



Psychological resilience, resilient coping, and health behaviors among adults in Puerto Rico after multiple adverse events

Laura Sampson^{a,b,c,*}, Ariel H. Kim^c, H. June O'Neill^d, Martha Tamez^d, Luis M. Falcon^e, Katherine L. Tucker^f, Edna Acosta-Pérez^g, Jose F. Rodriguez Orengo^{h,i}, Laura D. Kubzansky^j, Karestan C. Koenen^{c,k}, Josiemer Mattei^d

^a Program in Public Health, Stony Brook University, Stony Brook, NY, USA

^b Department of Family, Population, and Preventive Medicine, Renaissance School of Medicine, Stony Brook University, Stony Brook, NY, USA

^c Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA

^d Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, MA, USA

^e Department of Sociology, College of Fine Arts, Humanities, & Social Sciences, University of Massachusetts Lowell, Lowell, MA, USA

^f Department of Biomedical and Nutritional Sciences, Zucker College of Health Sciences, and Center for Population Health, University of Massachusetts Lowell, Lowell, MA, USA

^g Center for Evaluation and Sociomedical Research, Graduate School of Public Health and The Hispanic Alliance of Clinical and Translational Research, Chancellor Office University of Puerto Rico - Medical Sciences Campus, San Juan, Puerto Rico, USA

^h Department of Biochemistry, University of Puerto Rico - Medical Sciences Campus, San Juan, Puerto Rico, USA

ⁱ FDI Clinical Research, San Juan, Puerto Rico, USA

^j Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA, USA

^k Psychiatric and Neurodevelopmental Genetics Unit, Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA

ARTICLE INFO

Keywords:
Resilience
Coping
Trauma
Natural disasters
Pandemic
Health behaviors

ABSTRACT

Objective: Residents of Puerto Rico have recently experienced multiple adverse events, including hurricanes, earthquakes, and political unrest. Such adversity is associated with worse mental and physical health. Psychological resilience and effective coping may mitigate these relations by fostering positive health behaviors, like consuming a high-quality diet and being physically active. However, empirical evidence for these relationships is limited. **Methods:** We assessed psychological resilience, resilient coping, and health behaviors among two groups of adults in Puerto Rico, before and during the pandemic, in 2019–2023 (total N = 1,342). Resilience and resilient coping were assessed using the Brief Resilience Scale and Brief Resilient Coping Scale. Diet quality was defined by the Alternate Healthy Eating Index from a food frequency questionnaire. We collected data on sleep, physical activity, alcohol intake, and tobacco use using validated questionnaires. **Results:** Adjusting for confounders, higher resilience z-scores were associated with being in the highest category of diet quality [OR: 1.25, 95 % CI: 1.04, 1.50]; getting 7–8 h of sleep per night [OR: 1.15, 95 % CI: 1.02, 1.30]; and reporting moderate or heavy physical activity (vs. light or sedentary) [OR: 1.17, 95 % CI: 1.02, 1.34]. The same patterns were observed for higher resilient coping z-scores, and for categorical measures of resilience and resilient coping. These relationships were stronger among participants interviewed during (vs. before) the COVID-19 pandemic, suggesting that resilience and resilient coping may be particularly relevant during an ongoing stressor. **Conclusion:** Identifying supportive strategies to cultivate resilience and effective coping mechanisms may contribute to healthier behaviors, particularly in a vulnerable population.

1. Introduction

Traumatic societal events can adversely influence health (Lantz et al., 2005; Pietrzak, Goldstein, et al., 2012a). Society-wide trauma can

range from persistent financial scarcity or violence to less predictable events like economic shocks or climate-related disasters. For example, high-income nations saw a decline in self-rated health and increased morbidity and psychological distress after the 2007–2009 Great

* Corresponding author at: Program in Public Health, Stony Brook University, Stony Brook, NY, USA.

E-mail address: Laura.Sampson@stonybrookmedicine.edu (L. Sampson).

<https://doi.org/10.1016/j.pmedr.2024.102874>

Received 10 May 2024; Received in revised form 22 August 2024; Accepted 23 August 2024

Available online 30 August 2024

2211-3355/© 2024 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Recession (Margerison-Zilko et al., 2016). Political events of vast magnitude (e.g., presidential elections) also have negative health effects, particularly in communities that have been marginalized or oppressed (Williams & Medlock, 2017).

Systematic reviews suggest that individuals with higher psychological resilience or positive coping strategies have better mental and physical health (Avila et al., 2017; Cal et al., 2015; Park et al., 2022; Taylor & Stanton, 2007). Population-based studies have shown that most individuals demonstrate resilience after trauma (Bonanno, 2004; Bonanno et al., 2006; Pietrzak, Tracy, et al., 2012b), by engaging core aspects of resilience, e.g., personal control, a sense of coherence, and use of resources, which guide effective stress responses (Reich, 2006). Resilience can also be defined as positive psychological functioning, the absence of significant psychopathology despite experiencing of trauma, or the ability to cope effectively after adversity (Bonanno, 2004; Bonanno & Diminich, 2013; Luthar et al., 2000). Investigators speculate that resilience and coping may buffer negative health outcomes partly through a health behavior pathway (Krok et al., 2023). Although some studies have found that health behaviors influence later resilience and coping levels (Segovia et al., 2013; Wister et al., 2022), the bulk of the literature suggests that the directionality of this association proceeds from resilience to health behaviors. For example, in the NutriNet-Santé study, participants with higher resilience reported better overall diet quality, including a greater intake of seafood and whole-grain foods and lower intake of ultra-processed foods and confectionery products (Robert et al., 2022). Similarly, higher resilience among Australian adolescents was associated with higher physical activity levels, independent of psychological distress (To et al., 2022). In the Women's Health Initiative, higher resilience was associated with higher odds of adhering to a better diet and recommended physical activity, sleeping 7–9 h per night, and consuming alcohol moderately (Springfield et al., 2020).

Despite data suggesting a connection between resilience and health behaviors, few studies on this topic have been conducted in the context of population-level adversity, instead primarily focusing on individual-level experiences like childhood trauma (Hughes et al., 2017; Nishimi et al., 2022). Furthermore, scant research in this area is conducted among vulnerable communities who already experience disproportionate social inequities that increase their risk for unhealthy behaviors and disease (OHCHR, United Nations, n.d.).

Residents of Puerto Rico, a territory of the United States, are a vulnerable population with documented social and health inequities (Previdi & Vega, 2020) who have recently experienced multiple society-wide traumas. In the past seven years, Puerto Rico has faced Hurricanes Irma and María (2017), earthquakes in 2019–2020, Hurricane Fiona (2022), sociopolitical unrest, an enduring economic crisis, and the COVID-19 pandemic (Ezell et al., 2021). Studies have documented adverse physical, mental, and behavioral health outcomes, including higher sedentarism and binge drinking, after these events (Ezell et al., 2021; García et al., 2021; Hernández-Torres et al., 2023; Llibre-Guerra et al., 2020; López-Cepero et al., 2022; Mattei et al., 2022; Scaramutti et al., 2019). Simultaneously, these events sparked narratives of resilience, unity, crafting a 'new normal', and rebuilding, as individuals shifted their outlook, especially among underserved groups (Marrero et al., 2022; Petrun Sayers et al., 2023; Sato et al., 2022; Yabe et al., 2021). Meaning-making (the meaning that individuals give to a difficult event) is likely to be a key process here, as it was shown to be a primary mediator in the relationship between resilience and health behaviors in a serial mediation analysis of data collected among recovered COVID-19 patients in a different geographic setting (Krok et al., 2023).

