

---

# Rates and Predictors of Loneliness and Generalized Anxiety among Latinx College Students in Puerto Rico

---

*Tasas y predictores de soledad y ansiedad generalizada en estudiantes latinxs universitarios en Puerto Rico*

Ángela Chevres-Pérez<sup>1</sup>, Anamaria Rey Bollentini<sup>1</sup>, Carolina I. Reyes-Cariño<sup>1</sup>, Julián M. Hernández-Torres<sup>2</sup>, Yamil O. Ortiz-Ortiz<sup>1</sup> & Natalia Giraldo-Santiago<sup>3,4</sup>

<sup>1</sup> University of Puerto Rico, Río Piedras Campus

<sup>2</sup> University of Puerto Rico, Medical Science Campus

<sup>3</sup> Massachusetts General Hospital

<sup>4</sup> Harvard Medical School, Department of Psychiatry

---

*Received: June 15, 2023 / Accepted: December 12, 2023*

## Abstract

Loneliness and Generalized Anxiety Disorder (GAD) are among college students' most common mental health problems. In the last years, there has been an increase in the prevalence of these conditions due to COVID-19 social distancing measures. Despite this, few studies have explored the relationship feelings of loneliness had anxiety symptoms in higher education Hispanic institutions. Puerto Rican college students are a unique and vulnerable group at the intersection of socioeconomic and health disparities. Therefore, the present study explored whether loneliness experienced during the Pandemic could predict GAD symptoms of students from the University of Puerto Rico, Río Piedras campus. Researchers used a cross-sectional study design with an online survey that collected sociodemographic data, anxiety symptoms (GAD-7), and feelings of loneliness (TILS) from a sample of 356 university students between April and December 2022. Researchers performed two simple linear regression models to predict anxiety symptoms. The first model results revealed that loneliness predicted 15% of the variance related to anxiety symptoms ( $R^2 = .15$ ,  $F(1,340) = 59.17$ ,  $p < .001$ ). In the second model, researchers controlled for sex; however, no significant changes were observed in the model ( $r = .08$ ). The results of this study suggest that feelings of loneliness during the Pandemic were significantly related to GAD symptoms experienced by college students. In addition, being female was significantly associated with anxiety symptoms compared to males, although the effect was small. Implications for future research, clinical practice, and academic institutions are discussed.

*Keywords:* loneliness, college students, Puerto Rico, anxiety, lockdown, latinxs

## Resumen

La soledad y el trastorno de ansiedad generalizada (TAG) se encuentran entre los problemas de salud mental más comunes del estudiantado universitario. Estudios recientes han revelado un aumento en la prevalencia de estas condiciones debido a las medidas de distanciamiento social del COVID-19. A pesar de esto no se encontraron estudios recientes que exploren la relación que tiene la soledad con los síntomas del TAG en estudiantes puertorriqueño/as. El presente estudio exploró si los sentimientos de soledad durante la Pandemia podrían predecir los síntomas del TAG en el estudiantado de la Universidad de Puerto Rico. Se utilizó un diseño transversal a través de encuesta en línea que recopiló datos sociodemográficos, síntomas de ansiedad (GAD-7) y sentimientos de soledad (TILS) de una muestra de 356 estudiantes entre abril y diciembre del 2022. Los investigadores realizaron dos modelos de regresión lineal simples para predecir los síntomas de ansiedad. Los resultados del primer modelo revelaron que la soledad predijo el 15% de la varianza relacionada con los síntomas de ansiedad ( $R^2 = 0.15$ ,  $F(1340) = 59.17$ ,  $p < 0,001$ ). En el segundo modelo, los investigadores añadieron la variable de sexo, pero no se observaron cambios significativos a la varianza explicada ( $r = .08$ ). Los resultados de este estudio sugieren que los sentimientos de soledad durante la pandemia estuvieron significativamente relacionados con los síntomas de TAG experimentados por el estudiantado. Identificarse como mujer se asoció significativamente con síntomas de TAG, pero el efecto fue pequeño. Se discuten las implicaciones de estos hallazgos para futuras investigaciones, la práctica clínica y las instituciones educativas.

*Palabras claves:* soledad, estudiantes universitarios, Puerto Rico, ansiedad, cuarentena, latinxs

---

Acknowledgements: We acknowledge the following students for their hard work in collecting data for the study: Valeria Rodríguez Marcano, Emanuel Calderón Peña, Mariana Anquiera y Miguel Hernández Rodríguez.

All communication related to this article should be directed to the primary author at the following email address: [angela.chevres@upr.edu](mailto:angela.chevres@upr.edu)

Loneliness among college students in the United States is a serious and recurring problem (Diehl et al., 2018). A large-scale study by the American College Health Association (2022) revealed that most college students experience loneliness, which can lead to stress, anxiety, and depression (Mofatteh, 2020). According to the U.S. Surgeon General's Advisory, loneliness and isolation represent profound threats to the health and well-being of individuals, as social isolation and loneliness predict increased risk for developing mental illnesses that can worsen over time (U.S. Public Health Services, 2023). However, little is known about the link between feelings of loneliness and Generalized Anxiety Disorders (GAD) among college students in Puerto Rico.

Puerto Rican college students are a vulnerable population disproportionately impacted by social and natural determinants of health. In the last five years, students have endured two major hurricanes, a string of earthquakes, severe cuts to educational programs resulting in a sharp increase in tuition fees, and, more recently, a Pandemic. The impact of the pandemic on mental health hit vulnerable and racial/ethnic minorities was particularly hard. Czeisler et al. (2020) discovered notably elevated levels of depression (31.3%) and anxiety (35.5%) among Latinx college students. Despite these high rates, only a limited number of studies have explored how COVID-19 affected vulnerable groups such as Latinx college students in the United States. The Puerto Rican government imposed stringent lockdowns measures, including curfews, lockdowns, and social distancing guidelines. These actions aimed to reduce the virus's spread due to concerns about the healthcare system's vulnerability and the poor health outcomes experienced by the island's residents (Rosas, 2020). College students' perception of response strategies and

information regarding disasters can influence their experiences with anxiety (Shelton & Thompson, 2020). Natural disasters have been known to exacerbate mental health conditions in college students, leading to an increase in post-traumatic stress symptoms, reduced retention and motivation, and a lack of preparedness for future disasters (Shelton & Thompson, 2020). Violence and health inequalities are among the social determinants that have been known to impact students' academic performance, especially among minority groups (Cardona et al., 2021).

