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Are Anxious and Depressive Symptoms Associated with Gastro-Intestinal Symptoms in the Hispanic Community Health Study/ Study of Latinos (HCHS/SOL)?

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Abstract

Psychological distress is common among non-Hispanic/Latino adults with gastro-intestinal (GI) symptoms. Heartburn and acid regurgitation symptom prevalence, and their relationship with anxious and depressive symptoms, was examined in 16,415 Hispanic Community Health Study/ Study of Latinos participants aged 18-74 from 4 US cities (Bronx, NY; Chicago, IL; Miami, FL; San Diego, CA). Complex survey logistic regression models were used to test relations between GI, anxious, and depressive symptoms. 10.1% (95% confidence interval [CI] = 9.4, 10.8) and 8.9% (95% CI = 8.3, 9.5) of the overall sample (estimates are weighted and adjusted for age and body mass index) respectively self-reported heartburn and acid regurgitation at least several times/

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Authors' Contributions

Marisa Perera and Maria Llabre were engaged in study conception and design, with input and contributions from all authors. Material preparation and data collection were performed by the HCHS/SOL coordinating center team. Data analysis was performed by Marisa Perera and Maria Llabre. The first draft of the manuscript was written by Marisa Perera and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest/Competing Interests

All the authors declare that they have no conflict of interest.

Ethics Approval

All procedures performed were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Consent to Participate

Informed consent was obtained from all individual participants included in the study.

Consent for Publication

Patients signed informed consent regarding publishing their data as part of a research study.

Availability of Data and Material

Not applicable.

Code Availability

Not applicable.

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week within the past year. Adults who reported GI symptoms several times/week or more also self-reported higher psychological distress compared to adults who reported GI symptoms less frequently. For one standard deviation higher in anxious symptoms (5.6 units), GI prevalence odds were respectively 1.14 (95% CI = 1.10, 1.17) and 1.14 (95% CI = 1.09, 1.18) for heartburn and acid regurgitation. GI prevalence odds (heartburn = 1.14, 95% CI = 1.11, 1.18; acid regurgitation = 1.15, 95% CI = 1.10, 1.18) were similar for one standard deviation higher in depressive symptoms (5.9 units). Demographic, health, and clinical characteristics did not significantly attenuate relationships between GI and psychological distress symptoms. Psychological distress is related to GI symptoms in US Hispanics/Latinos.

Keywords

heartburn; acid regurgitation; anxiety; depression; Hispanic/Latino

Gastro-intestinal (GI) symptoms, including heartburn and acid regurgitation, are common among US inhabitants [1-3]. Though prevalence of GI symptoms is known to vary by ethnicity [4], few studies have examined symptoms among the largest ethnic minority in the US, the Hispanic/Latino population. In population-based studies of Hispanics/Latinos in South America and Spain, annual prevalence of common GI symptoms varied from approximately 30 to 60% [5,6]. Of the few studies that included Hispanics/Latinos residing in the US, GI complaints were found to be more common among Hispanics/Latinos compared to African, Asian, and/or non-Hispanic/Latino White Americans [7,8]. Yet, existing studies have not included heterogeneous samples that are more representative of the US Hispanic/Latino population. Prevalence of common GI symptoms in a heterogeneous sample of US Hispanics/Latinos has not been documented.

Persons with GI symptoms are known to have high rates of psychological comorbidity, particularly anxiety and depression [9,10]. A complex and reciprocal relationship between the GI tract and the brain, or the gut-brain axis, has been established and it has been suggested that the biological pathways of psychological distress (e.g., body vigilance, anxiety sensitivity) are similar to those of GI distress [11,12]. That is, GI symptoms are affected by psychological distress and emotional status is affected by GI function. For instance, psychological factors can affect perceptions of pain through the gut-brain axis, thereby influencing severity of GI symptoms [13]. Through stress-related automatic arousal interfering with GI sensitivity and function, psychological distress can also impact number of GI symptoms experienced [14]. Beyond exacerbated GI symptoms, psychological factors have been linked with poor health outcomes, functional impairment, poor quality of life, and high healthcare utilization [15], necessitating understanding of the relationship between GI symptoms and psychological distress to ensure optimal understanding and treatment of GI symptoms.

In non-Hispanic/Latino samples, psychological distress symptoms have consistently been positively linked with presence of GI symptoms [16-19]. Moreover, in the most comprehensive study of US Hispanics/Latinos to date, a high prevalence (over 25%) of overall anxious and/or depressive symptoms was observed, highlighting notable presence of

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psychological distress among this population [20]. Despite established knowledge of the gut-brain axis and an evident presence of psychological distress symptoms among US Hispanics/Latinos, whether psychological distress symptoms relate to GI symptoms among the heterogenous US Hispanic/Latino population remains unknown.

Using an epidemiological sample of Hispanics/Latinos residing in the US, we first aimed to examine prevalence, defined as symptoms reported to occur several times/week or more, of the two common GI symptoms of heartburn and acid regurgitation. Second, we aimed to determine if anxious and depressive symptoms are associated with GI symptoms, and if the relationship between psychological distress and GI symptoms is accounted for by other demographic, health, and/or clinical factors often associated with GI symptoms.