Based on a meaning-making theoretical model positing that reframing negative experiences may help people adopt healthy behaviors (Krok et al., 2023), and on the existing literature above, we hypothesized that higher psychological resilience and resilient coping in the context of these events in Puerto Rico would be associated with better diet quality, more physical activity, healthier sleep duration, moderate or no alcohol use, and no tobacco use. We further

hypothesized that the relationships between psychological resilience and health behaviors would be strongest (i.e., most evident) among participants interviewed during the COVID-19 pandemic, an additional stressful event that began in the middle of our recruitment period, contributing to worsening health behaviors in other populations (Du et al., 2021; Knell et al., 2020) and plausibly operating as an effect modifier in the relationships between resilience or resilient coping and health behaviors.

2. Methods

2.1. Sample

This study used cross-sectional data from the Puerto Rico Observational Study of Psychosocial, Environmental, and Chronic Disease Trends (PROSPECT), an ongoing study beginning in 2019 (Mattei et al., 2021). See Appendix for recruitment details. Briefly, adults aged 30–75 who had lived in Puerto Rico for at least the prior year and were able to answer questions without assistance were recruited using multiple sampling strategies. Eligible participants were invited to an interview administered by trained research assistants at partner clinics, following standardized procedures. Participants provided written, informed consent. The Harvard T.H. Chan School of Public Health Institutional Review Board approved this study. All procedures were performed in compliance with relevant laws and institutional guidelines.

At the time of analysis, 1,367 individuals were interviewed. After removing 25 incomplete or inaccurate interviews, 1,342 individuals were included in this study. Analyses considering diet quality as an outcome used a smaller sample of 738 participants whose food frequency questionnaires were processed by the time of analysis.

2.2. Resilience and resilient coping

Self-rated resilience was measured with the Spanish Brief Resilience Scale (BRS), which assesses the ability to rebound from stressful events (Rodríguez-Rey et al., 2016). Self-reported resilient coping was measured with the Spanish Brief Resilient Coping Scale (BRCS), which assesses perceived competence and coping tactics (Limonero et al., 2014). Both measures have been shown to be reliable in other Spanish-speaking populations. The BRS includes six items (e.g., "I tend to bounce back quickly after hard times"), each rated on a scale from 1 to 5 ("totally disagree" to "totally agree"). The overall score is calculated as the mean of the individual responses. The mean score was categorized into low resilience (1.0–2.9), medium resilience (3.0–4.2), and high resilience (4.3–5.0) for clearer interpretations, and based on prior work (Smith et al., 2013). The BRCS includes four items (e.g., "I look for creative ways to alter difficult situations"), each rated on a scale from 1 to 5 ("does not describe me at all" to "describes me very well"). The total score is calculated as the sum of the individual responses. The total score ranges from 4 to 20, with pre-defined categories of low (4–13), medium (14–16), and high resilient coping (17–20), based on prior work (Lee Kum Sheung Center for Health and Happiness, Harvard T.H. Chan School of Public Health, n.d.; Limonero et al., 2014; Sinclair & Wallston, 2004). Cronbach's alpha was 0.79 for the BRS and 0.84 for the BRCS. The Pearson correlation between the two standardized scores was 0.40 ($P < 0.0001$), suggesting that the two scales share variance but are distinct. Thus, each variable was included as an exposure in separate models (i.e., no models included both exposures simultaneously). Further, each was modeled as both a continuous, standardized variable and a categorical variable in separate models.

2.3. Health behaviors

We considered diet quality, sleep duration, physical activity, alcohol use, and smoking (tobacco use) as outcomes. Diet was measured with a food frequency questionnaire, culturally adapted for this population and

validated against biomarkers of intake (Palacios et al., 2015; Tucker et al., 1998, 2010). The Minnesota Nutritional Data System (NDS-R, version 5.0.35) was used for food and nutrient analyses, and the Alternate Healthy Eating Index (AHEI) was used to classify diet quality (McCullough & Willett, 2006). We tertiled the overall AHEI scores to create three categories of diet quality, relative to the sample, as done in the Multiethnic Cohort to determine association with type 2 diabetes and cardiometabolic factors (Jacobs et al., 2017).

Physical activity at work, outside, or at home was measured using a modified version of the Paffenbarger questionnaire from the Harvard Alumni Activity Survey, which was validated against objective activity measures and tested in Puerto Rican adults (Paffenbarger et al., 1978, 1993; Tucker et al., 2010). A physical activity score was calculated as the sum of hours spent on typical daily activities, multiplied by weighting factors that parallel the rate of oxygen consumption associated with each activity. Physical activity levels were defined as sedentary, light, moderate, and vigorous/heavily active, using cutoffs previously established among Puerto Rican adults to reflect physical activity guidelines (Sotos-Prieto et al., 2015). For regressions, a binary variable was created to combine sedentary and light activity vs. moderate/vigorous physical activity.

Sleep duration, alcohol intake, and tobacco use information was collected using questions previously asked in this and similar populations (Li et al., 2014; Tucker et al., 2010). Usual hours of sleep per 24-hour period were classified as short (≤ 6 h), healthy (7–8 h), or long duration (≥ 9 h). For the regressions, we created a binary variable of extreme sleep (short or long) vs. healthy sleep, based on evidence of association with both short and long sleep duration and overall mortality and incidence of various chronic diseases (Cappuccio et al., 2010; Chaput et al., 2020; Jike et al., 2018). Alcohol use was probed for frequency of intake of common alcoholic beverages; responses were categorized into heavy drinking (≥ 8 drinks per week for women or ≥ 15 drinks per week for men) vs. moderate or no drinking; we also ran a sensitivity analysis excluding non-drinkers. Tobacco use was categorized as being a never, former, or current smoker; a binary variable was created to define non-smoker vs. current or former smoker for regressions.

2.4. Covariates

The Supplemental Methods (Appendix) details the covariates. Briefly, participants provided information on sex at birth, ethnicity, marital status, education, income, area of residence, household size, health insurance, and personal and family history of major chronic diseases (Choi et al., 2019; Garg et al., 2022). A physical morbidity index was created by summing responses to 25 self-reported chronic health conditions ever diagnosed by a health professional (Appendix Table 1).

A “mental health index” was considered as an additional potential covariate in sensitivity analyses, given the relationships between other aspects of mental health and both resilience/resilient coping and health behaviors (Walsh et al., 2013; Weitzel et al., 2022). See Appendix for more details. Briefly, the index was calculated by summing probable disorders based on screeners of depression (Center for Epidemiologic Studies-Depression Scale (Falcón & Tucker, 2000; González et al., 2017; Radloff, 1977)), anxiety (Generalized Anxiety Disorder-7 (García-Campayo et al., 2010; Löwe et al., 2008; Spitzer et al., 2006)), and post-traumatic stress syndrome (Eisenman et al., 2003; Lang & Stein, 2005), or self-reported current or past medical diagnosis of depression, anxiety, and “other mental or psychological diagnosis”. Other psychosocial covariates considered in sensitivity analyses were short-term stress (14-item Perceived Stress Scale (Cohen et al., 1983; Falcon et al., 2009; Perera et al., 2017)); loneliness (3-item UCLA Loneliness Scale (Hughes et al., 2004)); and social support (Interpersonal Support Evaluation List-12 (Merz et al., 2014; Sarason & Sarason, 1985)).

2.5. Effect modifier

We stratified analyses into two groups of participants by date of completing the interview in relation to the COVID-19 pandemic: participants who completed interviews between March 21, 2019–March 16, 2020 were considered pre-pandemic. Those who completed interviews between May 12, 2020–April 4, 2023 were considered “during pandemic.” These were two separate groups of individuals, based on interview timing; no longitudinal within-person data was available.