These social determinants could lead to loneliness and GAD. Loneliness can also compromise the economic development of individuals, communities, and society in general, as people affected by loneliness and anxiety may struggle to engage in economic activities (Morrish et al., 2022). In addition, it is imperative to study loneliness and the potential harm to Puerto Rican college students' mental health. This experience could impact the development of their personalities, as well as their communities and society (Rodríguez-Pose & Burlina, 2021).

Socialization is an integral part of the mental health of young adults. College students have been known to highly value social interactions. A study by Finlay et al. (2012), as cited by Hager et al. (2022), revealed that college students prefer socializing over engaging in college-related activities such as attending class, involvement in clubs or sports, and volunteering. The recent COVID-19 Pandemic forced governments to take preventative measures to reduce the spread of the virus. College students were among the most heavily impacted, transitioning to online education and social distancing, which heavily altered their social interactions. Although effective in reducing the spread of

the virus, these measures proved detrimental to college students' mental health (Son et al., 2020). According to Sanz et al. (2020), referencing Rodriguez et al.'s (2020) study, the transition to online education amid the Pandemic resulted in challenges and impediments for university students stemming from the sudden shift in educational practices implemented in response to COVID-19. These challenges encompass difficulties in adapting to novel technologies, experiences of social isolation, economic accessibility issues, and concerns related to the Pandemic. Another investigation conducted by Rodriguez et al. (2020), as cited by the International Institute for Higher Education in Latin America and the Caribbean (2020), Regmi and Jones (2020), UNESCO (2020), and Uprichard (2020), demonstrated that the adoption of distance education significantly impacted the mental and physical well-being of university students, manifesting in discomforts such as anxiety and depression. Loneliness and GAD were among the most common mental health problems reported by college students due to quality-of-life changes during the Pandemic. Many students experienced loneliness and had trouble establishing social connections due to COVID-19 restrictions. According to Ellwardt et al. (2013), loneliness is an unpleasant experience that occurs when a person's network of relationships is felt to be deficient in some important way. Moreover, loneliness is multidimensional, meaning several social, relational, and individual factors contribute to loneliness (Montero & Lopez, 2021). One of the factors that has been found to occur with loneliness is GAD (Mushtaq et al., 2014).

According to recent studies, experiencing loneliness has been identified as a factor contributing to social isolation, which, in turn, is associated with the development of Generalized Anxiety Disorder (GAD) during social interactions (Wikialis et al., 2021). In

addition, people who feel alone tend to have less support and limited access to opportunities and resources, a poor social condition affecting their well-being. In contrast, young people who perceive themselves as socially connected have better academic, social, and health outcomes (Foster et al., 2017; Umberson & Karas Montez, 2010). Moreover, socially connected people with stable and supportive relationships are likelier to make healthy choices and have better mental and physical health outcomes ("How Does Social Connectedness Affect Health," 2023). Socially connected individuals, in this case, college students, could better cope with difficult times and stress caused by external factors (Ozbay et al., 2007).

This study builds upon the existing literature that Puerto Ricans are experiencing loneliness due to various factors such as poverty, unemployment, and lack of opportunities. One factor that has significantly impacted Puerto Ricans experiencing loneliness has been crime and safety linked to a range of mental health problems, including post-traumatic stress and anxiety disorders (Alto et al., 2021). On the other hand, Puerto Ricans' recurrent and extensive migration could be a risk factor for loneliness among college students, specifically those who remain on the island, attempting to complete their academic degrees. In 2017, nearly 160,000 Puerto Ricans relocated to the United States (Hinojosa & Melendez, 2018), and a recent study with a sample of professionals in Puerto Rico found that 44 % had thoughts of migration to Mainland U.S. and younger age was a predictor of migration (Authors, 2023; blinded for review). The devastation caused by atmospheric events and the ongoing outmigration of young classmates and friends could create feelings of loneliness among college students in Puerto Rico. However,

little is known about the needs of college students in Puerto Rico and how loneliness can impact GAD.

Additionally, the restrictions due to COVID-19 and deaths related to this virus may have caused abundant worries among young people in Puerto Rico (Vidal et al., 2022). For example, educational institutions are a primary location for socialization among this group, but COVID restrictions, isolation, and closure of institutions could represent a threat to the social needs of this group. Loneliness is multidimensional, meaning several social, relational, and individual factors contribute to loneliness (Yanguas et al., 2018). Thus, academic institutions are responsible for understanding how loneliness affects their students' mental health (in this case, the presence of generalized anxiety disorders in their students) and promoting the social conditions to prevent and intervene with the presence of loneliness.

Lack of social interaction plays a vital role in the perception of loneliness, which is a crucial factor for college students at a stage of development where they are building an identity. Guided by a bio-psychosocial model of life course development model (Halfon et al., 2014), we hypothesized that a lack of experience in building social and collective identity could lead to loneliness and the development of GAD. Furthermore, there have been documented decreases in enrollment and admissions and reductions in higher education budgets in Puerto Rico (Labandera et al., 2021). However, no study has examined how these contextual factors contribute to university students' experiences of loneliness and its association with GAD.