Method

Participants

We examined data from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) cohort of 16,415 self-identified US Hispanics/Latinos aged 18-74 years. Participants were recruited and enrolled from randomly selected households through a multi-stage area probability design from four US communities (Bronx, NY; Chicago, IL; Miami, FL; San Diego, CA). The institutional review board at each community site approved study protocols and all participants gave informed consent. From 2008-2011, participants underwent a baseline clinic examination during which they completed questionnaires and anthropometric measurements. A detailed description of the overall study design and methods is available [21,22].

Materials and procedure

GI symptoms.—At the baseline visit (conducted from 2008-2011), participants were first asked if they had heartburn, defined as burning pain or discomfort behind the breastbone in the chest, and/or acid regurgitation, defined as a bitter or sour-tasting fluid coming into the throat or mouth, at least once in the year prior to the time of each participant's HCHS/SOL baseline exam (or the 12-month period directly preceding each participant's baseline visit; hereafter referenced as "in the past year"). For participants who responded yes, they were then asked how often they had heartburn and/or acid regurgitation in the past year as either less than once per month, about once per month, about once per week, several times per week, or daily. Given that occasional GI symptoms are common and not necessarily clinically meaningful, we adopted GI symptoms experienced at least several times/week as the threshold for GI symptom presence. Of the 16,415 participants, 5693 participants reported heartburn at least once in the past year and 1889 of the 5693 reported heartburn several times/week or more. Of the 16,415 participants, 6712 reported acid regurgitation at least once in the past year and 1716 of the 6712 reported acid regurgitation several times/week or more. For the purposes of the present study, it was considered that 1889 participants reported presence of heartburn and 1716 participants reported presence of acid regurgitation.

Anxious symptoms.—The Spielberger Trait Anxiety Inventory (STAI) [23] was used to measure anxious symptoms. The STAI measures trait anxiety, or a general tendency to

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experience anxious emotion-cognition. There are 10 items on which respondents rated how they generally feel on a 4-point scale ranging from 1 (*almost never*) to 4 (*almost always*). Total scores range from 10 to 40. Internal consistency reliability for the total sample was α = .80.

Depressive symptoms.—The Center for Epidemiologic Studies Depression Scale (CESD-10) [24] was used to measure depressive symptoms. The CESD-10 measures frequency of depressive symptoms experienced during the past week from *rarely or none of the time* (*< 1 day*) to *all the time* (*5-7 days*). An abbreviated 10-item version was used in the present study, with total scores ranging from 0 to 30 [25]. Internal consistency reliability for the total sample was α = .83. The validity, reliability, and invariance of the English- and Spanish-translated CESD-10 versions used by HCHS/SOL have been supported [26].

Demographic variables.—Age, sex, self-identified Hispanic/Latino background (Mexican, Puerto Rican, Dominican, Cuban, and Central and South American), household income (> $30,000; ≤ $30,000), and continuous education years were collected during standardized interviews.

Health variables.—Body mass index was calculated as measured weight in kilograms (Tanita Body Composition Analyzer, TBF 300A) divided by the square of measured height in meters. Anthropometric measurements were performed by trained and certified staff following a standard protocol. Tobacco use was classified as never smoked, former smoker, or current smoker. Alcohol intake was classified as never consumed, formerly consumed, or currently consume. Caffeine was measured as self-reported milligrams (mg) of daily caffeine consumption.

The Alternative Healthy Eating Index (AHEI) [27] has been widely used in dietary quality assessment based on foods and nutrients predictive of chronic disease risk, and a variant of the AHEI was recently used with a GI population [28]. AHEI is a composite score constituted by 11 components; higher scores are assigned for higher intake (servings/day) of vegetables, fruit, whole grains, nuts and legumes, long-chain (n-3) fats (EPA+DHA) mg/day, polyunsaturated fatty acids (PUFA) % energy, and lower scores for higher intakes of sodium (mg/day), red/processed meat, and sugar-sweetened beverages and fruit juice, and alcohol (drinks/day). For whole grains and alcohol, sex-specific cutoffs were used (AHEI scoring criteria shown in Online Resource 1). Scores ranged from 0 to 110 where higher scores indicate higher diet quality. AHEI dietary components were assessed with two gold standard 24-hour dietary recalls to assess current nutrient intake [29]; recalls with daily energy intake below the 1st percentile, above the 99th percentile by sex, or unreliable according to the interviewer were excluded.

Sedentary time was measured as total minutes/day of sedentary activity of <100 counts/minute using actical data. Participants left clinics wearing actical version B-1 accelerometer (model 198-0200-03; Philips-Respironics Co. Inc., Bend, OR) around the waist on an elasticized belt. The actical sampled raw acceleration data at 32 Hz, which were filtered and aggregated over a user-defined period. Participants were instructed to wear the actical for seven days during all waking hours and to remove it for sleeping and water-based activities.

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For standardization across sites, we used data collected between 5:00 AM the morning after the clinic visit over 3-6 days.

Sleep duration was measured via self-report and derived as a weighted average of daily sleep duration in hours during one week (5 weekdays and 2 weekend days). Sleep durations less than 3 hours or greater than 14 hours were set to missing.