2.6. Statistical analyses

We assessed the distribution of participants’ sociodemographic, psychosocial, and health factors, overall, and by levels of resilience or resilient coping (Table 1). We assessed the distributions of the five health behavior outcomes, overall and by levels of resilience or resilient coping, before dichotomizing the outcomes for regressions (Table 2). Separate logistic models estimated odds ratios (95 % confidence intervals) of engaging in high diet quality, healthy sleep duration, moderate or heavy physical activity, non-heavy alcohol use, and being a non-smoker, with BRS and BRCS separately entered as a continuous score (z-score) or as categories (Table 3). Outcomes were dichotomized for comparability across models and practical interpretation. Models were adjusted for the potential confounders listed above. Given correlations among health behaviors (Saint Onge & Krueger, 2017; Sotos-Prieto et al., 2015), we also adjusted for the health behaviors other than the outcome of interest in our primary models (e.g., when modeling diet quality as the outcome, we adjusted for sleep duration, physical activity, alcohol use, and smoking status). We further adjusted models for mental health and psychosocial indicators listed above as a sensitivity analysis (Table 3). Finally, we stratified the primary models by pre-pandemic timing vs. during the pandemic (Fig. 1, Appendix).

Missing data information is included in the Appendix.

3. Results

The mean BRS score in this sample was 3.7 (standard deviation (SD) = 0.9). The mean BRCS score was 17.9 (SD = 2.9). For the BRS categories, participants had low (17.9 %), medium (44.4 %), and high resilience (37.7 %). For the BRCS, participants had low (7.3 %), medium (20.6 %), and high (72.2 %) coping.

The mean age was 52.1 years (SD = 11.6; Table 1). Participants were predominantly female at birth and of Puerto Rican ethnicity. Participants in the high BRS category were more likely to be married, have higher educational attainment, report higher income, and report fewer mental health conditions, compared to the low and medium BRS groups. Similar trends were observed for BRCS categories.

Participants in the high (vs. low or medium) BRS category were more likely to be in the top tertile for total AHEI score, have healthy sleep hours, and engage in moderate/vigorous physical activity; similar patterns were observed for BRCS (Table 2). There were also more current smokers in the low BRS (14.0 %) and BRCS (18.0 %) categories, compared to only 12.1 % in the overall sample. Finally, there were more heavy drinkers in the high BRS (16.8 %) and BRCS (14.0 %) groups, compared to 13.2 % in the total sample.

After adjusting for potential confounders, we observed positive associations for both resilience and resilient coping with better diet quality, healthier sleep hours, and more physical activity, when modeling either the standardized scores or the categorical variables as predictors (Table 3). For example, participants in the highest BRS category had higher odds of being in the healthiest diet quality group [OR: 1.87, 95 % CI: 1.08, 3.22]. Similarly, those in the highest BRCS category had higher odds of reporting healthy sleep hours compared to extreme sleep hours [OR: 2.05, 95 % CI: 1.27, 3.31]. Neither resilience nor resilient coping were clearly or meaningfully associated with alcohol use or smoking status. Findings were similar in analyses with alcohol use

Table 1
Descriptive characteristics, overall and by levels of resilience and resilient coping, among 1,342 adults interviewed in 2019–2023 in Puerto Rico.

	Resilience (BRS; total score range: 1–5;mean: 3.7)			Resilient coping (BRCS; total score range: 4–20; mean: 17.9)			
	Low resilience (1.0–2.9)	Medium resilience (3.0–4.2)	High resilience (4.3–5.0)	Low coping (4–13)	Medium coping (14–16)	High coping (17–20)	
	n (%) or mean (SD)	n (%) or mean (SD)		n (%) or mean (SD)			
Age	52.1 (11.6)	50.9 (11.1)	52.3 (11.6)	52.7 (12.0)	50.0 (10.9)	50.5 (11.2)	52.9 (11.8)
Sex at birth							
Male	344 (26.5)	58 (26.2)	139 (25.4)	127 (27.4)	27 (30.3)	70 (27.7)	226 (25.5)
Female	956 (73.5)	163 (73.8)	408 (74.6)	337 (72.6)	62 (69.7)	183 (72.3)	660 (74.5)
Ethnicity							
Puerto Rican	1219 (93.8)	205 (92.8)	514 (94.0)	437 (94.2)	87 (97.8)	237 (93.7)	828 (93.5)
Dominican	36 (2.8)	4 (1.81)	19 (3.5)	10 (2.2)	1 (1.1)	4 (1.6)	29 (3.3)
Other	45 (3.46)	12 (5.4)	14 (2.6)	17 (3.7)	1 (1.1)	12 (4.7)	29 (3.3)
Marital status							
Married or partnered	617 (47.6)	93 (42.3)	264 (48.4)	235 (50.7)	39 (44.3)	129 (51.2)	423 (47.7)
Divorced, separated, or widowed	321 (24.8)	61 (27.7)	127 (23.3)	113 (24.4)	20 (22.7)	55 (21.8)	225 (25.4)
Single	358 (27.6)	66 (30.0)	155 (28.4)	116 (25.0)	29 (33.0)	68 (27.0)	238 (26.9)
Education							
Less than high school	85 (6.6)	24 (10.9)	39 (7.1)	16 (3.46)	16 (18.2)	20 (7.9)	44 (5.0)
High school graduate or GED	228 (17.6)	47 (21.4)	93 (17.0)	75 (16.2)	17 (19.3)	46 (18.3)	152 (17.2)
Some college or Associates degree	325 (25.1)	68 (30.9)	135 (24.7)	106 (22.9)	21 (23.9)	68 (27.0)	217 (24.6)
College degree	364 (28.1)	47 (21.4)	147 (26.9)	152 (32.9)	22 (25.0)	69 (27.4)	253 (28.6)
Graduate degree	292 (22.6)	34 (15.5)	132 (24.2)	113 (24.5)	12 (13.6)	49 (19.4)	218 (24.7)
Yearly income							
≤\$10,000	359 (28.6)	88 (41.3)	142 (27.1)	102 (22.3)	35 (40.2)	85 (34.3)	209 (24.5)
\$10,001–20,000	328 (26.1)	56 (26.3)	142 (27.1)	117 (25.6)	27 (31.0)	62 (25.0)	223 (26.1)
\$20,001–50,000	427 (34.0)	56 (26.3)	186 (35.4)	169 (37.0)	18 (20.7)	83 (34.3)	308 (36.1)
>\$50,000	141 (11.2)	13 (6.10)	55 (10.5)	69 (15.1)	7 (8.1)	16 (6.5)	114 (13.4)
Area of residence							
Urban	866 (66.7)	144 (65.8)	373 (68.2)	302 (65.1)	58 (65.2)	181 (71.8)	577 (65.2)
Rural	330 (25.4)	58 (26.5)	135 (24.7)	126 (27.2)	26 (29.2)	55 (21.8)	237 (26.8)
Peri-urban	102 (7.9)	17 (7.8)	39 (7.1)	36 (7.8)	5 (5.6)	16 (6.4)	71 (8.2)
Household family size	2.49 (1.2)	2.47 (1.2)	2.45 (1.3)	2.56 (1.3)	2.22 (1.0)	2.62 (1.3)	2.49 (1.2)
Survey timing							
Completed during COVID-19	784 (60.3)	138 (62.4)	279 (51.0)	323 (69.6)	51 (57.3)	115 (45.5)	572 (45.6)
Completed before COVID-19	516 (39.7)	83 (37.6)	268 (49.0)	141 (30.4)	38 (42.7)	138 (54.6)	314 (35.4)
Health insurance							
No health insurance	51 (3.9)	8 (3.6)	25 (4.6)	17 (3.7)	7 (7.9)	5 (2.0)	38 (4.3)
Health insurance	1246 (96.1)	212 (96.4)	522 (95.4)	447 (96.3)	82 (92.1)	247 (98.0)	848 (95.7)
Family history of chronic conditions							
<5 of 8 conditions in family history	725 (56.4)	100 (45.7)	325 (59.7)	259 (56.2)	54 (60.7)	151 (59.7)	477 (54.3)
≥5 of 8 conditions in family history	561 (43.6)	119 (54.3)	219 (40.3)	202 (43.8)	35 (39.3)	102 (40.3)	401 (45.7)
Physical morbidity Index	3.3 (2.6)	3.8 (2.7)	2.5 (1.3)	2.6 (1.3)	3.7 (2.7)	3.2 (2.6)	3.3 (2.5)
Mental health morbidity index	1.4 (1.7)	3.1 (1.8)	1.4 (1.6)	0.7 (1.1)	2.8 (2.0)	1.7 (1.8)	1.2 (1.5)
Loneliness scale	4.5 (1.7)	5.5 (2.2)	4.5 (1.6)	3.9 (1.3)	5.9 (2.1)	4.7 (1.7)	4.2 (1.6)
Social support scale	27.8 (8.5)	23.0 (10.2)	27.2 (7.5)	31.0 (7.3)	19.8 (9.5)	26.0 (7.3)	29.2 (8.1)
Perceived Stress Scale	17.0 (10.4)	25.0 (10.8)	18.2 (9.3)	11.7 (8.4)	27.1 (10.5)	20.5 (8.7)	14.9 (10.0)

