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ORIGINAL ARTICLE



Asthma and allergy as risk factors for suicidal behavior among young adults

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ABSTRACT

An association between allergic disease, depression and suicidality has been reported. Objective: To explore the relationships between suicidality and asthma, allergy, internet addiction, stress, sleep quality, pain/discomfort, and depression, among emerging adults. Participants: 929 college students completed an online survey between October 2015 and April 2017. Methods: A cross-sectional study using multivariate analysis techniques was implemented. Results: Using structural equation modeling, we found that allergies and stress were directly related to pain/discomfort; pain/discomfort was associated to poor sleep, depression, and suicidality. Sleep quality was also affected by stress; while sleep, stress, pain/discomfort, and internet addiction were directly related to depression (all $p < .05$). Ultimately, four factors impacted suicidality: stress, pain/discomfort, depression, and, indirectly, sleep quality (all $p < .05$). Although allergy had some effects, these did not reach statistical significance ($p < .09$). Conclusion: Findings suggest that allergy might impact suicidality indirectly through increased pain/discomfort, poor sleep, and depression.

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Asthma is the most common chronic disease among children and young adults¹; with approximately 8% of the U.S. population affected by the condition.² In 2011, approximately 15.6% of people 15–34 years reported lifetime asthma.^{3–5} It is estimated that up to 80% of patients with asthma have co-morbid allergic rhinitis (AR)⁴; a symptomatic disorder of the nose (i.e., sneezing, rhinorrhea, nasal obstruction, and nasal itching) caused by inflammation of the nasal membranes triggered by allergen exposure.⁴ AR is a highly prevalent condition, often underdiagnosed and undertreated, that negatively impacts asthma control and outcomes.⁴ AR sufferers struggle to alleviate their symptoms with over-the-counter medications (75.8%) and/or prescription medications (53.5%) because many have low efficacy and bothersome side effects.⁵ Compared to those with asthma alone, patients with asthma and comorbid AR tend to have more asthma exacerbations, more visits to their primary care provider, more visits to the emergency department, and more hospitalizations.⁴ It has also been shown that AR significantly compromises the quality of life of sufferers by impacting sleep and cognition, and by increasing feelings of fatigue and psychological distress.^{4,6–9} Importantly, compared to patients without asthma or AR, patients with asthma^{10–13} and patients with AR are more likely to report symptoms of depression^{4,6–9,14–21} and suicide.^{22–25}

Although the association between ADz (e.g., asthma, AR, and atopic dermatitis), depression^{26,27} and suicide^{22–25} is widely acknowledged, the underlying mechanisms remain unclear. Major depression disorder affects approximately 6.6% of U.S. adults annually.²⁸ Young adults are particularly vulnerable, with 18–29 year olds being the most likely adult age group to experience depression over a 12 month period.²⁸ In addition, depression is the strongest predictor of suicide and suicidal ideation, with a greater than 15-fold increased risk for suicide among patients suffering depression.²²

Between 1999 and 2014, there was a 24% age-adjusted increase in suicide rate in the U.S.²⁹ Of great concern is that this increase impacted more significantly younger Americans, such that in 2014 suicide was the second leading cause of death among children (10–14 years), adolescents (15–24 years), and young adults (25–34 years).²⁹ It is well established that increased depression severity is associated with more risk for suicidality.³⁰ Nonfatal suicidal behaviors are classified into *suicide ideation*, *suicide planning*, and *suicide attempt*.³¹ Although most patients with depression ($\geq 85\%$) will have suicidal ideation, only one third will make an attempt sometime during adolescence or young adulthood, and, 2.5% – 7% will commit suicide by young adulthood.³² Given the catastrophic nature of suicide, identifying all potential risk factors that might aid in preventing it is paramount. The

main aim of the present study was to investigate the complex relationships of these co-morbid conditions as a network. A network perspective assumes that some symptoms/conditions (such as rhinitis, wheezing, stress, pain/discomfort) trigger other symptoms (like trouble sleeping, fatigue, and poor concentration) that, over time, lead to depressive symptoms and suicidal behaviors which further exacerbate stress, pain/ discomfort, and sleep. At the heart of the theory is the notion that symptoms of co-morbid conditions are causally connected through multiple mechanisms.³³ Most theoretical accounts of suicidal behavior propose a diathesis-stress model in which biological, social/ environmental, and psychological factors predispose a person to suicidal behavior, while stressful life events interact with such factors to increase risk.^{34,35} According to these models, among the most important contributing factors associated with suicidal risk are interpersonal stressors, having a physical chronic illness, sleep disturbances and insomnia, and concurrent depression.³⁴