This study builds on previous research that highlights differences in loneliness (Chang, 2018), stress (Graves et al., 2021) and GAD

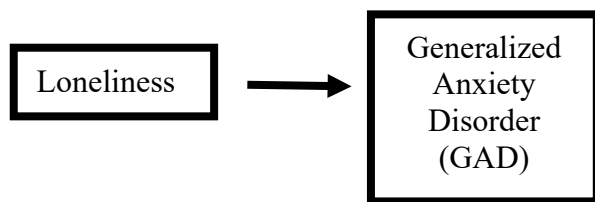
(Gao et al., 2020) experiences based on gender among college populations. The findings of this study indicate a connection between GAD symptoms observed during the Pandemic and the loneliness felt by college students. These results align with existing literature indicating that individuals who felt socially isolated or lonely during the Pandemic might have experienced increased stress, uncertainty, and a reduced sense of support (Boursier et al., 2020; Owczarek et al., 2022). International literature on college students showed that females reported higher loneliness than their male counterparts (Khatib, 2012). However, meta-analyses studying sex differences associated with loneliness have shown mixed results (Maes et al., 2019). For example, when studying sex, which consists of the trait assigned at birth, statistical differences in loneliness are not usually found when using the Three Item Loneliness Scale (TILS), but when they are found, males typically have higher loneliness scores (Pagan, 2020). In contrast, several studies have found that females are more likely than males to suffer from anxiety and to be diagnosed with GAD (Christiansen, 2015).

### **The Current Study**

The present study represents the preliminary results of a screening effort on the mental health needs of college students in Puerto Rico during the Pandemic. Building upon the prior literature, this study aimed to examine the prevalence of loneliness and generalized anxiety disorders among college students, followed by an investigation of whether loneliness, a proxy for depression, was a predictor of GAD, a proxy for post-traumatic stress disorders that many have experienced in Puerto Rico as a result of COVID, hurricanes, and ongoing losses or symptoms of post-traumatic stress disorders. (See Figure 1). Results indicated that anxiety

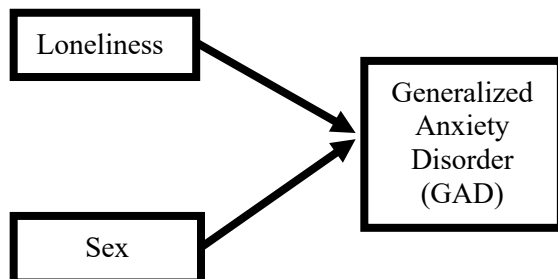
sensitivity and PTSD symptom severity were reciprocally related, such that anxiety predicted subsequent PTSD symptom severity and symptom severity predicted later anxiety sensitivity (Marshall, 2010). Findings have both theoretical and clinical implications.

**Figure 1**  
*Model 1 Establishing Loneliness as a Predictor of Generalized Anxiety Disorder*



Moreover, we hypothesized that sex influences the relationship between loneliness and GAD. In Puerto Rico, significant differences in the experiences of mental health needs (i.e., PTSD and major depressive disorders) by sex have been found among Puerto Rican children (Orengo-Aguayo et al., 2019). However, little is known about the mental health needs of college students in Puerto Rico, with particular emphasis on loneliness and generalized anxiety disorders.

**Figure 2**  
*Model 2 Establishing Loneliness and Sex as Predictors of Generalized Anxiety Disorders*



## Methods

### Participants

This study employed a secondary data analysis from an ongoing exploratory and cross-sectional web-based survey studying the mental health needs of college students at the University of Puerto Rico, Rio Piedras Campus. Most participants identified as Puerto Ricans (96.9%), were female (75.0%), with the remainder being male (20.5%) or identifying with other sex categories (4.2%). Age ranged between 16 to 57 years old, with a mean age of 22.61 +/- 6.72. Participants were recruited via convenience sampling and were required to be actively enrolled in a degree-granting program (B.A., MA, Ph.D., etc.). The exclusion criteria are students who did not consent to participate, those who completed the survey in less than 8.5 minutes, and those not enrolled in a degree-granting program at the UPRRP campus. The sample for this study consisted of 356 students. Graduate and undergraduate students, as well as students under 18 years of age, were included.

### Recruitment and Procedures

The study was approved by the UPRRP Institutional Review Board under protocol number 2122-084. Researchers used convenience sampling to recruit University Puerto Rico Rio Piedras Campus students. Participants were recruited around the university campus using flyers, information stands, and word-of-mouth between April and December 2022. Off-campus recruitment was done through Facebook and Instagram posts, email, and text messages. The online format allowed eligible participants to take the survey whenever and wherever they could as long as they had access to a mobile device and a reliable internet connection. Data collection settings included university

halls, student lounging areas, classrooms, and their residences. Participants accessed the survey using a quick response code or a web link. After submitting their answers, participants received a list of references to mental health counseling services for students offered by the university and other non-profit/public institutions.

The online survey started with a consent form that allowed participants to consent online. In order to assess participants' comprehension of the consent form, participants were asked to mention the purpose of this study and which university was involved in it. Participants who answered at least one question wrong had to re-read the consent form and answer the questions again. If at least one of the questions was answered incorrectly on the second try, the form was automatically closed, and the participant was not allowed to answer the survey.

The online self-administered survey was developed in Microsoft Forms and comprised 84 items. The survey was developed in Spanish and took approximately 16 minutes to be completed. Participants were given as much time as they needed to answer the survey. The survey also requested information on social media and video gameplay habits. Participants who completed the survey were invited to participate in a giveaway for one of three Amazon \$50 gift cards as an incentive for their time. Participants who wished to participate in the giveaway were provided a separate link at the end of the questionnaire, leading to a separate form asking for their contact information.

## Measures

Anxiety symptoms were assessed through the Spanish version of the Generalized Anxiety Disorder 7-item scale (GAD-7). The GAD-7 is a brief, 7-item anxiety self-report

scale used to measure symptoms of generalized anxiety disorder (Spitzer et al., 2006). Items were rated on a four-point Likert scale ranging from not at all (0) to every day (3). Scores between five and 10 points were considered mild GAD, 11 to 15 moderate GAD, and above 15 severe GAD. The GAD-7 has shown adequate psychometric properties in a Puerto Rican sample of workers (Merino-Soto et al., 2023). In the present sample, internal consistency was considered good at a Cronbach's alpha of 0.88 (95% CI: 0.86 – 0.90).