BRS = Brief Resilience Scale (higher score = higher resilience), BRCS = Brief Resilient Coping Scale (higher score = higher coping). Physical morbidity index: sum of 25 self-reported conditions ever diagnosed by a health professional (see Appendix). Mental health index: sum of endorsements of probable depression, anxiety, or post-traumatic stress disorder, as well as self-reported current or past medical diagnosis of depression, anxiety, or “other mental or psychological diagnosis” (range: 1–6). Loneliness: 3-item UCLA Loneliness Scale (higher score = more loneliness). Social support: Interpersonal Support Evaluation List-12 (higher score = more social support).

that excluded non-drinkers (not shown).

Across outcomes, after additionally adjusting for the mental health index and other psychosocial factors, results remained consistent, albeit with wider confidence intervals and slightly attenuated estimates for healthy sleep hours (e.g., OR for standardized BRCS: 1.09 [95 % CI: 0.95, 1.26] in Model 2 compared to OR: 1.25 [95 % CI: 1.10, 1.41] in Model 1, Table 3). Across outcomes, consistent results were also observed in analyses that did not adjust for other health behaviors (see Appendix Table 2).

In our analyses stratified by date of interview in relation to the pandemic, associations between BRS and BRCS with higher diet quality,

healthy sleep duration, and more physical activity were consistently stronger among individuals interviewed during COVID-19, compared to those interviewed pre-pandemic (Fig. 1 and Appendix Table 3). For example, no relationship was observed between standardized BRCS and healthy sleep duration among those interviewed pre-pandemic [OR: 0.98, 95 % CI: 0.81, 1.18], whereas the magnitude of the estimate was substantially stronger among those interviewed during the pandemic [OR: 1.48, 95 % CI: 1.24, 1.76], with non-overlapping confidence intervals (Fig. 1, Appendix Table 3).

Table 2
Prevalence of health behaviors, overall and by levels of resilience and resilient coping, among 1,342 adults, 2019–2023, Puerto Rico.

	AHEI tertiled (n (%))			Average sleep hours (3 categories)(n (%))				
	Bottom AHEI tertile	Middle AHEI tertile	Top AHEI tertile	6 or fewer hours per night	7–8 h per night	9 or more hours per night		
Total sample	246 (33.3)	246 (33.3)	246 (33.3)	509 (40.3)	675 (53.4)	79 (6.3)		
By level of resilience (BRS):								
Among those with low resilience	44 (38.6)	43 (37.7)	27 (23.7)	109 (49.6)	94 (42.7)	17 (7.7)		
Among those with medium resilience	108 (33.8)	106 (33.1)	106 (33.1)	221 (40.5)	297 (54.4)	28 (5.1)		
Among those with high resilience	78 (29.8)	83 (31.7)	101 (38.6)	162 (35.1)	270 (58.4)	30 (6.5)		
By level of resilient coping (BRCS):								
Among those with low resilient coping	32 (65.3)	8 (16.3)	9 (18.4)	49 (55.7)	33 (37.5)	6 (6.8)		
Among those with medium resilient coping	57 (38.8)	53 (36.1)	37 (25.2)	110 (43.5)	128 (40.6)	15 (5.9)		
Among those with high resilient coping	142 (28.5)	171 (34.3)	186 (37.3)	333 (37.7)	496 (56.2)	54 (6.1)		
	Physical Activity (n (%))			Heavy drinking (n (%))		Smoking status (n (%))		
	Sedentary/ Lightly active	Moderately active	Heavily active	Heavy drinking	Non-heavy drinking	Never smoker	Former smoker	Current smoker
Total sample	897 (69.0)	286 (22.0)	117 (9.0)	135 (13.2)	891 (86.8)	869 (68.6)	244 (19.3)	153 (12.1)
By level of resilience (BRS):								
Among those with low resilience	159 (72.0)	48 (21.7)	14 (6.3)	20 (11.3)	157 (88.7)	152 (68.8)	38 (17.2)	31 (14.0)
Among those with medium resilience	403 (73.7)	96 (17.6)	48 (8.8)	49 (10.8)	403 (89.2)	377 (69.1)	107 (19.6)	62 (11.4)
Among those with high resilience	284 (61.2)	128 (27.6)	52 (11.2)	63 (16.8)	311 (83.2)	320 (69.0)	92 (19.8)	52 (11.2)
By level of resilient coping (BRCS):								
Among those with low resilient coping	65 (73.0)	15 (16.9)	9 (10.1)	7 (10.9)	57 (89.1)	60 (67.4)	13 (14.6)	16 (18.0)
Among those with medium resilient coping	188 (74.3)	46 (18.2)	19 (7.51)	24 (11.3)	188 (88.7)	176 (69.6)	52 (20.6)	25 (9.9)
Among those with high resilient coping	589 (66.5)	211 (23.8)	86 (9.71)	101 (14.0)	623 (86.1)	609 (68.8)	171 (19.3)	105 (11.9)

BRS = Brief Resilience Scale, BRCS = Brief Resilient Coping Scale, AHEI = Alternative Healthy Eating Index.

4. Discussion

In this cross-sectional study of adults in Puerto Rico who experienced multiple adversities, we found higher self-rated resilience and resilient coping were associated with healthier quality diet, physical activity, and sleep duration after adjusting for confounders, including physical and mental health conditions and other health behaviors. These positive associations were stronger among individuals interviewed during the COVID-19 pandemic, suggesting that resilience and resilient coping may be particularly relevant for health behaviors during an ongoing, collective stressor.

Some ways in which resilience and coping may influence health behaviors like diet and physical activity are through meaning-making, self-efficacy, and effective use of resources—skills or processes that individuals may have relied on during prior instances of trauma as well (Choi et al., 2023). As noted in our theoretical model based on Krok et al. (Krok et al., 2023), meaning-making can help re-frame negative experiences and promote positive health behaviors.

The finding that observed associations were stronger among participants interviewed during the COVID-19 pandemic points to the unique nature of this protracted, collective stressor. The pandemic led to strict lockdown policies that affected behaviors for many people, for example the closing of gyms and social gathering spaces, in addition to limited supermarket access (Du et al., 2021; Knell et al., 2020). Given this unique and unprecedented situation, participants may have had to utilize coping skills and resilience more strongly than before the pandemic. Furthermore, coping and resilience themselves can change over time and may be situation-dependent (Nielsen & Knardahl, 2014; Stewart & Schwarzer, 1996), and thus may be activated or enhanced during extremely stressful periods. However, it is important to note that these stratified analyses compared two different groups of individuals interviewed at different times. Given the lack of longitudinal data, we could not assess changes over time within the same individuals.

