These frames represent the household population of the contiguous U.S. The Latino component of the sample ($N=2554$) focused on Puerto Ricans, Mexican Americans, Cubans and other Latinos; in this article, we focus only on responses from NLAAS Puerto Ricans between ages 18 and 64 ($N=419$). The survey was carried out from 2001 to 2003, with a response rate of 75.7%. Participants were offered the option of completing surveys in their preferred language (i.e., English or Spanish). Of note, the sample designs and core instruments of the NCS-R and NLAAS were identical, which allows them to be used concurrently. Details of the designs and sampling methods are reported elsewhere (e.g., [15, 16, 25]).

Procedures

Study procedures were approved by the Institutional Review Board of all involved institutions. Lay interviewers with at least an associate's or bachelor's degree were trained for a 1-week period by supervisors on standard interview techniques and administration of study measures. Computer-assisted interviews were completed in participant homes.

Measures

The interview protocol consisted of measures designed to assess psychiatric disorders, health care utilization, and common risk and protective factors associated with mental health disorders. Given that this report focuses on psychiatric disorder prevalence and its association with social support, only these instruments and measures of sociodemographic characteristics are described. All three surveys used the same measures to assess these constructs.

Psychiatric disorders

Psychiatric disorders were assessed with the most recent version of the World Health Organization Composite International Diagnostic Interview (WMH-CIDI Version 21) [29]. The WMH-CIDI is a standardized diagnostic interview designed to assess current (past 12-month) and lifetime

mental disorders based on criteria from the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) [30]. Although the DSM has since been updated to the DSM-5 [31], at the time of the island survey, the CIDI had not yet been updated to reflect this change. The English and Spanish translations of the instrument have demonstrated diagnostic concordance with blinded clinical interviewers using the Structured Clinical Interview for DSM IV Axis 1 disorders (SCID) for mood, anxiety, and substance use disorders [32]. The following psychiatric disorders were assessed across all three surveys and were examined in the current study: major depressive disorder, dysthymia, panic disorder, social phobia, agoraphobia, general anxiety disorder, alcohol abuse, alcohol dependence, drug abuse, and drug dependence for the following drugs: tranquilizers, stimulants, analgesics, marijuana, cocaine, club drugs, hallucinogens, heroin, inhalants and other drugs.

Psychiatric disorders were clustered into four main categories: mood disorders (major depressive disorder and dysthymia), anxiety disorders (panic disorder, social phobia, agoraphobia, and generalized anxiety disorder), and substance use disorders (alcohol abuse and dependence, drug abuse and dependence).

Family and friend network and support

Social support was assessed with four items that measured frequency of contacts with family and friends and whether the respondent could count on them when in need that was the same across the three surveys. For example, one item asked: "How often do you talk on the phone or get together with family or relatives who do not live with you?" with responses ranging from 1 (most every day) to 5 (less than once a month). Another item asked: "How much can you rely on relatives who do not live with you for help if you need to talk about worries?" with responses ranging from 1 (a lot) to 4 (not at all). Similar questions were asked about friends. These four items provide an indication of social support resources that are available to participants, and they were asked in all three surveys. However, they are not items that have a traditional relation to a latent variable (e.g. reflective psychometric model); rather, they indicate an accumulation of network and emotional support from different sources (e.g. a formative model). In such models Cronbach's alpha underestimates reliability [33]. In the three surveys, alpha was 0.51 (NLAAS), 0.56 (NCR-R), and 0.58 (MHAASA). Because the items had two different response scales, we transformed them to have comparable ranges and then combined them into an overall index of social support that ranged from 0 (rare contact and no support availability) to 10 (highest frequency of contact and highest support availability).

Socio demographic variables

Age We categorized Age into young adult: 18–25, mid adult: 26–45, and older adult: 46–64 years (with last category as reference group).

Poverty To calculate the monthly income of participating households, respondents were asked to report salaries and other sources of income (e.g., benefits from pensions, social security) for each household member; these values were then summed to identify the household's monthly income. For the present analyses, household monthly income was identified as one of four categories: less than $1000, $1000 to $1999, $2000 to $2999, and $3000 or more (reference category).