Clinical characteristics.—Participants reported (yes/no) whether a doctor had ever diagnosed them as having any of the following: angina, cancer or a malignant tumor, liver disease, kidney problems, migraine headaches with or without an aura, sleep disorder, and/or painful inflammation or swelling of joints that limit activities.

Analyses

NC), and Statistical Package for the Social Science (SPSS) version 24. HCHS/SOL clustering stratification and sampling weights were used in all analyses. Means or frequencies and 95% confidence intervals (CI) were examined for all variables. Prevalence of GI symptoms were age- and body mass index-adjusted and examined overall and by Hispanic/Latino background group. Group differences were tested using chi-square and t tests.

A series of logistic regression models regressed heartburn or acid regurgitation on anxious or depressive symptoms and odds ratios (OR) and CIs was estimated. To compute standardized ORs, standardized logistic regression coefficients were exponentiated. A 4-step hierarchical model was used to examine the cross-sectional relationship between anxious or depressive symptoms with GI symptoms. First, crude associations were analyzed. Second, associations were adjusted for demographic factors of age, sex, education, income, Hispanic/Latino background, and HCHS/SOL center. Third, associations were additionally adjusted for health-related variables of body mass index, alcohol use, tobacco use, caffeine consumption, physical activity, diet, and sleep. Fourth, associations were additionally adjusted for clinical conditions of angina, cancer, liver disease, kidney problems, migraines, sleep disorder, and activity-limiting joint swelling.

Maximum likelihood robust (MLR) estimation, a full-information maximum likelihood approach to missing data, was used to estimate model parameters in the presence of missing data. MLR allows cases with missing data on study variables to be included in analyses. Across variables, missing data ranged from .001% - 6.7% and were assumed missing completely at random. Unbiased parameter estimates are provided under this assumption [30].

Results

Overall, the average age was 41 years and 52.1% were women. Majority earned more than a high school degree, had an annual household income less than $30,000, and were of Mexican or Cuban background (see Table 1). Average body mass index fell within the upper end of the overweight range (29.3 kg/m^2). Majority reported current alcohol use (51.6%) and no history of tobacco use (61.2%). On average, adults consumed 95mg of caffeine daily,

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engaged in sedentary activity for approximately 700 minutes/day, had a diet quality score of 47.4, and slept approximately 8 hours per night. Fewer than 10% reported medical history remarkable for angina, cancer, or liver disease. Approximately 10-15% reported medical history remarkable for kidney problems, migraines, sleep disorder, or joint swelling (see Table 1).

In the past year, age- and body mass index-adjusted heartburn prevalence was 10.1% and acid regurgitation prevalence was 8.9% (see Table 2). Differences in GI symptom prevalence between Hispanic/Latino groups were observed (see Table 2). Compared to prevalence among individuals of Mexican background (7.4%), prevalence of heartburn was higher among those of Cuban (15.7%; $\chi^2 = 136.6$, $P < .001$), Puerto Rican (12.4%; $\chi^2 = 59.2$, $P < .001$), and Central American (11.8%; $\chi^2 = 34.6$, $P < .001$) backgrounds. Compared to prevalence among persons of Mexican background (8.1%), prevalence of acid regurgitation was again higher among those of Cuban (11.4%; $\chi^2 = 22.0$, $P < .001$) background.

Overall, the average anxious symptom score was 17.0 (CI = 16.8, 17.2; see Table 3). Adults with heartburn at least several times/week reported higher average anxious symptoms (N=1889; M = 19.0, 95% CI = 18.7, 19.2) than those without heartburn or with heartburn less frequently (N=14,526; M = 16.8, 95% CI = 16.7, 16.9; t (16413) = 9.2, $P < .001$). Similarly, adults with acid regurgitation at least several times/week reported higher average anxious symptoms (N=1716; M = 19.2, 95% CI = 18.9, 19.5) than those without acid regurgitation or with symptoms less frequently (N=14,699; M = 16.8, 95% CI = 16.7, 16.9; t (16413) = 9.6, $P < .001$).

The average depressive symptom score overall was 7.0 (95% CI = 6.8, 7.2; see Table 3). Adults with heartburn at least several times/week endorsed greater depressive symptoms (M = 9.5, 95% CI = 9.3, 9.7) than adults without heartburn or with symptoms less often (M = 6.7, 95% CI = 6.6, 6.8; t (16413) = 11.8, $P < .001$). Similarly, adults with acid regurgitation several times/week reported greater anxious symptoms on average (M = 9.7, 95% CI = 9.2, 10.2) than adults without acid regurgitation or with symptoms less often (M = 6.7, 95% CI = 6.6, 6.8; t (16413) = 10.0, $P < .001$).

Associations between GI symptoms and psychological distress symptoms

Regression models included all adults (N=16,415). As seen in Table 4, GI symptoms were significantly associated with anxious symptoms (standardized heartburn OR = 1.20, 95% CI = 1.16, 1.24; standardized acid regurgitation OR = 1.22, 95% CI = 1.17, 1.26). After adjusting for demographic, health, and clinical factors, GI symptoms remained significantly associated with anxious symptoms (standardized heartburn OR = 1.14, 95% CI = 1.10, 1.17; standardized acid regurgitation OR = 1.14, 95% CI = 1.10, 1.18). For one standard deviation higher (5.6 units) in anxious symptoms, odds of either heartburn or acid regurgitation in the past year was 1.14 times greater after adjusting for demographic, health, and clinical factors. Of the varied demographic, health, and clinical factors, age, sex (heartburn only), living in the Bronx, NY (heartburn only), body mass index, tobacco use, angina (heartburn only), kidney disease, migraines, sleep disorders, and painful joint swelling were positively associated with GI symptoms that occur at least several times/week (P's < .01; see Table 5).