The unique context of Puerto Rico adds nuance to the observed

relationships. The political and economic colonialism and oppression that the population has faced for more than a century, on top of individual trauma, undoubtedly shape resilience and behaviors (Marín & Marín, 1991; Rodríguez-Madera et al., 2021). Additionally, the island has faced numerous challenges including natural disasters, which have further tested the resilience of its residents (Rodríguez-Madera et al., 2021). At the same time, there is a strong cultural history, identity, and a sense of community that may buffer some trauma, promote greater resilience, and influence health behaviors (Gallo et al., 2009; Marín & Marín, 1991; Petrun Sayers et al., 2023). Thus, the community’s cohesion and cultural history may serve as protective factors against the negative impacts of stressors on health behaviors. This sense of belonging and shared identity may foster support networks and encourage healthier coping mechanisms among individuals (Idali Torres et al., 2008; Ramos-Olazagasti et al., 2013).

Despite differences in populations and context, results from our study are consistent with findings in other populations, including a study of older US women from the Women’s Health Initiative (WHI), which found that higher resilience was associated with better quality diet, recommended physical activity, and 7–9 h of sleep per night, with estimates of similar magnitude to those found here (Springfield et al., 2020). The WHI study also found a null relationship between resilience and smoking status, consistent with ours. However, unlike in their study, we did not observe an association between higher resilience and moderate (non-heavy) alcohol use. This could be because moderate or non-heavy alcohol use was defined differently across the two studies, or because our study included both men and women, or because the WHI data were collected before COVID-19. Importantly, when we adjusted for loneliness and social support, we did not see large changes in these results, even though individuals who socialize frequently may report higher resilience and consume more alcohol (Sudhinaraset et al., 2016). One potential reason for the null relationships we observed between resilience/resilient coping and smoking could be the relative stability of smoking patterns over time compared to other behaviors; smoking may

Table 3

Adjusted logistic models estimating odds (95% confidence interval) of engaging in health behaviors by continuous z-scores or categories of resilience or resilient coping, among 1,342 adults, 2019–2023, Puerto Rico.

	Top AHEI tertile vs. middle or low	Healthy sleep hours vs. extreme sleep hours	Moderate or heavy physical activity vs. sedentary or light activity	Non-heavy drinking vs. heavy drinking	Non-smoker vs. current or former smoker
<i>Odds ratio (95 % confidence interval)</i>					
Model 1					
Resilience (BRS) score, standardized	1.25 (1.04, 1.50)	1.15 (1.02, 1.30)	1.17 (1.02, 1.34)	0.83 (0.67, 1.03)	1.01 (0.84, 1.22)
BRS categorical:					
Medium resilience vs. low resilience	1.58 (0.93, 2.68)	1.39 (0.99, 1.95)	0.95 (0.65, 1.39)	1.20 (0.66, 2.19)	1.02 (0.61, 1.70)
High resilience vs. low resilience	1.87 (1.08, 3.22)	1.68 (1.19, 2.38)	1.62 (1.11, 2.37)	0.79 (0.44, 1.43)	0.96 (0.57, 1.64)
Resilient coping (BRCS) score, standardized	1.31 (1.07, 1.60)	1.25 (1.10, 1.41)	1.19 (1.04, 1.37)	0.83 (0.66, 1.05)	0.91 (0.75, 1.10)
BRCS categorical:					
Medium resilient coping vs. low resilient coping	1.34 (0.57, 3.15)	1.65 (0.98, 2.79)	0.83 (0.46, 1.48)	0.86 (0.32, 2.28)	1.47 (0.68, 3.17)
High resilient coping vs. low resilient coping	2.02 (0.92, 4.46)	2.05 (1.27, 3.31)	1.32 (0.78, 2.23)	0.72 (0.29, 1.76)	0.97 (0.49, 1.89)
Model 2					
Resilience (BRS) score, standardized	1.28 (1.03, 1.59)	0.97 (0.84, 1.12)	1.17 (0.99, 1.37)	0.83 (0.65, 1.07)	0.84 (0.66, 1.06)
BRS categorical:					
Medium resilience vs. low resilience	1.54 (0.87, 2.71)	1.16 (0.80, 1.67)	0.98 (0.65, 1.47)	1.02 (0.53, 1.97)	0.72 (0.41, 1.28)
High resilience vs. low resilience	1.89 (1.03, 3.49)	1.13 (0.75, 1.69)	1.66 (1.07, 2.58)	0.81 (0.41, 1.62)	0.59 (0.31, 1.13)
Resilient coping (BRCS) score, standardized	1.35 (1.07, 1.70)	1.09 (0.95, 1.26)	1.18 (1.01, 1.38)	1.02 (0.78, 1.33)	0.83 (0.67, 1.04)
BRCS categorical:					
Medium resilient coping vs. low resilient coping	1.35 (0.56, 3.23)	1.27 (0.74, 2.19)	0.77 (0.43, 1.40)	1.13 (0.41, 3.10)	1.12 (0.49, 2.57)
High resilient coping vs. low resilient coping	2.08 (0.90, 4.81)	1.40 (0.84, 2.34)	1.23 (0.71, 2.16)	1.24 (0.46, 3.32)	0.70 (0.32, 1.50)

BRS = Brief Resilience Scale, BRCS = Brief Resilient Coping Scale, AHEI = Alternative Healthy Eating Index.

Model 1: adjusted for age, sex, income, marital status, rural vs. urban residence, health insurance, morbidity index, family history of chronic conditions, household family size, and the health behaviors other than the outcome (e.g., for the diet quality model, the following covariates were included: healthy sleep, physical activity level, heavy drinking, and smoking status).

Model 2: Model 1 covariates + mental health index (including probable depression, anxiety, and post-traumatic stress disorder), social support score, perceived stress score, and loneliness score.

not be as responsive to stressful events and resulting resilience, particularly for individuals without a smoking history, which comprised most of our sample. Moreover, individuals may consider smoking or alcohol use to be forms of coping (Park & Iacocca, 2014) and, therefore, may rate themselves higher on resilient coping, even though the BRCS aims to measure psychological coping strategies rather than broader coping behaviors. The absence of clear associations with smoking status and alcohol use could also suggest that additional factors, such as cultural norms and individual histories, may influence these behaviors differently within this context.

Future directions include assessing longitudinal relationships between resilience and resilient coping with physical health outcomes such as cardiometabolic factors, with potential mediation by the health behaviors assessed here. Extending these findings to other communities vulnerable to multiple societal traumas would also be useful. Furthermore, although resilience manifests at the individual level, it is not necessarily an individual trait or characteristic; many contextual level factors may relate to or help define ultimate resilience (Park et al., 2022). Future work should therefore seek to understand contextual factors that ultimately lead to certain individuals and populations demonstrating high resilience. A deeper understanding of the complexities of Puerto Rico’s socio-cultural context could enrich our interpretation of the study findings, highlighting the interplay between historical, cultural, and environmental factors in shaping resilience, coping, and health behaviors among its residents. It is also important not to overly promote the idea of resilience to the point of encouraging

individuals to “stay strong” at all times throughout multiple adversities, which can deplete reserves; this idea has been termed a hidden “cost” of resilience (De France et al., 2022; Suslovic & Lett, 2023).