Loneliness was assessed using a Spanish translation of the Three Item Loneliness Scale (TILS). The TILS is a shortened version of the UCLA Loneliness Scale that measures perceived feelings of loneliness (Hughes et al., 2004). The scale asked how often students felt lacking companionship, left out, or isolated from others on a Likert scale ranging from (1) hardly ever to (3) always. Scores ranged from 3 to 9, with higher scores indicating higher levels of loneliness. The TILS has shown acceptable psychometric properties in Spanish-speaking samples (Trucharte et al., 2023). In this study, TILS demonstrated a Cronbach internal consistency index of 0.8 (95% CI: 0.76 - 0.83), which is considered good. The TILS version used in this study was obtained from Trucharte et al. (2021).

## Data Analysis

Descriptive and bivariate analyses were conducted between key variables. A multiple linear regression model assessed the association between loneliness and generalized anxiety symptoms. A simple model regressing loneliness to anxiety symptoms was fit and compared to a sex-adjusted model. Both models went through model diagnostics. Partial  $R^2$  and the local  $f^2$  effect size measure (Cohen et al., 2002) are

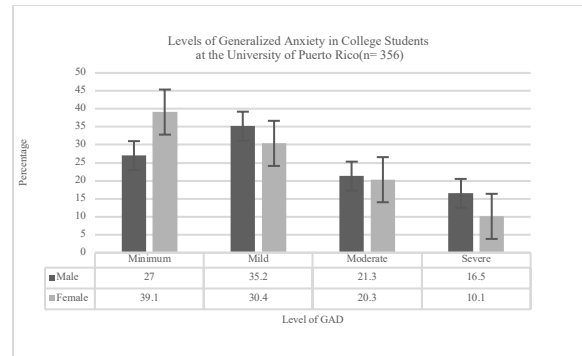
reported for each predictor. Variables in the model with a partial  $R^2$  of 5% or less and an  $f^2$  of 0.05 or less were considered to have a weak effect on anxiety symptoms. P-values for the sex-adjusted were corrected for multiple comparisons using the Benjamini-Hochberg approach (Benjamini & Hochberg, 1995), which adjusts according to the false discovery rate. 95% confidence intervals (CI) are reported. In order to address the lack of normality in the residuals of an initial run of the model, GAD-7 scores were normalized using a Yeo-Johnson transformation (Yeo & Johnson, 2000). The Yeo-Johnson transformation is a flexible alternative to the Box-Cox family of transformations (Box & Cox, 1964) for variables taking 0 or negative values, which is true for GAD-7 scores. Box-Cox transformations approximate the data to a normal distribution according to a tuning parameter  $\lambda$ . This transformation is related to the log, square root, and cubic transformations; hence, it is considered a power transformation. Results of the transformation on model residuals for the simple model are shown. All analyses were conducted in R version 4.2.2 (R Core Team, 2021).

## Results

Most participants identified as Puerto Ricans (96.9%), female (75.0%), with the remainder being male (20.5%) or identifying with other sex categories (4.2%). Age ranged between 16 to 57 years old, with a mean age of 22.61 +/- 6.72. More than a quarter (30.2%) of participants reported being diagnosed by a mental health professional with an anxiety disorder in their lifetime. Mean (S.D) scores on the Three Item Loneliness Scale (TILS) were 6.30 (2.06) and 8.79 (5.49) for Generalized Anxiety Disorder (GAD-7). For female participants, the mean (S.D) GAD-7 and TILS scores were 9.15 (5.46) and 6.24 (1.91), respectively. In

addition, more than a third of the sample (32.3%) reported having mild symptoms of anxiety, almost a quarter (19.9%) had moderate symptoms, and a high number (14.3%) of participants endorsed severe anxiety symptoms (See Figure 3).

**Figure 3**  
*College Student's GAD Levels by sex*



## Assumptions

Model diagnostics revealed some heteroscedasticity in the residuals of the simple and sex-adjusted model. Although the ordinary least squares estimator was unbiased even under some degree of heteroscedasticity (Cohen et al., 2002), standard error (S.E.) estimates can be biased. Ordinary and robust S.E. were compared to assess significant differences, as King and Roberts (2015) suggested, to verify this degree of bias in S.E. estimates. Ordinary (0.048) and robust (0.047) S.E. were practically identical for the simple model. For the sex-adjusted model, this was also the case. Hence, ordinary S.E. are reported. Cook's distance (Cook & Weisberg, 1982) and differences in the model coefficient estimates when deleting observations (Fox, 1997) did not reveal any significant outliers on either model. No issues of multicollinearity or non-normality of residuals were detected.

## Regression model

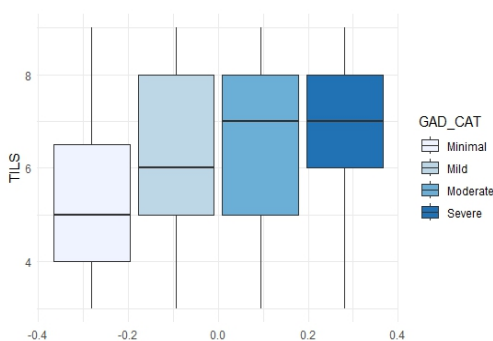
Feelings of loneliness were significantly associated with anxiety symptoms. A one-unit increase in the TILS score produced a 0.39 standard deviation from the mean in anxiety symptoms. In addition, loneliness alone explained close to 15% of the variance in anxiety symptoms in this sample. After adjusting for sex differences, the percentage of variance in anxiety symptoms explained by loneliness only dropped marginally (13.7%). Being female was significantly associated with anxiety symptoms when compared to males. However, it explained less than 1% of the variance in anxiety symptoms among this sample (See Table 1).