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As seen in Table 4, heartburn and acid regurgitation were also significantly associated with depressive symptoms (standardized heartburn OR = 1.24, 95% CI = 1.20, 1.28; standardized acid regurgitation OR = 1.25, 95% CI = 1.21, 1.29). After adjusting for demographic, health, and clinical factors, heartburn and acid regurgitation remained significantly associated with depressive symptoms (standardized heartburn OR = 1.14, 95% CI = 1.11, 1.19; standardized acid regurgitation OR = 1.15, 95% CI = 1.11, 1.19). For one standard deviation higher (5.9 units) in depressive symptoms after adjusting for demographic, health, and clinical factors, odds of heartburn or acid regurgitation in the past year was 1.14 or 1.15 times greater, respectively. Of the varied demographic, health, and clinical factors, age, sex (heartburn only), income (acid regurgitation only), living in the Bronx, NY (heartburn only), Puerto Rican background (heartburn only), body mass index, tobacco use, angina (heartburn only), kidney disease, migraines, sleep disorders, and painful joint swelling were positively associated with GI symptoms that occur at least several times/week (*P*'s < .01; see Table 6).

Discussion

This is the first study to investigate the relationship between GI symptoms, anxiety, and depression in a large, diverse population of US Hispanics/Latinos. Prevalence of heartburn or acid reflux was defined as symptoms reported to occur several times/week or more. After adjusting for age and body mass index, prevalence of heartburn was 10.1% and of acid regurgitation was 8.9% in the overall sample. The overall average levels of anxious (M = 17.0) and depressive symptoms (M = 7.0) were similar to prior established means and/or clinical cut-points [31]. Among adults with marked GI symptoms, or symptoms several times/week or more, average psychological distress symptoms were significantly higher by approximately 2-3 units. Moreover, GI symptoms were associated with psychological distress symptoms independent of demographic, health, and clinical characteristics. The observed findings, some of the first to examine GI symptoms and psychological distress among heterogenous Hispanics/Latinos in the US, indicate a strong relationship between GI symptoms and psychological distress.

Whereas prior studies have demonstrated a positive relationship between psychological distress and GI symptoms among non-Hispanic/Latino adults, the present study is the first to proffer robust evidence of higher psychological distress symptoms among US Hispanic/Latino adults reporting GI symptoms at least several times/week. Given that psychological distress symptoms can exacerbate GI symptoms and vice versa, the present findings emphasize value in identifying presence of psychological symptoms among Hispanic/Latino patients presenting with frequent GI symptoms. In medical settings, providers may screen for comorbid physical and psychological symptoms using standardized self-report questionnaires. Areas of psychological assessment may include measures of anxiety and depression, somatization, health-related anxiety, illness impact, and quality of life. Given that biological and psychological factors work concertedly to influence symptom expression, psychological treatment (cognitive-behavioral therapy; hypnosis; exposure treatments) may be considered when significant psychological distress is present. In particular, patients who do not gain sufficient symptom relief from basic medical management and/or for whom stress is likely to exacerbate symptoms or impair coping may benefit. Psychological

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treatments have demonstrated moderate effectiveness in reducing clinically-significant GI symptoms [32,33].

In addition, in view of prior findings of low awareness of GI-related disease and of television advertisements as a major source of GI-related information among US Hispanics/Latinos [7], the present findings also extend support for interventions to educate the US Hispanic/Latino community on GI symptoms and disease. Such efforts may aim to elucidate the relations between GI symptoms, modifiable lifestyle behaviors (body mass index, tobacco use), and behaviors to aid with GI symptom management (avoid fried foods; sleep with head of bed raised, etc.) with the intent to improve awareness and prevent delayed seeking of treatment until increased symptom severity.

Whereas past studies have primarily sampled adults of one or a few Hispanic/Latino background groups (e.g., Mexican), another contribution of the present work is enhanced understanding of the prevalence of two common GI symptoms among several diverse Hispanic/Latino heritage groups. Present findings suggest heterogeneity in GI symptom prevalence across such Hispanic/Latino groups. On average, prevalence of heartburn was higher among adults of Cuban, Puerto Rican, and Central American backgrounds and prevalence of acid regurgitation was higher among adults of Cuban background. Our estimates did account for differences in age and body mass index, suggesting observed group differences are attributable to other factors. Dietary intake, which has been found to be specific to Hispanic/Latino heritage, may be one such factor particularly among adults of Cuban background [34]. HCHS/SOL adults of Cuban descent with diabetes have been found to report overall higher energy and sodium intake, lower fiber intake, and more frequent consumption of traditional Hispanic/Latino and fast foods compared to adults of other Hispanic/Latino heritage groups with diabetes [34], which may contribute to increased GI symptoms. Further attention is warranted to discern dietary components as well as other factors potentially unrelated to heritage, such as those related to GI symptoms (i.e., use of GI medications, Helicobacter pylori infection) or to acculturation (i.e., time spent residing in the US), that may contribute to Hispanic/Latino group differences in GI symptoms. When working with Hispanic/Latino adults in the US presenting with marked GI complaints, providers may assess and consider the patient's specific Hispanic/Latino background.