Employment status Respondents were asked to provide their employment status—i.e., unemployed and looking for work, employed (reference), or out of the labor force (e.g., not looking for work, retired, homemaker, student)—at the time of the interview. *Level of education* Participants were grouped into four educational categories: (a) less than high school; (b) completed high school or GED; (c) some college or technical or vocational school; (d) completed 4-year college or higher (reference category).

Statistical analyses

Analyses were conducted using STATA Version 14.2 [34]. To account for the multistage, multi-cluster design of each survey, we calculated 12-month prevalence rates after weighting the data to correct for unequal probabilities of selection into each sample so that each estimate referred to the target population. In addition, a post-stratification weight was applied, which corrected for nonresponse and adjusted the sample to age and gender population distributions per the 2000 Census for the US population and 2010 for the island population [35].

To address the first question (comparison of Island Puerto Ricans to the general US population), we used logistic regression to test site differences for both individual diagnoses and higher rank groupings of mood, anxiety, and substance use disorders. Inferences were based on Wald tests of log odds ratios. These initial comparisons did not adjust for demographic differences in the populations; however, follow-up comparisons adjusted for age, gender, monthly income, educational level, and employment status. Similar analyses were carried out to address the second question (comparison of Island Puerto Ricans to US Puerto Ricans), first without adjustment and then with adjustments for the same demographic factors. To address the third question (regarding social support), we compared reported levels of social support across all three groups and then revisited the adjusted logistic regressions for the first two questions by including social support as an additional adjustment variable. Variance was estimated using the Delta Method with

a first-order Taylor approximation for all logistic regression analyses.

Results

How comparable are Island Puerto Ricans to general residents of the US mainland and to Puerto Ricans living on the US mainland? Table 1 shows the demographic characteristics of the weighted study sample for Island Puerto Ricans, the general US population, and US Puerto Ricans. Across the three samples, there were no significant differences in gender or age. However, significant differences were observed in educational level, monthly income, and employment status. Island Puerto Ricans were relatively disadvantaged compared to the US total population in all three of these characteristics; they were less likely to complete college, to be employed, and their median monthly income fell in the $1000–$1900 category, whereas the median in the US population was in the $3000 and larger category. Island Puerto Ricans were also relatively disadvantaged compared to US Puerto Ricans on income and employment status. However, the Island Puerto Ricans were somewhat better off in terms of education. Fewer Island Puerto Ricans failed to complete high school and many more attended some college/vocational school.

How comparable are the prevalence rates of CIDI/DSM-IV psychiatric disorders among Puerto Ricans living

Table 1 Weighted sociodemographic characteristics of adults 18–64 years of age in Puerto Rico and the US