**Table 1**  
*Findings of Regression Models 1 and 2*

	Beta	Std. Beta	SE	95% CI		p	R <sup>2</sup> (%)	f <sup>2</sup>
				LL	UL			
<i>Model 1</i>								
Intercept	1.70	--	0.31	1.08	2.31	<.001	--	0.17
TILS	0.37	0.39	0.05	0.28	0.47	<.001	14.8	0.17
<i>Model 2</i>								
Intercept	1.70	--	0.31	1.08	2.31	<.001	15.7 <sup>a</sup>	0.19
TILS	0.37	0.39	0.05	0.27	0.46	<.001	13.7	0.16
Female	0.52	0.38	0.22	0.08	0.97	0.021	0.8 <sup>b</sup>	0.01 <sup>b</sup>

Note. <sup>a</sup> = adjusted R<sup>2</sup>; <sup>b</sup> = partial R<sup>2</sup>; <sup>c</sup> = partial f<sup>2</sup>

**Figure 4**  
*Loneliness scores of college students by anxiety levels*



## Discussion

The purpose of the present study was to describe the prevalence of loneliness and generalized anxiety disorders among Puerto Rican college students during the Pandemic. Additionally, we examined the relationship between feelings of loneliness and GAD among college students. Moreover, we controlled for sex to investigate whether significant differences existed in the link between loneliness and GAD in females and males. This study builds upon prior literature suggesting differences in the experiences of loneliness (Chang, 2018), stress (Graves et al., 2021), and GAD (Gao et al., 2020) by sex among college samples. The results of the current study suggest that there is an association between GAD symptoms experienced during the Pandemic and college students' loneliness. These results coincide with existing literature stating that individuals who felt socially isolated or lonely during the Pandemic may experience heightened stress, uncertainty, and a diminished sense of support (Boursier et al., 2020; Owczarek et al., 2022).

The findings of this study suggest significantly high levels of loneliness among this sample, with the mean score on the three-item Loneliness Scale (TILS) of this study 6.30 (SD = 2.06), which is higher than that of a study with a large and representative sample of young adults in Spain between the ages of 18-24 (M = 5.36; SD = 1.87) (Trucharte et al., 2023). Contrastingly, the mean (S.D.) scores on Generalized Anxiety Disorders (GAD-7) were 8.79 (5.49), respectively, which are slightly lower than a large clinical sample of 2739 adult patients who had been diagnosed with a mental health diagnosis, where the mean of GAD-7 score was 6.1 in women and 4.6 in men (Spitzer et al., 2006). Scores of 10 or greater on the GAD-7 represent a reasonable cutoff point



for identifying cases of GAD, which suggests that this sample was marginally close to having a GAD diagnosis. For example, 16.5 % of males and 10.1 % of females met the criteria for a severe diagnosis of GAD, while almost a quarter of males (21.3 %) and females (20.3 %) met the cutoff point for moderate symptoms of anxiety.

The results of the present study coincide with the current literature on the effects of social isolation measures on college students' mental health (Giovenco et al., 2022; Son et al., 2020). We believe that measures to reduce the spread of the virus may have significantly impacted students' social and economic activities. In this study, GAD and loneliness experienced by the surveyed students were well above the average for this population. Moreover, as hypothesized, we found a significant association between loneliness and GAD. That is, college students in Puerto Rico are vulnerable to loneliness, which may result in significant stress and GAD. In the context of economic austerity and the recent COVID-19 pandemic in Puerto Rico, this link could be explained by the many responsibilities that college students have, such as being caregivers of older family members, breadwinners at an early age, and other factors that may intensify their feelings of social isolation.

In addition, the results highlight the importance of social interactions in mental health, considering the effect of loneliness on general anxiety symptoms. The results of this study suggest that the Pandemic could have severely affected Puerto Rican college students' mental health. Pandemic mitigation measures are not without consequences, resulting in mental health difficulties that could impair college students' academic performance. Researchers have stressed the importance of providing mental health services to college students to mitigate social

isolation's effects. Continuous cuts to educational institutions could further affect college students' mental health, impacting retention and graduation rates. There is a need for accessible mental health services as students strive to reclaim socialization spaces in the university that were lost during the Pandemic.

This study showed that loneliness alone could explain approximately 15% of the variance in anxiety symptoms in this sample. This percentage is relatively high in the social sciences, considering the model only includes one variable. It should be noted that this 15% also considers various social and contextual factors for which students also experience loneliness and GAD, such as poverty, migration, and environmental disasters. One interesting finding of this study was that while sex was a statistically significant predictor of the link between loneliness and GAD, it was a weak predictor in the model and did not explain more than one percent of the variance ( $r = .08$ ). Future research should examine how social, economic, and political factors, as well as university-level factors (such as crime, migration, economic problems, declining enrollment, and environmental phenomena) mediate the well-established link between loneliness and GAD.

## Implications

At this stage of development (18-25 years of age), isolation and GAD may be significant risk factors for developing more severe and chronic health conditions. Thus, interventions promoting social connectedness and positive experiences during college are essential components of promoting students' academic development and mental health. Educational institutions must recognize the vulnerability of their students and intervene with necessary

services. For example, students can benefit from welcoming environments and events in which they can develop social connections and skills. These findings could have implications for leaders of academic institutions, mental health providers, and policymakers. Educational institutions and leaders should be aware of psychosocial factors, such as loneliness and GAD, which could directly impact academic performance, educational outcomes, and retention of students.

Social connectedness and a sense of belonging could be targets of psychosocial interventions within university campuses to prevent loneliness, as students must establish positive social connections that could help them in times of difficulty. Developing university-wide events and interventions focused on promoting healthy relationships and social interactions could be protective factors in promoting positive mental health outcomes and, consequently, better academic outcomes. Following the COVID-19 restrictions, the precautionary measures implemented to curb the spread of the virus resulted in social isolation, with consequential impacts on the mental health of university students. These measures introduced a form of social distancing that contributed to psychological discomfort (Torres et al., 2022). Existing literature posits that social distancing may precipitate social isolation, consequently leading to psychological distress. Studies further indicate an inverse relationship between reported levels of social connections and psychological distress, with higher reported social connections associated with lower psychological distress (Torres et al., 2022). Researchers recommend that universities address the psychological distress arising from crises such as pandemics by implementing family care and support programs (Torres et al., 2022). The findings

of this study have implications for clinical practice in that mental health providers and university counselors should target loneliness via individual or group interventions, which could also be valuable recommendations for educators. Educators should promote educational experiences beyond virtual classes that allow students to feel connected, heard, and part of an academic institution.