Beyond anxious and depressive symptoms, several demographic, health, and clinical characteristics were related to prevalence of GI symptoms. Older age was associated with GI symptoms, which may reflect the physiological changes that occur with aging (e.g., aging muscles, including the lower esophageal sphincter; hiatal hernia) and/or frequently prescribed medications that impact the esophagus (e.g., antihypertensive medications) [4]. Consistent with previous findings of heartburn and regurgitation more frequently reported by women than men [35], female sex also emerged as a predictor in all heartburn models. Beyond demographic factors, several recognized and modifiable GI disease risk factors were related to GI symptom prevalence among Hispanics/Latinos, including higher body mass and use of tobacco [36-32]. In addition, numerous clinical characteristics were associated with GI symptoms present several times/week, including angina (heartburn only), kidney problems, migraines, sleep disorder, and joint problems, all of which have been previously linked with GI symptoms and disease [37-39] and/or been associated with substantial

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disease burden specifically among Hispanics/Latinos [40-43]. The multitude of clinical conditions associated with GI symptoms may point to the importance of modifiable health behaviors, such as reducing body mass index to improve gastric motility or quitting tobacco to improve lower esophageal sphincter functioning, for earlier prevention of more severe GI symptoms.

While cultural idioms of distress and somatization were not an explicit focus of the present study, it is worthwhile to note that higher rates of somatic symptoms have been documented among US Hispanics/Latinos compared to non-American Hispanics/Latinos [44] as well as compared to Americans of non-Hispanic/Latino background [45]. Further, several Hispanic/Latino culture-bound syndromes of psychological distress (e.g., ataque de nervios, susto) have been closely associated with presence of psychiatric mood disorders, including anxiety and depression [44]. The present findings support the notion of related physical and psychological symptoms among US adults from heterogenous Hispanic/Latino backgrounds. Moreover, by identifying a robust relationship of anxious and depressive symptoms specifically with heartburn and acid regurgitation, the present findings extend prior understanding in the area of physical-psychological comorbidity among US Hispanics/Latinos to GI health. Future work may more closely consider varied factors that contribute to physical-psychological comorbidity in GI health (e.g., language preference, nativity status, acculturation).

A key strength of the present study is the large sample of US Hispanics/Latinos from representative communities, allowing for generalizability to the US Hispanic/Latino target population. Yet, our study is not without limitations. While HCHS/SOL participants resided in the largest US metropolitan areas with heterogenous Hispanic/Latino populations, estimates are not generalizable to the entire US Hispanic/Latino population as Hispanics/Latinos in rural US communities, who may express psychological distress and/or GI symptoms differently than urban-dwelling US Hispanics/Latinos, were not targeted in the study sample. In addition, our measurement of GI and psychological distress symptoms was not conducted by an objective interviewer but was self-reported. Relatedly, although we were able to identify GI symptoms experienced several times per week or more, our absence of measures of more detailed severity of GI symptoms and functional impairment due to GI symptoms prevented us from making clearer clinically-significant conclusions. Present findings should be replicated in future studies with attention paid to symptom severity and functional impairment to improve clinical relevance of findings. Our results were also cross-sectional, precluding us from determining whether anxious or depressive symptoms preceded GI symptoms or vice versa. Future studies may seek to obtain more comprehensive, objective measurements of anxiety and depression using longitudinal data. Also, the present study's objective was to examine the relationship between psychological distress and GI complaints at a symptom level. Future work may more closely examine this relationship in the context of medical conditions where GI complaints are common (i.e., diabetes, helicobacter pylori) and among individuals with diagnosed psychiatric mood disorders. Future work may also explore dietary and pharmacological factors in the GI-psychological distress relationship, including any possible relation to Hispanic/Latino heritage differences in GI symptoms. Finally, though international studies demonstrate medically explained and unexplained GI symptoms do not differ in their relation to

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psychological distress, we are unable to make such conclusions because our GI symptom measurements did not differentiate between functional or organic [46,47].

In conclusion, prevalence of heartburn or acid regurgitation at least several times/week was present in approximately one-tenth of a heterogenous population of US Hispanics/Latinos and marked prevalence differences among the varied Hispanic/Latino heritage groups emerged. Psychological distress symptoms of anxiety and depression were higher, on average, among adults reporting GI symptoms several times/week or more. The associations between GI symptom prevalence and psychological distress symptoms were not significantly mitigated by common demographic, health, or clinical characteristics. Practitioners working with US Hispanics/Latinos presenting with marked GI complaints may consider use of psychological assessments and interventions as appropriate on a case-by-case basis. Further studies are needed to more clearly identify factors that can mitigate the associations between gastro-intestinal, anxious, and depressive symptoms, as well as to better understand heritage differences in GI symptoms among the US Hispanic/Latino population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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To preserve anonymity of this blinded manuscript, please refer to document entitled “Declarations” for detailed information regarding funding and conflict of interest. Note, all authors declare that they have no conflict of interest.