	Island Puerto Ricans ($N=3062$)			US population ($N=4983$)			US Puerto Ricans ($N=419$)			Independence test F ($df1$, $df2$)
	%	N	CI	%	N	CI	%	N	CI	
Gender										0.02 (1.71, 526.96)
Female	52.4	1771	[49.7, 55.0]	52.1	2864	[49.9, 54.3]	52.0	242	[47.3, 56.7]	
Male (ref)	47.6	1291	[45.0, 50.3]	47.9	2119	[45.7, 50.1]	48.0	177	[43.3, 52.7]	
Age										1.80 (2.61, 807.68)
18–25	18.6	725	[14.7, 23.1]	20.5	921	[18.2, 22.9]	21.2	82	[16.8, 26.4]	
26–45	42.9	964	[40.0, 45.9]	44.9	2399	[42.9, 47.0]	50.4	212	[42.9, 57.8]	
46–64 (ref)	38.5	1373	[35.5, 41.6]	34.6	1,663	[31.9, 37.3]	28.4	125	[22.7, 34.9]	
Educational level										64.94*** (4.08, 1259.24)
Less than high school	9.9	309	[8.2, 11.8]	14.0	646	[12.4, 15.7]	33.0	139	[29.1, 37.1]	
Completed high school/GED	21.1	666	[19.3, 23.1]	31.8	1476	[29.3, 34.4]	29.1	124	[25.4, 33.0]	
Some college	55.2	1694	[52.4, 58.0]	29.5	1561	[27.8, 31.3]	25.5	103	[21.9, 29.4]	
Completed college (ref)	13.8	374	[11.9, 16.0]	24.7	1300	[22.6, 27.0]	12.5	53	[9.4, 16.4]	
Household monthly income										108.09*** (4.71, 1450.48)
Less than 1000	34.8	1099	[31.2, 38.6]	11.9	559	[10.1, 13.9]	21.6	95	[17.6, 26.1]	
$1000 to $1999	25.2	730	[23.1, 27.3]	11.4	596	[9.9, 13.2]	14.2	61	[10.2, 19.3]	
$2000 to $2999	17.4	475	[15.6, 19.4]	10.4	548	[9.1, 11.9]	11.7	47	[8.9, 15.2]	
$3000 or more (ref)	22.6	597	[20.0, 25.4]	66.3	3280	[63.3, 69.1]	52.6	216	[46.1, 59.0]	
Employment status										71.87*** (3.65, 1127.78)
Unemployed	13.1	415	[11.3, 15.1]	3.4	190	[2.7, 4.3]	7.4	30	[4.8, 11.1]	
Employed (ref)	49.0	1359	[46.0, 52.0]	74.6	3655	[72.4, 76.6]	63.7	262	[57.1, 69.9]	
Out of the labor force	37.9	1281	[34.8, 41.0]	22.0	1127	[20.3, 23.8]	28.9	127	[23.6, 34.8]	
	Island Puerto Ricans			US population			US Puerto Ricans			Independence test
	M	SE	CI	M	SE	CI	M	SE	CI	F ($df1$, $df2$)
Social support	7.11	0.05	[7.00, 7.21]	6.68	0.04	[6.59, 6.77]	5.98	0.13	[5.71, 6.26]	38.38*** (2, 309)

US population incorporates respondents from the National Comorbidity Study Revised (NCS-R) [36]; US Puerto Rican sample includes respondents from the National Latino and Asian American Study that self-identified as Puerto Rican [14]. The NCS-R sample is composed of Non-Latino Whites ($N=3568$), African American ($N=621$), Mexican ($N=335$), Other Hispanic ($N=170$), Asian ($N=81$), Afro-Caribbean ($N=35$), and other ($N=173$). There were some individuals in the "Other Hispanic" group who identified as Puerto Rican; however, they comprise just 1.1% of the NCS-R sample

*Refers to $p \leq 0.05$

**Refers to $p \leq 0.01$

***Refers to $p \leq 0.001$

in Puerto Rico to general US residents? Table 2 shows 12-month prevalence rates of psychiatric disorders for the adult population of Puerto Rico (MHAASA), the general US population (NCS-R), and the US Puerto Rican population (NLAAS) without adjustments for demographic differences. The bottom row of the table shows a summary of any mood, anxiety or substance disorders. There is no statistically significant evidence that the overall rate for island Puerto Ricans (22.5%) is higher than for the US (20.7%). Similar findings were obtained for any mood disorder and any anxiety disorder. However, there was statistically significant evidence that island Puerto Ricans had higher rates of substance disorder (7.8% vs. 4.6%). This difference is apparent for both, any alcohol and any psychoactive drug disorder (See Table 2).

How comparable are the prevalence rates of CIDI/DSM-IV psychiatric disorders among Puerto Ricans living in Puerto Rico to self-identified Puerto Ricans living in the US? Table 2 also contains the answer to this question. The overall rate of disorder was similar (22.5% vs. 24.2%). There was no significant difference in the rates for any mood disorder (9.9% vs. 11.2%) or any anxiety disorder (12.5% vs. 15.8%). However, island Puerto Ricans did have higher rates of substance disorders (7.8% vs. 3.3%); this pattern was evident for any alcohol (but was not conclusive for any drug use).