There are some limitations to our study. First, this analysis was cross-sectional, so we cannot disentangle whether resilience and coping preceded health behaviors; these relationships may be reciprocal, as indicated in other studies (Segovia et al., 2013; Windle, 2012; Wister et al., 2022). Future work should assess health behaviors with repeated measures to understand longitudinal and longer-term effects. Second, selection bias may have resulted from our recruitment; individuals who enrolled in the study may be healthier or more interested in health and may report greater psychological resilience than the general population of Puerto Rico. Although our multi-prong sampling design included probabilistic household sampling through census blocks, this process proved to be less fruitful than initially anticipated, given outdated Census data and several vacant and unresponsive households, largely due to the destructive 2017 hurricanes (Mattei et al., 2021). Third, we could not account specifically for recent individual traumatic and stressful events (outside the context of the recent hurricanes), which likely affected self-rated resilience, resilient coping, and health behaviors. However, for this study, we were primarily interested in the relationship between these variables in the context of collective, widespread trauma. Finally, misclassification of variables is a potential limitation in this study, given that they were all self-reported. Our use of validated measures reduces this limitation.

To sum, we found consistent relationships between resilience and

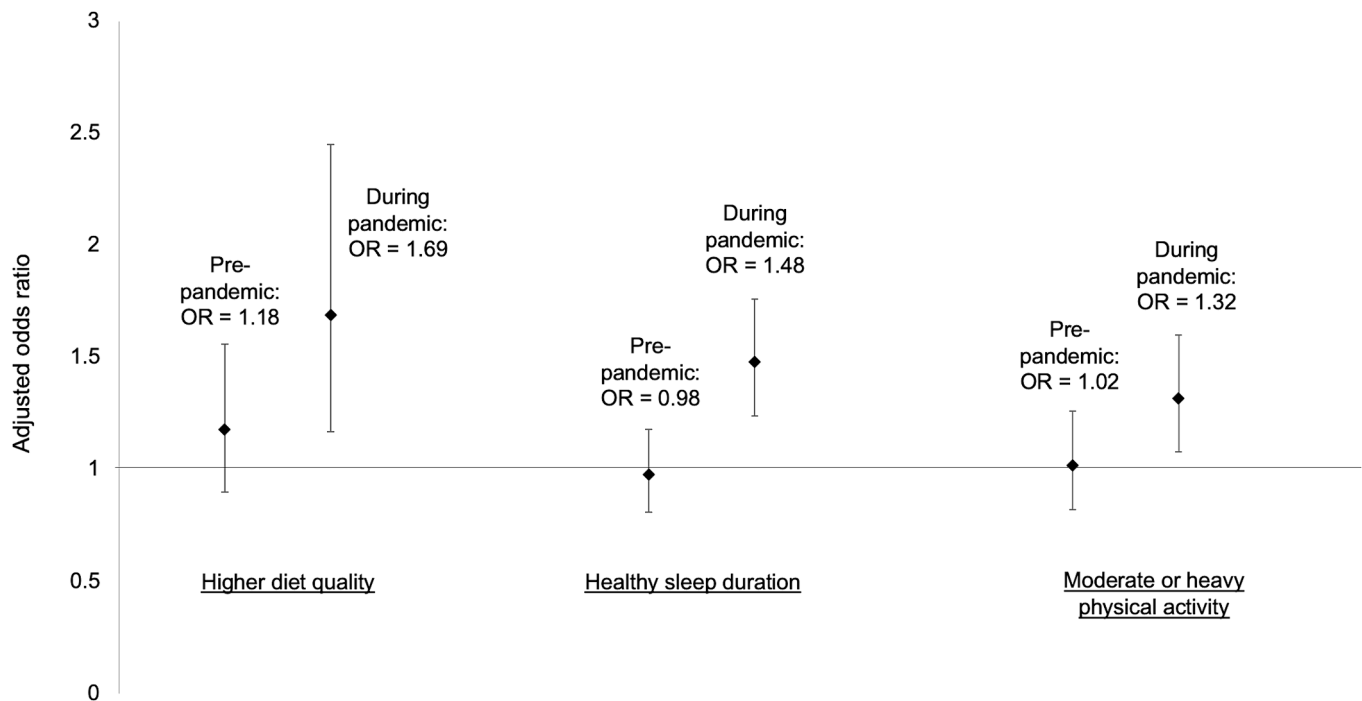


Fig. 1. Odds ratios for engaging in health behaviors by continuous BRCS z-score, stratified by pandemic timing, among 1,342 adults, 2019–2023, Puerto Rico. BRCS = Brief Resilient Coping Scale (higher score = higher resilience). OR = odds ratio. Vertical bars indicate 95% confidence intervals. Pre-pandemic: interviewed between March 21, 2019 – March 16, 2020. During pandemic: interviewed between May 12, 2020 – April 4, 2023. Higher diet quality: in the top tertile of Alternative Healthy Eating Index in the sample compared to middle or lowest tertile. Healthy sleep duration: 7–8 h on average compared to ≥ 9 h on average. Moderate or heavy physical activity: compared to sedentary and light activity. All models are adjusted for age, sex, income, marital status, rural vs. urban residence, health insurance, morbidity index, family history of chronic conditions, household family size, and the health behaviors other than the outcome (e.g., for the diet quality model, the following covariates were included: healthy sleep, physical activity level, heavy drinking, and smoking status).

resilient coping with three health behaviors that are strongly linked to conditions like type 2 diabetes and cardiovascular disease. Our results suggest practical public health implications, including assessing resilience in communities that are vulnerable to disasters or other negative events to gauge their level of preparedness before disasters occur, and leveraging or strengthening population-level resilience for disaster preparation and response. For example, programs that generate social connectedness or empower people's sense of control or cohesion during an event may benefit both resilience and healthy behaviors, in addition to established post-disaster interventions like Psychological First Aid (Hobfoll et al., 2008; Sandifer & Walker, 2018). Ultimately, given Puerto Rico's susceptibility to adversity and the already high prevalence of chronic health conditions (Mattei et al., 2018), identifying supportive strategies to build and maintain resilience and resilient coping mechanisms in Puerto Rico may contribute to better cardiovascular health over the life course.

Funding

This study was supported by the US National Institutes of Health's National Heart Lung and Blood Institute (R01 HL143792 to JM) and National Institute on Minority Health and Health Disparities (R21 MD013650 to JM) as well as a Robert Wood Johnson Foundation Culture of Health Leaders Award (to JM). L. Sampson and M Tamez were supported by the National Institutes of Health grant T32 HL098048. Additional support in community engagement was received from the Hispanic Alliance for Clinical and Translational Research (Alliance), National Institute of General Medical Sciences, National Institutes of Health (U54GM133807). These funding sources were not involved in the research.

CRediT authorship contribution statement

Laura Sampson: Writing – original draft, Methodology, Formal analysis, Conceptualization. **Ariel H. Kim:** Writing – review & editing, Formal analysis. **H. June O'Neill:** Writing – review & editing, Formal analysis. **Martha Tamez:** Writing – review & editing, Formal analysis. **Luis M. Falcon:** . **Katherine L. Tucker:** Writing – review & editing, Investigation. **Edna Acosta-Pérez:** Writing – review & editing, Investigation. **Jose F. Rodriguez Orengo:** Writing – review & editing, Investigation. **Laura D. Kubzansky:** Writing – review & editing, Investigation, Writing – review & editing, Conceptualization. **Karestan C. Koenen:** . **Josiemer Mattei:** Writing – review & editing, Supervision, Project administration, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr. Koenen has been a paid consultant in the past three years for the US Department of Justice and Covington and Burling, LLP. She receives royalties from Guilford Press and Oxford University Press. Dr. Kubzansky receives royalties from Oxford University Press. The other authors have no competing interests to disclose.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmr.2024.102874>.