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Table 1

Demographic, Health, and Clinical Characteristics, HCHS/SOL 2008-2011

	M or %	95% CI
Demographic variables		
Age (years)	41.1	40.5, 41.5
Sex		
Female	52.1%	51.1, 53.2
Male	47.8%	46.7, 48.9
Education		
< High school	32.2%	30.8, 33.5
High school/GED	28.1%	27.0, 29.1
> High school	39.2%	37.7, 40.8
Missing	0.4%	0.3, 0.5
Household income		
> $30,000	60.8%	59.0, 62.7
≤ $30,000	32.4%	30.4, 34.3
Don't know/missing	6.7%	6.0, 7.4
Hispanic/Latino background		
Central American	7.3%	6.3, 8.4
Cuban	19.9%	16.6, 23.2
Dominican	9.8%	8.5, 11.2
Mexican	37.2%	33.9, 40.3
Puerto Rican	16.1%	14.5, 17.6
South American	4.9%	4.3, 5.5
Other/mixed	4.1%	3.5, 4.6
Missing	0.4%	0.3, 0.6
HCHS/SOL center		
Bronx, NY	28.9%	26.1, 31.9
Chicago, IL	15.7%	13.8, 17.7
Miami, FL	29.2%	25.0, 33.4
San Diego, CA	25.9%	22.5, 29.3
Health-related variables		
Body mass index (kg/m^2)	29.3	29.1, 29.5
Alcohol use		
Never	18.3%	16.9, 19.7
Former	29.9%	28.6, 31.2
Current	51.6%	50.1, 53.2
Tobacco use		
Never	61.2%	60.0, 62.4
Former	17.3%	16.5, 18.1

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	M or %	95% CI
Current	21.3%	20.2, 22.4
Caffeine/daily (mg)	95.0	90.7, 97.3
Sedentary activity, hours/day	708.8	701.3, 716.3
AHEI diet quality score	47.4	47.1, 47.7
Sleep duration, hours/day	7.9	7.9, 8.0
Clinical conditions		
Angina	2.0%	1.7, 2.2
Cancer	3.6%	3.1, 4.1
Liver disease	6.4%	5.8, 6.9
Kidney problems	10.3%	9.7, 11.1
Migraines	15.8%	14.9, 16.7
Sleep disorder	10.5%	9.8, 11.3
Joint swelling	13.9%	13.1, 14.7

Note. N = 16415.

M = mean.

95% CI = 95% confidence interval.

HCHS/SOL = Hispanic Community Health Study/Study of Latinos.

All estimates are weighted.

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Table 2

Age- and Body Mass Index-Adjusted Prevalence of Gastro-Intestinal Symptoms Several Times per Week or More Overall and by Hispanic/Latino Group

		Heartburn (several times/week or more)		Acid Regurgitation (several times/week or more)	
	N	**%**	**95% CI**	**%**	**95% CI**
Overall	16,415	10.1%	9.4, 10.8	8.9%	7.5, 8.5
Hispanic/Latino Background					
Central American	1732	11.8% **	10.1, 13.6	10.1%	8.3, 11.8
Cuban	2348	15.7% **	14.2, 17.3	11.4% **	9.9, 12.9
Dominican	1473	6.2%	4.8, 7.7	8.2%	6.5, 9.9
Mexican *R*	6472	7.4%	6.4, 8.5	8.1%	7.1, 9.1
Puerto Rican	2728	12.4% **	10.6, 14.1	8.5%	7.0, 9.9
South American	1072	7.1%	5.3, 8.8	8.1%	6.0, 10.1
Other/mixed	503	8.4%	5.3, 11.4	6.6%	3.5, 9.7

Note. N = 16415.

95% CI = 95% confidence interval.

R = reference group for pairwise contrast testing.

All estimates are weighted and examined at the sample mean age (41.1 years) and body mass index (29.3 kg/m^2).

87 missing cases.

** = *P* <.001.

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Table 3

Gastro-Intestinal and Psychological Distress Symptoms

		Anxious Symptoms		Depressive Symptoms	
	N	M	95% CI	M	95% CI
Overall	16415	17.0	16.8, 17.2	7.0	6.8, 7.2
Heartburn					
None *R*	10618	16.5	16.3, 16.6	6.3	6.1, 6.5
Less than once/month	1471	17.4 *	17.0, 17.9	7.3	6.7, 7.8
Once/month	1396	17.8 **	17.1, 18.6	7.9 *	7.2, 8.5
Once/week	937	17.6 *	17.1, 18.2	8.0 *	7.5, 8.5
Several times/week	1252	18.5 **	17.9, 19.1	8.8 **	8.2, 9.3
Daily	637	20.2 **	19.3, 20.9	11.2 **	10.4, 11.9
Acid regurgitation					
None *R*	9602	16.4	16.3, 16.6	6.3	6.1, 6.5
Less than once/month	2233	17.3	16.8, 17.8	7.4	6.8, 7.8
Once/month	1723	17.9 **	17.4, 18.2	7.7 **	7.3, 8.1
Once/week	1040	17.9 **	17.4, 18.5	8.1 **	7.3, 8.6
Several times/week	1158	18.3 **	18.3, 19.3	9.0 **	8.4, 9.5
Daily	558	20.1 **	19.2, 20.9	11.2 **	10.4, 12.1

Note.