Do island Puerto Ricans, US-based Puerto Ricans, and the general US population experience significantly different levels of social support—a potentially important protective factor against psychopathology? We found that island Puerto Ricans did indeed report more social support ($M = 7.10$; 95% CI 7.0–7.2) than the general US population ($M = 6.68$; 95% CI 6.6–6.8) and the US Puerto Ricans ($M = 5.98$; 95% CI 5.7–6.3). The question is whether this difference explains the apparent resilience of island Puerto Ricans to economic stress. To answer this second question, we extended the analyses in Table 2 to adjust for social

Table 2 Comparison of 12-Month prevalence rates of any CIDI/DSM-IV psychiatric disorders among adults 18–64 years of age in Puerto Rico and the US

	Island Puerto Ricans ($N = 3062$)		US population ($N = 4983$)		US Puerto Ricans ($N = 419$)		US Pop vs. Island PR		US PR vs. Island PR	
	% (*N*)	CI	% (*N*)	CI	% (*N*)	CI	OR	CI	OR	CI
Mood disorders										
Major depressive	9.7 (308)	(8.6–10.9)	7.6 (610)	(7.0–8.4)	9.6 (41)	(7.2–12.8)	0.77**	(0.66–0.91)	1.00	(0.71–1.39)
Dysthymia	2.3 (72)	(1.8–3.0)	2.6 (208)	(2.2–3.0)	4.1 (18)	(2.5–6.7)	1.11	(0.82–1.50)	1.81*	(1.04–3.15)
Any mood	9.9 (315)	(8.8–11.1)	8.5 (681)	(7.8–9.3)	11.2 (48)	(8.3–14.9)	0.85	(0.72–1.00)	1.15	(0.81–1.62)
Anxiety disorders										
Panic	2.5 (78)	(1.9–3.3)	3.2 (247)	(2.7–3.7)	3.5 (16)	(1.9–6.3)	1.30	(0.94–1.79)	1.41	(0.73–2.73)
Social phobia	6.3 (195)	(5.3–7.3)	7.8 (601)	(7.1–8.6)	8.7 (34)	(5.4–13.7)	1.27*	(1.04–1.55)	1.43	(0.84–2.41)
Agoraphobia	2.5 (84)	(1.9–3.1)	1.6 (132)	(1.4–1.9)	4.1 (15)	(1.8–9.1)	0.66**	(0.49–0.89)	1.71	(0.73–4.00)
Generalized anxiety	5.2 (168)	(4.4–6.1)	4.6 (360)	(4.0–5.1)	6.0 (24)	(3.9–9.1)	0.87	(0.70–1.07)	1.17	(0.73–1.85)
Any anxiety	12.5 (401)	(11.3–14.0)	12.9 (999)	(12.1–13.7)	15.8 (63)	(11.3–21.6)	1.03	(0.90–1.19)	1.31	(0.88–1.93)
Substance disorders										
Alcohol abuse	5.2 (155)	(4.2–6.4)	3.5 (212)	(2.9–4.2)	2.5 (10)	(1.2–4.9)	0.66**	(0.49–0.88)	0.46*	(0.22–0.95)
Alcohol dependence	1.5 (40)	(1.0–2.1)	1.6 (105)	(1.2–2.2)	1.8 (7)	(0.7–4.3)	1.10	(0.68–1.77)	1.23	(0.48–3.16)
Any alcohol	5.7 (168)	(4.7–6.9)	3.7 (227)	(3.1–4.5)	2.7 (11)	(1.3–5.4)	0.64**	(0.48–0.84)	0.45*	(0.22–0.94)
Drug abuse	3.0 (99)	(2.3–3.9)	1.6 (101)	(1.2–2.0)	1.2 (3)	(0.3–4.4)	0.52***	(0.36–0.73)	0.38	(0.10–1.45)
Drug dependence	1.2 (38)	(0.8–1.7)	0.5 (36)	(0.3–0.8)	0.5 (2)	(0.1–2.0)	0.42**	(0.24–0.73)	0.41	(0.10–1.70)
Any drug	3.3 (109)	(2.5–4.2)	1.7 (108)	(1.3–2.1)	1.2 (3)	(0.3–4.4)	0.50***	(0.36–0.70)	0.35	(0.09–1.32)
Any substance	7.8 (240)	(6.6–9.3)	4.6 (283)	(3.9–5.5)	3.3 (12)	(1.6–6.8)	0.57***	(0.44–0.74)	0.41*	(0.20–0.85)
Any disorder	22.5 (704)	(20.6–24.6)	20.7 (1555)	(19.6–21.9)	24.2 (94)	(20.1–28.7)	0.90	(0.79–1.02)	1.02	(0.80–1.32)