- (PROSPECT). *Am J Epidemiol*, 190(5), 707–717. <https://doi.org/10.1093/aje/kwaa231>.
- Mattei, J., Tamez, M., Ríos-Bedoya, C.F., Xiao, R.S., Tucker, K.L., Rodríguez-Orengo, J.F., 2018. Health conditions and lifestyle risk factors of adults living in Puerto Rico: A cross-sectional study. *BMC Public Health* 18 (1), 1–12. <https://doi.org/10.1186/S12889-018-5359-Z/FIGURES/1>.
- Mattei, J., Tamez, M., O'Neill, J., Haneuse, S., Mendoza, S., Orozco, J., Lopez-Cepero, A., Ríos-Bedoya, C.F., Falcón, L.M., Tucker, K.L., Rodríguez-Orengo, J.F., 2022. Chronic Diseases and Associated Risk Factors Among Adults in Puerto Rico After Hurricane Maria. *JAMA Netw. Open* 5 (1), e2139986–e. <https://doi.org/10.1001/JAMANETWORKOPEN.2021.39986>.
- McCullough, M.L., Willett, W.C., 2006. Evaluating adherence to recommended diets in adults: the Alternate Healthy Eating Index. *Public Health Nutr.* 9 (1A), 152–157. <https://doi.org/10.1079/phn2005938>.
- Merz, E.L., Roesch, S.C., Malcarne, V.L., Penedo, F.J., Llabre, M.M., Weitzman, O.B., Navas-Nacher, E.L., Perreira, K.M., Gonzalez, F., Ponguta, L.A., Johnson, T.P., Gallo, L.C., 2014. Validation of Interpersonal Support Evaluation List-12 (ISEL-12) scores among English- and Spanish-Speaking Hispanics/Latinos from the HCHS/SOL Sociocultural Ancillary Study. *Psychol. Assess.* 26 (2), 384. <https://doi.org/10.1037/A0035248>.
- Nielsen, M.B., Knardahl, S., 2014. Coping strategies: A prospective study of patterns, stability, and relationships with psychological distress. *Scand. J. Psychol.* 55 (2), 142–150. <https://doi.org/10.1111/SJOP.12103>.
- Nishimi, K.M., Koenen, K.C., Coull, B.A., Kubzansky, L.D., 2022. Association of Psychological Resilience with Healthy Lifestyle and Body Weight in Young Adulthood. *J. Adolesc. Health*. 70 (2), 258. <https://doi.org/10.1016/J.JADOHEALTH.2021.08.006>.
- Paffenbarger, R.S., Wing, A.L., Hyde, R.T., 1978. Physical activity as an index of heart attack risk in college alumni. *Am. J. Epidemiol.* 108 (3), 161–175. <https://doi.org/10.1093/OXFORDJOURNALS.AJE.A112608>.
- Paffenbarger, R.S., Hyde, R.T., Wing, A.L., Lee, I.-M., Jung, D.L., Kampert, J.B., 1993. The association of changes in physical-activity level and other lifestyle characteristics with mortality among men. *N. Engl. J. Med.* 328 (8), 538–545. <https://doi.org/10.1056/NEJM199302253280804>.
- Palacios, C., Trak, M.A., Betancourt, J., Joshupura, K., Tucker, K.L., 2015. Validation and reproducibility of a semi-quantitative FFQ as a measure of dietary intake in adults from Puerto Rico. *Public Health Nutr.* 18 (14), 2550–2558. <https://doi.org/10.1017/S1368980014003218>.
- Park, C.L., Iacocca, M.O., 2014. A stress and coping perspective on health behaviors: theoretical and methodological considerations. *Anxiety Stress Coping* 27 (2), 123–137. <https://doi.org/10.1080/10615806.2013.860969>.
- Park, J.W., Mealy, R., Saldanha, I.J., Loucks, E.B., Needham, B.L., Sims, M., Fava, J.L., Dulin, A.J., Howe, C.J., 2022. Multilevel resilience resources and cardiovascular disease in the United States: A systematic review and meta-analysis. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association* 41 (4), 278–290. <https://doi.org/10.1037/HEA0001069>.
- Perera, M.J., Brintz, C.E., Birnbaum-Weitzman, O., Penedo, F.J., Gallo, L.C., Gonzalez, P., Gouskova, N., Isasi, C.R., Navas-Nacher, E.L., Perreira, K.M., Roesch, S.C., Schneiderman, N., Llabre, M.M., 2017. Factor Structure of the Perceived Stress Scale-10 (PSS) Across English and Spanish Language Responders in the HCHS/SOL Sociocultural Ancillary Study. *Psychol. Assess.* 29 (3), 320. <https://doi.org/10.1037/PAS0000336>.
- Petrun Sayers, E.L., Anthony, K.E., Tom, A., Kim, A.Y., Armstrong, C., 2023. 'We will rise no matter what': community perspectives of disaster resilience following Hurricanes Irma and Maria in Puerto Rico. *J. Appl. Commun. Res.* 51 (2), 126–145. <https://doi.org/10.1080/00909882.2022.2069473>.
- Pietrzak, R.H., Goldstein, R.B., Southwick, S.M., Grant, B.F., 2012a. Physical Health Conditions Associated with Posttraumatic Stress Disorder in U.S. Older Adults: Results from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. *J. Am. Geriatr. Soc.* 60 (2), 296. <https://doi.org/10.1111/J.1532-5415.2011.03788.X>.
- Pietrzak, R.H., Tracy, M., Galea, S., Kilpatrick, D.G., Ruggiero, K.J., Hamblen, J.L., Southwick, S.M., Norris, F.H., 2012b. Resilience in the face of disaster: Prevalence and longitudinal course of mental disorders following Hurricane Ike. *PLoS One* 7 (6). <https://doi.org/10.1371/JOURNAL.PONE.0038964>.
- Previdi, I.L., Vega, C.M.V., 2020. Health Disparities Research Framework Adaptation to Reflect Puerto Rico's Socio-Cultural Context. *Int. J. Environ. Res. Public Health* 17 (22), 1–11. <https://doi.org/10.3390/IJERPH17228544>.
- Radloff, L.S., 1977. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Appl. Psychol. Meas.* 1 (3), 385–401.
- Ramos-Olazagasti, M.A., Shrout, P.E., Yoshikawa, H., Canino, G.J., Bird, H.R., 2013. Contextual Risk and Promotive Processes in Puerto Rican Youths' Internalizing Trajectories in Puerto Rico and New York. *Dev. Psychopathol.* 25 (3), 755. <https://doi.org/10.1017/S0954579413000151>.
- Reich, J.W., 2006. Three psychological principles of resilience in natural disasters. *Disaster Prevention and Management: an International Journal* 15 (5), 793–798. <https://doi.org/10.1108/09653560610712739/FULL/PDF>.
- Robert, M., Shankland, R., Bellicha, A., Kesse-Guyot, E., Deschasaux-Tanguy, M., Andreeva, V.A., Srour, B., Hercberg, S., Touvier, M., Leys, C., Péneau, S., 2022. Associations between Resilience and Food Intake Are Mediated by Emotional Eating in the NutriNet-Santé Study. *J. Nutr.* 152 (8), 1907–1915. <https://doi.org/10.1093/JN/NXAC124>.
- Rodríguez-Madera, S.L., Varas-Díaz, N., Padilla, M., Grove, K., Rivera-Bustelo, K., Ramos, J., Contreras-Ramirez, V., Rivera-Rodríguez, S., Vargas-Molina, R., Santini, J., 2021. The impact of Hurricane Maria on Puerto Rico's health system: post-disaster perceptions and experiences of health care providers and administrators. *Global Health Research and Policy* 6 (1), 1–11. <https://doi.org/10.1186/S41256-021-00228-W/TABLES/1>.