M = mean. 95% CI = 95% confidence interval.

R = reference group for pairwise contrast testing.

All estimates, with the exception of N, are weighted.

* = *P* <.01.

** = *P* <.001.

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Table 4

Associations Between Gastro-Intestinal Symptoms Several Times per Week or More with Psychological Distress Symptoms

	Heartburn (several times/week or more)		Acid Regurgitation (several times/week or more)	
	OR	**95% CI**	**OR**	**95% CI**
Anxious Symptoms				
Crude	1.20 **	1.16, 1.24	1.22 **	1.17, 1.26
Model 1	1.18 **	1.14, 1.22	1.19 **	1.14, 1.23
Model 2	1.17 **	1.10, 1.21	1.18 **	1.13, 1.22
Model 3	1.14 **	1.10, 1.17	1.14 **	1.10, 1.18
Depressive Symptoms				
Crude	1.24 **	1.20, 1.28	1.25 **	1.21, 1.29
Model 1	1.20 **	1.16, 1.24	1.21 **	1.16, 1.25
Model 2	1.18 **	1.14, 1.23	1.20 **	1.16, 1.24
Model 3	1.14 **	1.11, 1.19	1.15 **	1.11, 1.19

Note. N = 16415.

Estimates presented for one standard deviation higher in anxious (5.6 units) or depressive (5.9 units) symptoms.

* = *P* <.01.

** = *P* <.001.

OR = standardized odds ratio. Unstandardized p-values reported.

Analysis accounted for complex survey design.

Model 1: Associations adjusted for demographic factors (age, sex, education, income, background, center).

Model 2: Model 1 plus adjusted for health variables (body mass index, alcohol, tobacco, caffeine consumption, physical activity, diet, sleep).

Model 3: Model 2 plus adjusted for clinical conditions (angina, cancer, liver disease, kidney problems, migraines, sleep disorder, activity-limiting joint swelling).

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Table 5

Associations Between Gastro-Intestinal Symptoms Several Times per Week or More with Anxious Symptoms

	Heartburn		Acid Regurgitation	
	OR	**95% CI**	**OR**	**95% CI**
Model 1				
Anxious symptoms	1.20 **	1.16, 1.24	1.22 **	1.18, 1.26
Model 2 (+Model 1)				
Anxious symptoms	1.18 **	1.14, 1.22	1.18 **	1.14, 1.23
Age	1.15 **	1.11, 1.19	1.16 **	1.12, 1.21
Sex	0.94 *	0.91, 0.97	0.95	0.91, 0.99
Education	0.98	0.94, 1.02	0.96	0.92, 1.01
Income	0.97	0.92, 1.01	0.91	0.86, 0.95
Bronx	0.83 **	0.78, 0.90	0.93	0.86, 1.00
Chicago	0.94	0.89, 1.00	0.97	0.91, 1.03
San Diego	0.92	0.83, 1.01	0.94	0.84, 1.05
Dominican	1.01	0.95, 1.07	0.99	0.92, 1.07
Central American	1.04	0.99, 1.09	1.00	0.95, 1.06
Cuban	1.08	0.99, 1.17	1.00	0.90, 1.10
Puerto Rican	1.13	1.05, 1.20	0.97	0.88, 1.07
South American	0.98	0.93, 1.02	0.98	0.92, 1.04
Other/mixed background	1.02	0.98, 1.07	0.98	0.93, 1.05
Model 3 (+Model 2)				
Anxious symptoms	1.17 **	1.10, 1.21	1.18 **	1.13, 1.22
Body mass index	1.10 **	1.06, 1.14	1.04 *	1.01, 1.08
Former alcohol use	1.01	0.96, 1.05	1.03	0.98, 1.08
Current alcohol use	1.04	0.98, 1.08	1.05	0.99, 1.11
Former tobacco use	1.06 *	1.02, 1.09	1.05 *	1.02, 1.09
Current tobacco use	1.06 *	1.02, 1.11	1.04	1.00, 1.09
Caffeine	0.99	0.95, 1.02	0.96	0.93, 1.00
Sedentary activity	0.96	0.92, 1.01	1.00	0.95, 1.05
Diet quality	0.97	0.92, 1.03	1.03	0.97, 1.09
Sleep duration	0.97	0.93, 1.01	0.96	0.92, 1.00
Model 4 (+Model 3)				
Anxious symptoms	1.14 **	1.10, 1.17	1.14 **	1.09, 1.18
Angina	1.06 **	1.03, 1.08	1.03	1.00, 1.05
Cancer	1.02	0.98, 1.04	1.01	0.97, 1.04
Liver disease	1.04	1.01, 1.07	1.04	1.01, 1.08
Kidney problems	1.07 **	1.03, 1.10	1.10 **	1.06, 1.13

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	Heartburn		Acid Regurgitation	
	OR	**95% CI**	**OR**	**95% CI**
Migraines	1.05 *	1.02, 1.08	1.07 **	1.03, 1.10
Sleep disorder	1.03 *	1.01, 1.05	1.06 **	1.03, 1.08
Joint swelling	1.07 **	1.04, 1.11	1.07 **	1.03, 1.10

Note. N = 16415.