US population incorporates respondents from the National Comorbidity Study Revised (NCS–R) [36]. Any disorder indicates whether individuals meet criteria for any mood disorder, any anxiety disorder, or any substance disorder. Additionally, although the original NLAAS sample had 495 Puerto Rican participants, 41 of these individuals were over the age of 65, so they were removed from the sample for this analysis. Then, 35 of the remaining NLAAS-PR individuals represented strata with 1 sampling unit and could not be included in the analysis, so they were removed as well. Thus, 419 members of the NLAAS-PR group were included in analyses

*Refers to $p \leq 0.05$

**Refers to $p \leq 0.01$

***Refers to $p \leq 0.001$

support, as well as some demographic that might be making comparisons of the three groups.

Table 3 presents results of two sets of adjusted comparisons between island Puerto Ricans and both the general US population and the US Puerto Rican sample. The first analyses (Model 2) adjusted for age, gender, monthly income, educational attainment, and employment. After these adjustments, there was a slight change in the comparison of island Puerto Ricans to the US population. There still was no difference in the any disorder result, and the excess risk of alcohol and psychoactive drug disorder persisted after adjustment. However, following adjustment there is a significant decline in any anxiety disorder for island Puerto Ricans relative to the US sample. After a further adjustment was made for social support (Model 3), the results from Model 2 remained essentially unchanged: Island Puerto Ricans were similar in their overall rate of disorder to the US population, but appeared to have relatively less anxiety disorder and relatively more alcohol and psychoactive drug disorder.

When comparing island Puerto Ricans to US Puerto Ricans, adjusting for demographics changed two results from the unadjusted comparisons in Table 2. Although there still was no statistically significant difference in overall disorder in Model 2, demographic adjustment led to significant differences in the rate of any mood and any anxiety, indicating lower rates of disorder in the island survey. When social support differences were further adjusted in Model 3, both the mood and anxiety differences were reduced in magnitude and were no longer significant (Table 3). Social support differences help explain the higher odds of mood and anxiety disorder in the US Puerto Rican sample; we cannot claim that all risk is explained as the non-significant ORs are still 1.26 or greater.

Discussion

This study investigated three questions. First, we examined whether island Puerto Ricans would demonstrate similar rates of overall psychopathology as the general US population—as they did decades ago. Our results were generally consistent with the comparison of the island to the US 3 decades ago [5]. Despite ongoing economic and social adversity in Puerto Rico as compared to the US, the overall burden of mood and anxiety disorder was similar across the sites, even after adjusting for socio-demographic differences between sites.

A qualification of this overall conclusion is a finding that both alcohol disorders and psychoactive drug disorders had 1-year rates that were nearly double in the Island Puerto Ricans relative to the US survey. This contrasts with the 1987 published results of Canino et al. [5]. Although, then, the prevalence of psychoactive drug disorders was not published, an increase in alcohol abuse/dependence in Puerto Rico relative to three sites of the epidemiological catchment area program was not found. Three years later, in another psychiatric epidemiology study, the prevalence of psychoactive drug disorder in the island was found to be considerably lower [37] than the reported rate of the five Epidemiologic Catchment Areas (ECA) of the United States [38].