- Rodríguez-Rey, R., Alonso-Tapia, J., Hermansaiz-Garrido, H., 2016. Reliability and validity of the Brief Resilience Scale (BRS) Spanish Version. *Psychol. Assess.* 28 (5), e101–e110. <https://doi.org/10.1037/PAS0000191>.
- Saint Onge, J.M., Krueger, P.M., 2017. Health lifestyle behaviors among U.S. adults. *SSM - Population Health* 3, 89–98. <https://doi.org/10.1016/J.SSMPH.2016.12.009>.
- Sandifer, P.A., Walker, A.H., 2018. Enhancing disaster resilience by reducing stress-associated health impacts. *Front. Public Health* 6 (DEC), 425313. <https://doi.org/10.3389/FPUBH.2018.00373/BIBTEX>.
- Sarason, I.G., Sarason, B.R. (Eds.), 1985. *Social Support: Theory, Martinus Nijhoff Publishers, Research and Applications*.
- Sato, M., Horner, P.S., Vélez Ortiz, D., Nelson, A., 2022. The role of spirituality in family adjustment and resilience among Puerto Rican families post-Hurricane Maria. *J. Relig. Spiritual. Soc. Work Soc. Thought* 41 (1), 90–103. <https://doi.org/10.1080/15426432.2021.2000553>.
- Scaramutti, C., Salas-Wright, C.P., Vos, S.R., Schwartz, S.J., 2019. The Mental Health Impact of Hurricane Maria on Puerto Ricans in Puerto Rico and Florida. *Disaster Med. Public Health Prep.* 13 (1), 24–27. <https://doi.org/10.1017/DMP.2018.151>.
- Segovia, F., Moore, J.L., Linnville, S., Hoyt, R.E., Hain, R.E., 2013. Sleep and Resilience: A Longitudinal 37-Year Follow-up Study of Vietnam Repatriated Prisoners of War. *Mil. Med.* 178 (2), 196–201. <https://doi.org/10.7205/MILMED-D-12-00227>.
- Sinclair, V.G., Wallston, K.A., 2004. The development and psychometric evaluation of the Brief Resilient Coping Scale. *Assessment* 11 (1), 94–101. <https://doi.org/10.1177/1073191103258144>.
- Smith, B. W., Epstein, E. M., Ortiz, J. A., Christopher, P. J., & Tooley, E. M. (2013). *The Foundations of Resilience: What Are the Critical Resources for Bouncing Back from Stress?* 167–187. https://doi.org/10.1007/978-1-4614-4939-3_13.
- Sotos-Prieto, M., Bhupathiraju, S.N., Falcón, L.M., Gao, X., Tucker, K.L., Mattei, J., 2015. A Healthy Lifestyle Score Is Associated with Cardiometabolic and Neuroendocrine Risk Factors among Puerto Rican Adults. *J. Nutr.* 145 (7), 1531. <https://doi.org/10.3945/JN.114.206391>.
- Spitzer, R.L., Kroenke, K., Williams, J.B.W., Löwe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.* 166 (10), 1092–1097. <https://doi.org/10.1001/ARCHINT.166.10.1092>.
- Springfield, S., Qin, F., Hedlin, H., Eaton, C.B., Rosal, M.C., Taylor, H., Staudinger, U.M., Stefanick, M.L., 2020. Resilience and CVD-protective health behaviors in older women: Examining racial and ethnic differences in a cross-sectional analysis of the women's health initiative. *Nutrients* 12 (7), 1–18. <https://doi.org/10.3390/nu12072107>.
- Stewart, S.M., Schwarzer, R., 1996. Stability of coping in Hong Kong medical students: a longitudinal study. *Pers. Individ. Differ.* 20 (2), 245–255. [https://doi.org/10.1016/0191-8869\(95\)00162-X](https://doi.org/10.1016/0191-8869(95)00162-X).
- Sudhinaraset, M., Wigglesworth, C., Takeuchi, D.T., 2016. Social and Cultural Contexts of Alcohol Use: Influences in a Social-Ecological Framework. *Alcohol Res.* 38 (1), 35. <https://doi.org/10.1016/j.pmc.2016.04.001>.
- Suslovic, B., Lett, E., 2023. Resilience is an Adverse Event: A Critical Discussion of Resilience Theory in Health Services Research and Public Health. <https://doi.org/10.1177/2752535X231159721>.
- Taylor, S.E., Stanton, A.L., 2007. Coping Resources, Coping Processes, and Mental Health. *Health Psychol.* 26 (3), 377–401. <https://doi.org/10.1037/0278-6133.26.3.377>.
- The impact of climate change on the rights of people in vulnerable situations. *OHCHR, United Nations*. (n.d.). Retrieved December 7, 2023, from <https://www.ohchr.org/en/climate-change/impact-climate-change-rights-people-vulnerable-situations>.
- To, Q.G., Vandelandotte, C., Cope, K., Khalessi, S., Williams, S.L., Alley, S.J., Thwaite, T.L., Fenning, A.S., Stanton, R., 2022. The association of resilience with depression, anxiety, stress and physical activity during the COVID-19 pandemic. *BMC Public Health* 22 (1), 1–8. <https://doi.org/10.1186/S12889-022-12911-9/TABLES/4>.
- Tucker, K.L., Bianchi, L.A., Maras, J., Bermudez, O.I., 1998. Adaptation of a Food Frequency Questionnaire to Assess Diets of Puerto Rican and Non-Hispanic Adults. *Am. J. Epidemiol.* 148 (5), 507–518. <https://doi.org/10.1093/oxfordjournals.aje.a009676>.
- Tucker, K.L., Mattei, J., Noel, S.E., Collado, B.M., Mendez, J., Nelson, J., Griffith, J., Ordovas, J.M., Falcon, L.M., 2010. The Boston Puerto Rican Health Study, a longitudinal cohort study on health disparities in Puerto Rican adults: challenges and opportunities. *BMC Public Health* 10, 107. <https://doi.org/10.1186/1471-2458-10-107>.
- Walsh, J.L., Senn, T.E., Carey, M.P., 2013. Longitudinal associations between health behaviors and mental health in low-income adults. *Transl. Behav. Med.* 3 (1), 104–113. <https://doi.org/10.1007/S13142-012-0189-5>.
- Weitzel, E.C., Löbner, M., Glaesmer, H., Hinz, A., Zeynalova, S., Henger, S., Engel, C., Reyes, N., Wirkner, K., Löffler, M., Riedel-Heller, S.G., 2022. The Association of Resilience with Mental Health in a Large Population-Based Sample (LIFE-Adult-Study). *Int. J. Environ. Res. Public Health* 19 (23). <https://doi.org/10.3390/IJERPH192315944/S1>.
- Williams, D.R., Medlock, M.M., 2017. Health Effects of Dramatic Societal Events — Ramifications of the Recent Presidential Election. *N. Engl. J. Med.* 376 (23), 2295–2299. https://doi.org/10.1056/NEJMMS1702111/SUPPL_FILE/NEJMMS1702111_DISCLOSURES.PDF.

- Windle, G., 2012. The contribution of resilience to healthy ageing. *Perspect. Public Health* 132 (4), 159–160. <https://doi.org/10.1177/1757913912449572>.
- Wister, A., Li, L., Whitmore, C., Ferris, J., Klasa, K., Linkov, I., 2022. Multimorbidity resilience and health behaviors among older adults: A longitudinal study using the Canadian Longitudinal Study on Aging. *Front. Public Health* 10. <https://doi.org/10.3389/FPUBH.2022.896312>.
- Yabe, T., Rao, P.S.C., Ukkusuri, S.V., 2021. Regional differences in resilience of social and physical systems: Case study of Puerto Rico after Hurricane Maria. *Environment and Planning b: Urban Analytics and City Science* 48 (5), 1042–1057. https://doi.org/10.1177/2399808320980744/ASSET/IMAGES/LARGE/10.1177_2399808320980744-FIG5.JPEG.