### **Strengths and limitations**

This study contributes to the literature on the link between loneliness and GAD. To the best of our knowledge, this is the first study to test the proximal effects of loneliness on GAD, and the analysis exploring differences by sex contributes to the literature suggesting that this demographic characteristic is significant but did not explain much of the variance. At the same time, the present findings should be interpreted in light of the study's limitations. The first is related to sample size, which could affect the power and reliability of the results. The second limitation concerns the sampling techniques, which limited the external validity of the results and generalizability of the present study findings. Researchers recommend that future studies use random, stratified sampling to obtain a clearer view of the impact of loneliness on GAD and strive to recruit a representative sample of college students from various campuses across the island. These methodological changes will provide a clearer view of the mental health of Puerto Rican college students. Third, the cross-sectional nature of this study design cannot be used to make causal inferences. More complex analysis is warranted to understand better the mechanisms contributing to the link between loneliness and GAD. For example, a longitudinal and experimental study design is recommended to obtain more precision regarding the development of the mental health needs of this group.

## Conclusion

Loneliness and GAD among college students are a growing concern as they have been found to compromise long-term health outcomes. College students in Puerto Rico are especially vulnerable due to their exposure to several life-changing socioeconomic and environmental events in recent years. Thus, there is a need to identify, intervene, and prevent the development of loneliness that may result in severe stress and GAD, which have been linked to increased morbidity and mortality rates (Prior et al., 2016). This study aimed to shed light on how social isolation could harm the development of psychopathology (in this case, generalized anxiety disorders). In sum, leaders and educational institutions should know the urgent need and responsibility to target social isolation among college students to mitigate its potential impact on their overall health and mental health.

## Compliance with Research Ethics Standards

### Funding

No external or internal funding was sought for this project.

### Conflict of interests

The authors have no conflict of interest to disclose.

### Approval of the Institutional Board for the Protection of Human Subjects in Research

The University of Puerto Rico Institutional Review Board approved the study in March 2022 (IRB #2022-084).

### Informed consent

Each participant's informed consent was obtained before collecting data for the study.

## References

- Alto, M. E., Nicasio, A. V., Stewart, R., Rodríguez-Sanfiorenzo, T. D., González-Eliás, G., & Orengo-Aguayo, R. (2021). Provision of mental health services immediately following a natural disaster: Experiences after Hurricane Maria in Puerto Rico. *Journal of Emergency Management (Weston, Mass.)*, 19(8), 167–175.  
<https://doi.org/10.5055/jem.0634>
- American College Health Association. (2022). Undergraduate student reference group: National college health assessment.  
<https://www.acha.org/>
- Benjamini, Y. & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society*. 57(1), 289-300.  
<https://doi.org/10.1111/j.2517-6161.1995.tb02031.x>
- Beugelsdijk, Sjoerd, Smulders, & Sjak. (2003, August 30). *Bridging and Bonding Social Capital: which type is good for economic growth?*  
[https://www.econstor.eu/bitstream/10419/116232/1/ERSA2003\\_517.pdf](https://www.econstor.eu/bitstream/10419/116232/1/ERSA2003_517.pdf)
- Borys, S., & Perlman, D. (1985). Gender differences in loneliness. *Personality and Social Psychology Bulletin*, 11(1), 63–74.  
<https://doi.org/10.1177/0146167285111006>
- Box, G. E. P. & Cox, D. R. (1964) An analysis of transformations. *Journal of the Royal Statistical Society*, 26(2), 211– 252.  
<https://www.jstor.org/stable/2984418>
- Centers for Disease Control and Prevention. (2023, March 30). Centers for Disease Control and Prevention. *How does social connectedness affect*

- health?  
<https://www.cdc.gov/emotional-wellbeing/social-connectedness/affect-health.htm#:~:text=When%20people%20are%20socially%20connected,stress%2C%20anxiety%2C%20and%20depression>
- Czeisler M.E., Lane R.I., Petrosky E., Petrosky, Wiley, J.F., Christensen, A., Njai, R., Weaver, M.D., Robbins, R., Facer-Childs, E.R., Barger, L.K., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W. (2020). Mental health, substance use, and suicidal ideation during the COVID-19 pandemic. *Morbidity and Mortality Weekly Report*, 69(32), 24-30 <https://doi.org/10.15585/mmwr.mm6932a1>
- Chang, E. C. (2018). Relationship between loneliness and symptoms of anxiety and depression in African American men and women: Evidence for gender as a moderator. *Personality and Individual Differences*, 120, 138–143. <https://doi.org/10.1016/j.paid.2017.08.035>
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2002). *Applied multiple regression/correlation analysis for the behavioral sciences*. Routledge. <https://doi.org/10.4324/9780203774441>
- Christiansen, D. M. (2015). Examining sex and gender differences in anxiety disorders. F. Durbano (Ed.), *A Fresh Look at Anxiety Disorders*. IntechOpen. <https://doi.org/10.5772/60662>
- Cook, R. D., & Weisberg, S. (1982). *Residuals and influence in regression*. Chapman and Hall. <https://hdl.handle.net/11299/37076>
- Dhira, T. A., Rahman, M. A., Sarker, A. R., & Mehareen, J. (2021). Validity and reliability of the Generalized Anxiety Disorder-7 (GAD-7) among university students of Bangladesh. *PLoS ONE*, 16(12), 1-16. <https://doi.org/10.1371/journal.pone.0261590>
- Diehl, K., Jansen, C., Ishchanova, K., & Hilger-Kolb, J. (2018). Loneliness at universities: Determinants of emotional and social loneliness among students. *International Journal of Environmental Research and Public Health*, 15(9), 1865. <https://doi.org/10.3390/ijerph15091865>
- Finlay, A. K., Ram, N., Maggs, J. L., & Caldwell, L. L. (2012, March). Leisure activities, the social weekend, and alcohol use: Evidence from a daily study of first-year college students. *Journal of studies on alcohol and drugs*, 73(2), 250–259 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3281983/>
- Foster, C. E., Horwitz, A., Thomas, A., Opperman, K., Gipson, P., Burnside, A., Stone, D. M., & King, C. A. (2017). Connectedness to family, school, peers, and community in socially vulnerable adolescents. *Children and Youth Services Review*, 81, 321–331. <https://doi.org/10.1016/j.childyouth.2017.08.011>
- Fox, J. (1997). *Applied regression analysis, linear models, and related methods*. Sage Publications, Inc.
- Gao, W., Ping, S., & Liu, X. (2020). Gender differences in depression, anxiety, and stress among college students: A longitudinal study from China. *Journal of Affective Disorders*, 263, 292–300. <https://doi.org/10.1016/j.jad.2019.11.121>