It may be that this change in findings (i.e., that Puerto Rico has higher adjusted rates of SUDs than the US population) may be related to differences in the time that the US and PR surveys were conducted. The NCS-R and NLAAS surveys were carried out more than 10 years before the MHAASA survey. There is evidence that the prevalence of SUDs has increased substantially over the past decade [39–41]. For example, in wave 1 of the National Epidemiologic Survey on Alcohol and Related Conditions

Table 3 Adjusted comparisons of 12-month prevalence rates of psychiatric disorders among adults 18–64 years of age in Puerto Rico and the US

	US Population vs. Island PR ($N=4983$) vs. ($N=3062$)				US PR vs. Island PR ($N=419$) vs. ($N=3062$)			
	Model 2		Model 3		Model 2		Model 3	
	OR	CI	OR	CI	OR	CI	OR	CI
Any mood disorder	1.17	(0.96–1.42)	1.16	(0.95–1.42)	1.46*	(1.02–2.07)	1.26	(0.87–1.80)
Any anxiety disorder	1.30***	(1.11–1.53)	1.27**	(1.07–1.51)	1.54*	(1.02–2.32)	1.29	(0.86–1.94)
Any alcohol use disorder	0.65**	(0.47–0.90)	0.66*	(0.48–0.91)	0.51	(0.23–1.10)	0.51	(0.23–1.10)
Any drug use disorder	0.53**	(0.36–0.79)	0.52**	(0.34–0.78)	0.38	(0.10–1.51)	0.34	(0.10–1.38)
Any disorder	1.08	(0.93–1.25)	1.07	(0.92–1.25)	1.18	(0.90–1.55)	1.01	(0.90–1.55)

Model 2 adjusts for age, gender, income, education, and employment; Model 3 adjusts for the same factors, as well as social support

*Refers to $p \leq 0.05$

**Refers to $p \leq 0.01$

***Refers to $p \leq 0.001$

(NESARC) carried out in 2001–2002, the past 12-month prevalence rate of alcohol use disorder was 8.5% [40]. Wave 3 of the NESARC survey was carried out in 2012–2013 and the 12-month prevalence rate of alcohol use disorder had increased to 13.9% [39]. Similar published data are not available for drug use disorders for this survey. However, 2017 data from the National Survey on Drug Use and Health (NSDUH, [42]) show a prevalence rate of any psychoactive drug disorder for the population 12 years and up of the US of 2.8%, almost double the rate published 10 years ago by the NLAAS [16]. As in the US, in Puerto Rico, the rates of last year illicit psychoactive drug disorders have increased from 1.4% in 1987 [37] to 3.3% in 2014–2016. Similarly, although not as dramatic, the rate of last year alcohol use disorder has increased from 4.9% in 1984 [5] to 5.7% more than 30 years later.

Our second question posed whether differences in disorder prevalence would emerge between Puerto Ricans living in the island and Puerto Ricans living in the mainland. Our results showed, that after controlling for socio-demographic factors, although no difference was observed in overall rates of disorder, US Puerto Ricans reported significantly more anxiety and depressive disorders as compared to island Puerto Ricans. Given previous findings [16], we expected that this group would demonstrate higher rates of psychiatric disorder compared to island Puerto Ricans, as US-based Puerto Ricans represent an ethnic minority subject to discrimination, as opposed to island Puerto Ricans who are members of an ethnic majority group. Although our survey did not assess ethnic/racial discrimination, it is less likely that the island population experiences this risk factor given that most of the population belongs to the same ethnic/racial group. Furthermore, prior studies comparing Puerto Rican adolescents in San Juan and the South Bronx indicated that Puerto Rican youth in the Bronx reported more ethnic/racial discrimination than Puerto Rican youth in San Juan [20].