Estimates presented for one standard deviation higher in anxious (5.6 units) symptoms.

* = *P* <.01.

** = *P* <.001.

OR = standardized odds ratio. Unstandardized p-values reported.

Analysis accounted for complex survey design.

For HCHS/SOL site (Bronx, Chicago, San Diego), the Miami site was the referent group.

For Hispanic/Latino background group (Dominican, Central American, Cuban, Puerto Rican, South American, Mixed/other background), Mexican background was the referent group.

For former/current alcohol/tobacco use, never used alcohol/tobacco was the referent group.

Model 1: Associations adjusted for demographic factors (age, sex, education, income, background, center).

Model 2: Model 1 plus adjusted for health variables (body mass index, alcohol, tobacco, caffeine consumption, physical activity, diet, sleep).

Model 3: Model 2 plus adjusted for clinical conditions (angina, cancer, liver disease, kidney problems, migraines, sleep disorder, activity-limiting joint swelling).

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Table 6

Associations Between Gastro-Intestinal Symptoms Several Times per Week or More with Depressive Symptoms

	Heartburn		Acid Regurgitation	
	OR	**95% CI**	**OR**	**95% CI**
Model 1				
Depressive symptoms	1.24 **	1.20, 1.28	1.25 **	1.21, 1.29
Model 2 (+Model 1)				
Depressive symptoms	1.20 **	1.16, 1.24	1.21 **	1.17, 1.25
Age	1.13 **	1.09, 1.17	1.14 **	1.09, 1.18
Sex	0.95 *	0.91, 0.98	0.95	0.91, 1.00
Education	0.97	0.93, 1.02	0.96	0.92, 1.00
Income	0.97	0.93, 1.01	0.91 **	0.86, 0.95
Bronx	0.84 **	0.87, 0.90	0.93	0.86, 1.01
Chicago	0.95	0.89, 1.00	0.97	0.91, 1.04
San Diego	0.92	0.83, 1.01	0.94	0.84, 1.05
Dominican	1.00	0.94, 1.06	0.98	0.91, 1.07
Central American	1.03	0.98, 1.08	0.99	0.94, 1.06
Cuban	1.07	0.99, 1.16	0.98	0.89, 1.09
Puerto Rican	1.11 *	1.04, 1.19	0.96	0.87, 1.06
South American	0.97	0.92, 1.02	0.97	0.92, 1.04
Other/mixed background	1.02	0.97, 1.06	0.97	0.92, 1.04
Model 3 (+Model 2)				
Depressive symptoms	1.18 **	1.14, 1.23	1.20 **	1.16, 1.24
Body mass index	1.09 **	1.05, 1.14	1.04 *	1.01, 1.08
Former alcohol use	1.01	0.96, 1.05	1.03	0.98, 1.09
Current alcohol use	1.04	0.99, 1.08	1.05	0.99, 1.11
Former tobacco use	1.05 *	1.01, 1.09	1.05 *	1.02, 1.09
Current tobacco use	1.06 *	1.02, 1.11	1.04	1.00, 1.09
Caffeine	0.98	0.95, 1.02	0.96	0.92, 1.00
Sedentary activity	0.95	0.92, 1.00	1.00	0.95, 1.04
Diet quality	0.98	0.93, 1.03	1.03	0.97, 1.09
Sleep duration	0.97	0.94, 1.01	0.96	0.92, 1.00
Model 4 (+Model 3)				
Depressive symptoms	1.14 **	1.11, 1.19	1.15 **	1.11, 1.19
Angina	1.06 **	1.03, 1.08	1.02	1.00, 1.05
Cancer	1.02	0.99, 1.05	1.01	0.97, 1.04

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	Heartburn		Acid Regurgitation	
	OR	**95% CI**	**OR**	**95% CI**
Liver disease	1.04	1.01, 1.07	1.04	1.01, 1.08
Kidney problems	1.06 **	1.03, 1.10	1.09 **	1.06, 1.12
Migraines	1.04 **	1.01, 1.08	1.06 **	1.02, 1.10
Sleep disorder	1.03 **	1.01, 1.05	1.05 **	1.03, 1.08
Joint swelling	1.07 **	1.04, 1.10	1.02 **	1.02, 1.10

Note. N = 16415.

Estimates presented for one standard deviation higher in depressive (5.9 units) symptoms.

* = *P* <.01.

** = *P* <.001.

OR = standardized odds ratio. Unstandardized p-values reported.

Analysis accounted for complex survey design.

For HCHS/SOL site (Bronx, Chicago, San Diego), the Miami site was the referent group.

For Hispanic/Latino background group (Dominican, Central American, Cuban, Puerto Rican, South American, Mixed/other background), Mexican background was the referent group.

For former/current alcohol/tobacco use, never used alcohol/tobacco was the referent group.

Model 1: Associations adjusted for demographic factors (age, sex, education, income, background, center).

Model 2: Model 1 plus adjusted for health variables (body mass index, alcohol, tobacco, caffeine consumption, physical activity, diet, sleep).

Model 3: Model 2 plus adjusted for clinical conditions (angina, cancer, liver disease, kidney problems, migraines, sleep disorder, activity-limiting joint swelling).