- Giovenco, D., Shook-Sa, B. E., Hutson, B., Buchanan, L., Fisher, E. B., & Pettifor, A. (2022). Social isolation and psychological distress among southern U.S. college students in the era of COVID-19. *PLOS ONE*, *17*(12), e0279485. <https://doi.org/10.1371/journal.pone.0279485>
- Graves, B. S., Hall, M. E., Dias-Karch, C., Haischer, M. H., & Apter, C. (2021). Gender differences in perceived stress and coping among college students. *PLoS ONE*, *16*(8), e0255634. <https://doi.org/10.1371/journal.pone.0255634>
- Halfon, N., Larson, K., Lu, M., Tullis, E., & Russ, S. (2014). Lifecourse health development: past, present and future. *Maternal and Child Health Journal*, *18*(2), 344–365. <https://doi.org/10.1007/s10995-013-1346-2>
- Hinojosa, J., & Melendez, E. (2018). *Puerto Rican exodus: one year since hurricane María*. Center for Puerto Rican Studies. [https://www.academia.edu/37500795/Puerto\\_Rican\\_Exodus\\_One\\_Year\\_Since\\_Hurricane\\_Maria](https://www.academia.edu/37500795/Puerto_Rican_Exodus_One_Year_Since_Hurricane_Maria)
- Hughes, M. E., Waite, L. J., Hawkey, L. C., & Cacioppo, J. T. (2004). A short scale for measuring loneliness in large surveys. *Research on Aging*, *26*(6), 655–672. <https://doi.org/10.1177/0164027504268574>
- Jiménez-Torres, B. R., Concepción-Lizardi, A., & Martínez-González, J. V. (2022, January 16). The relationship between social connections and psychological distress during the covid-19 Pandemic. *Revista Puertorriqueña de Psicología*, *32*(2), 244-258. <https://www.repsasppr.net/index.php/rep/article/view/697>
- King, G., & Roberts, M. E. (2015). How robust standard errors expose methodological problems they do not fix, and what to do about it. *Political Analysis*, *23*(2), 159-179. <https://gking.harvard.edu/publications/how-robust-standard-errors-expose-methodological-problems-they-do-not-fix>
- Khatib, S. A. A. (2012). Exploring the relationship among loneliness, self-esteem, self-efficacy and gender in United Arab emirates college students. *Europe's Journal of Psychology*, *8*(1), 159-181. <https://doi.org/10.5964/ejop.v8i1.301>
- Labandera, E., Santiago, D., & Laurel, J. (2021). *Higher education in Puerto Rico: Conditions and context influencing institutional resilience*. <https://www.edexcelencia.org/Higher-Education-Puerto-Rico-Conditions-Context-Influencing-Institutional-Resilience>
- Maes, M., Qualter, P., Vanhalst, J., Van den Noortgate, W., & Goossens, L. (2019). Gender differences in loneliness across the lifespan: A meta-analysis. *European Journal of Personality*, *33*(6), 642–654. <https://doi.org/10.1002/per.2220>
- Marshall, G. N., Miles, J. N. V., & Stewart, S. H. (2010, February 1). Anxiety sensitivity and PTSD symptom severity are reciprocally related: Evidence from a longitudinal study of physical trauma survivors. *Journal of abnormal psychology*, *119*(1), 143-150. <https://doi.org/10.1037/a0018009>
- Merino-Soto, C., Angulo-Ramos, M., Rovira-Millán, L. V., & Rosario-Hernández, E. (2023). Psychometric properties of the generalized anxiety