Our third question was related to whether these three groups experienced different levels of social support, which might help to explain the lack of differences in mood and anxiety disorder prevalence rates. We had hypothesized that the risk of mental disorders on island Puerto Ricans might be offset by higher rates of social support in the Island, given previous findings demonstrating the importance of social support among the US Puerto Rican population [11]. We found the level of social support was indeed higher in the island PR sample than in the two US samples. However, adjusting for social support when comparing island Puerto Ricans to the US sample did not lead to the expected increase in risk for the island Puerto Ricans. On the other hand, the hypothesis was supported in comparisons between island Puerto Ricans and US Puerto Ricans; the initially observed elevated risk in the US Puerto Rican sample was reduced in size and was no longer significant when adjusted for social support. This is consistent with prior research evidence that greater social support may serve to buffer stress and discrimination [43] and can act as a source of resilience against developing internalizing symptoms in Latinos [44, 45]. Social support may help shield against the effects of distress by lessening negative feelings about the self and exercising a lasting impact on mental health outcomes. The similarity in both island and US Puerto Ricans (after adjusting) regarding the role of social support in buffering stress and its impact on mental health may be related to the circulatory migration of a great portion of Puerto Ricans (from a quarter to a third of the island population) [21]. This circular migration may help to maintain traditional values of social support in the population. Circular migration has been associated with an escape valve that buffers stress and what has been called "intractable cultural borders" referring to Puerto Ricans who move back and forth but also retain their cultural values [22].

It was surprising that social support did not help explain the lack of differences between the US general population and the island. The absence of social support not having an impact for the general US population (composed of mainly non-Latino whites) as contrasted to Puerto Ricans in the island and mainland might have three potential explanations. First, there is evidence of cultural differences in how ethnic/racial groups seek support [46] and rely on kinship to disclose distress [47]. Chang and colleagues [47] describe how Latinos and Asian Americans, as compared to Whites, have a greater reliance on friends, which might allow them to effectively use social support to obtain emotional relief. A second explanation is that Latinos might be more willing to disclose their emotional needs to their social ties to solicit help than non-Latino whites [48]. A third explanation is that the obtained social support might be perceived as being less effective for non-Latino whites than for Latinos [46] and, therefore, lead to less benefit for relief. A final explanation is that the four-item measure of social support that was available in the three surveys might not have reflected the cultural complexity of social support systems in Puerto Rican culture. Moreover, the self-reported contact with friends and family and perceived availability of support might have itself been affected by experience with mental health problems. Ideally, social support systems would be measured independently of the assessment of disorder. These findings identify social support as a variable worthy of further exploration to better understand how it contributes to differences in disorder prevalence among ethnic/racial populations.

Interpretation of the described results should consider several acknowledged limitations, including the time difference in survey administration, as noted above. Other potential methodological differences between and among these surveys may have included interviewer training, quality control procedures, and participants' understanding of

the constructs assessed. These methodological differences could introduce unknown factors which may account for differences across studies in prevalence rates. Furthermore, the surveys were focused on the most common psychiatric disorders and excluded more severe disorders relatively rare such as obsessive compulsive disorders, schizophrenia, and impulse control disorders. These disorders were excluded given their low concordance with clinical diagnoses in clinical reappraisal studies which tended to show over-estimation of the rates of these disorders, particularly schizophrenia [49]. Given the high comorbidity rates of these severe disorders with some of the disorders measured in the three studies, we do not expect this exclusion to have affected our overall prevalence rates [50, 51].

Despite these methodological limitations, there is remarkable consistency of results across the three surveys Furthermore, for the first time we could compare the risk of psychopathology between island and mainland Puerto Rican populations and showed that as in the comparison with other US Latino groups, mainland Puerto Ricans had higher adjusted rates of anxiety and depressive disorders as compared to island Puerto Ricans. Finally, we note the importance of these findings for future research on the catastrophic impact of the 2017 hurricane Maria. This storm created unprecedented destruction on the island; it revealed the limitations of the US and island governments in providing relief from the destruction, and it prompted massive migration from the island in the weeks and months following the storm. The fact that Puerto Ricans on the island have maintained levels of mental health that are comparable to levels in the US in the face of previous economic adversity may give hope for their resilience following Hurricane Maria.

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Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

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