- disorder-7 (GAD-7) in a sample of workers. *Frontiers in Psychiatry*, *14*, 999242. <https://doi.org/10.3389/fpsy.2023.999242>
- Mofatteh, M. (2020). Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health*, *8*(1), 36–65. <https://doi.org/10.3934/publichealth.2021004>
- Morrish, N., Mujica-Mota, R., & Medina-Lara, A. (2022). Understanding the effect of loneliness on unemployment: Propensity score matching. *BMC Public Health*, *22*(1), 740. <https://doi.org/10.1186/s12889-022-13107-x>
- Mushtaq, R., Shoib, S., Shah, T., & Mushtaq, S. (2014). Relationship Between Loneliness, Psychiatric Disorders and Physical Health? A Review on the Psychological Aspects of Loneliness. *Journal of Clinical and Diagnostic Research: JCDR*, *8*(9), WE01–WE04. <https://doi.org/10.7860/JCDR/2014/10077.4828>
- N. E. L. M. D. (2013, February 9). Does loneliness mediate the relation between social support and cognitive functioning in later life? *Social science & medicine* (1982). <https://pubmed.ncbi.nlm.nih.gov/24331889/>
- Orengo-Aguayo, R., Stewart, R., Arellano, M. de, Pastrana, F., Villalobos, B., Martínez-González, K., Suárez-Kindy, J., & Brymer, M. (2019). Implementation of a Multi-Phase, Trauma-Focused Intervention Model Post-Hurricane Maria in Puerto Rico: Lessons Learned from the Field Using a Community Based Participatory Approach. *Journal of Family Strengths*, *19*(1), 1-41. <https://digitalcommons.library.tmc.edu/jfs/vol19/iss1/7>
- Ozbay, F., Johnson, D. C., Dimoulas, E., Morgan, C. A., Charney, D., & Southwick, S. (2007). Social support and resilience to stress: From neurobiology to clinical practice. *Psychiatry (Edmont)*, *4*(5), 35-40. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2921311/>
- Padilla-Rosas EJ. (2020). Puerto Rico and COVID-19: A Precarious Healthcare System Faces Serious Challenges. *Council on Hemispheric Affairs*. <https://www.coha.org/puerto-rico-and-covid-19-a-precarious-healthcare-system-faces-serious-challenges/>. Accessed September 14, 2023.
- Pagan, R. (2020, December 8). Gender and age differences in loneliness: Evidence for people without and with disabilities. *International journal of environmental research and public health*, *17*, 9176. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7763056/>
- Pagán-Torres, O.M., González-Rivera, J.A. & Rosario-Hernández, E. (2020). Reviewing the Psychometric Properties and Factor Structure of the Generalized Anxiety Disorder-7(Gad-7) in A Sample of Puerto Rican Adults. *International Journal of Recent Scientific Research*, *11*(01), 36885-36888. <http://www.doi.org/10.24327/IJRSR>
- Prior, A., Fenger-Grøn, M., Larsen, K. K., Larsen, F. B., Robinson, K. M., Nielsen, M. G., Christensen, K. S., Mercer, S. W., & Vestergaard, M. (2016). The Association Between Perceived Stress and Mortality Among People With Multimorbidity: A Prospective Population-Based

- Cohort Study. *American Journal of Epidemiology*, 184(3), 199–210. <https://doi.org/10.1093/aje/kwv324>
- R Core Team (2021) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>
- Rodríguez, A. R., González-Rivera, J. A., Santos, A., & Rodríguez-Ríos, L. (2020, July 15). Vista de demandas Tecnológicas, Académicas y Psicológicas en Estudiantes Universitarios Durante La Pandemia Por Covid-19: Revista Caribeña de Psicología. *Vista de Demandas Tecnológicas, Académicas y Psicológicas en Estudiantes Universitarios durante la Pandemia por COVID-19. Revista Caribeña de Psicología*, 4(2), 176-185. <https://revistacaribenadepsicologia.com/index.php/rcp/article/view/4915/4349>
- Rodríguez-Pose, A., & Burlina, C. (2021, December 19). *Alone and lonely: The economic cost of solitude*. CEPR. <https://cepr.org/voxeu/columns/alone-and-lonely-economic-cost-solitude>
- Sánchez-Cardona, I., Pedrogo, C. P., Lopez-Torres, S., & Sánchez-Cesáreo, M. (2021, September 20). Vulnerabilities and academic outcomes among students in Puerto Rico. Preventing school failure: *Alternative Education for Children and Youth*, 66(1), 77-88 <https://doi.org/10.1080%2F1045988x.2021.1972920>
- Shelton, L. J., & Thompson, C. J. (2020). Fostering Resilience for Puerto Rican College Students in Transition After Hurricane Maria. *The Journal of College Orientation, Transition, and Retention*. <https://pubs.lib.umn.edu/index.php/jcotr/article/view/2219/2383>
- Son, C., Hegde, S., Smith, A., Wang, X., & Sasangohar, F. (2020). Effects of COVID-19 on College Students' Mental Health in the United States: Interview Survey Study. *Journal of Medical Internet Research*, 22(9), e21279. <https://doi.org/10.2196/21279>
- Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, 166(10), 1092–1097. <https://doi.org/10.1001/archinte.166.10.1092>
- Trucharte, A., Calderón, L., Cerezo, E., Contreras, A., Peinado, V., & Valiente, C. (2023). Three-item loneliness scale: Psychometric properties and normative data of the Spanish version. *Current Psychology*, 42(9), 7466–7474. <https://doi.org/10.1007/s12144-021-02110-x>
- Umberson, D., & Karas Montez, J. (2010). Social Relationships and Health: A Flashpoint for Health Policy. *Journal of Health and Social Behavior*, 51(1\_suppl), S54–S66. <https://doi.org/10.1177/0022146510383501>
- U.S. Public Health Services. (2023). *New Surgeon General Advisory Raises Alarm about the Devastating Impact of the Epidemic of Loneliness and Isolation in the United States* [Text]. HHS.Gov. <https://www.hhs.gov/about/news/2023/05/03/new-surgeon-general-advisory-raises-alarm-about-devastating-impact-epidemic-loneliness-isolation-united-states.html>
- Vidal, C., Dobbs, P. D., Herrmann, E., Mena, D. A., & Jones, C. (2022). COVID-19

- Risk Perceptions and Health Behaviors in Puerto Rico. *The American Journal of Tropical Medicine and Hygiene*, 107(2), 278–283.  
<https://doi.org/10.4269/ajtmh.22-0186>
- Wilkialis, L., Rodrigues, N. B., Cha, D. S., Siegel, A., Majeed, A., Lui, L. M. W., Tamura, J. K., Gill, B., Teopiz, K., & McIntyre, R. S. (2021, December 8). Social isolation, loneliness and generalized anxiety: *Implications and associations during the COVID-19 quarantine*. *Brain sciences*, 11(12), 1620.  
<https://doi.org/10.3390%2Fbrainsci11121620>
- Yanguas, J., Pinazo-Henandis, S., & Tarazona-Santabalbina, F. J. (2018). The complexity of loneliness. *Acta Bio Medica: Atenei Parmensis*, 89(2), 302–314.  
<https://doi.org/10.23750/abm.v89i2.7404>
- Yeo, I.K. & Johnson, R.A. (2000) A new family of power transformations to improve normality or symmetry. *Biometrika*, 87(4), 954-959.  
<https://doi.org/10.1093/biomet/87.4.954>