Depression is a multifactorial mental health condition characterized by loss of positive affect, lack of self-care, poor concentration, anxiety, and lack of energy and interest in everyday experiences.³⁶ In 2011, 20.1% of U.S. adults reported significant depressive symptoms,³⁷ with women being 1.5 to 3 times more likely to report depressive symptoms than men.^{38–40} The American Psychiatric Association includes insomnia and sleep disturbances as core symptoms of depression,³⁶ however, recent studies suggest a different causal relation.^{41–43} The new evidence revealed a detrimental effect of poor sleep on emotional functioning (i.e., daytime mood, emotional reactivity and regulation),⁴⁴ suggesting that sleep difficulties may precede and trigger the symptoms of depression.^{41–43,45,46} In a longitudinal study, Roberts⁴⁶ found that after controlling for baseline depression, sleep deprivation increased the risk of symptoms of depression as well as major depression in adolescents, but not the contrary. That is, there was no increased risk of sleep deprivation among those with depressive symptoms.⁴⁶ In addition, depression, chronic pain, and insomnia have been shown to co-occur,^{45,47,48} with some evidence suggesting that chronic inflammation may be the common underlying factor.⁴⁹ The co-occurrence of depression and chronic disease associated with pain/ discomfort⁵⁰ seem to have a synergistic effect that increases the risk for suicide.^{22,51} A recent meta-analysis comparing rates of suicidal thoughts and behaviors in individuals with and without any type of physical pain found that individuals with pain, particularly headache, were significantly more likely to report suicide ideation, suicide planning, and suicide attempts, and they were also more likely to die by suicide.⁵² A similar association has been found between migraines

and suicidal behaviors;⁵³ which is relevant because a significant portion of the patients with AR reported suffering headaches, migraine headaches and/or “sinus headache.”⁵⁴

Over the past fifty years, social changes have altered the very nature of adolescence and early adulthood in the U.S. The Pew Research Center found, for example, that Internet usage in young adults and college graduates is nearly ubiquitous.⁵⁵ There is growing concern regarding how social media use may impact the psychological well-being of young adults,⁵⁶ particularly depression^{57,58} and suicide.^{59,60} The rise in the amount of time spent on the Internet has led to the formal recognition of “Internet addiction” as a psychiatric disorder closely associated with depression.⁶¹ Another relevant social change is the growing proportion of Americans attending college, which doubled since 1959, to a peak 70% in 2009.⁶² The increase in college attendance appears to have influenced marriage⁶³ and childbearing practices,⁶⁴ as college-bound, emerging adults in the U.S. are assuming much later in life responsibilities known to impact their own well-being (e.g., disease management, and management of work and sleep routines) than previous generations did.^{65–67} Poor-health practices and risky behaviors such as substance use peak during emerging adulthood,^{30,68} and have been clearly identified as major risk factors for depression^{69–71} and suicidality.⁷²

In addition to being susceptible to high-risk conditions, emerging adults, particularly men, access health services less often than any other age group; for example, only 59% of young adults report having a usual source of care.⁷³ Furthermore, young adults had the lowest rate of preventive health care utilization compared with children and adolescents, the lowest rate of office-based healthcare utilization, and higher rate of emergency room visits compared with adolescents.⁷³ Thus, treatable conditions known to impact the quality of life of emerging adults such as asthma and allergy, depression, and suicidal behaviors go untreated, with serious implications for their well-being.

We found no published studies looking at the relationship of asthma and allergy, internet addiction, substance use (i.e., smoking and drinking), stress, sleep quality, pain/ discomfort, and depression on suicidal behavior among emerging adults. While there is evidence of associations between ADz and depression, ADz and suicidality, and ADz and sleep impairment, there is a paucity of research looking at the interplay of these conditions together and their potential causal pathways. The purpose of this exploratory study was to investigate this complex network of co-morbid conditions³³ utilizing multivariate modeling methods that allow for the simultaneous statistical examination of multiple relationships.⁷⁴

Methods

Participants

A sample of 985 college students was recruited from a large university in the southwestern U.S. Forty-six records were excluded due to missing data needed to calculate the sleep quality score, and 10 records for other missing data, yielding a total sample of 929 complete records. The mean age was 22.73 (SD = 5.62) years, mostly females (79.8%). The study was approved by the University Committee on Human Subjects. No personal identifiers were collected and, after reading a description of the study, participants gave passive consent by proceeding to complete an online survey.

Measures

Current Health Conditions. *Current asthma* was ascertained by two questions: first, students were asked “have you ever received a physician’s diagnosis of asthma (No or Yes); then, students who answered *yes* were asked if they “have been taking any prescribed medications or treatment for asthma” (No or Yes); those who answered both questions positively were classified as having *Current asthma* (0-No or 1-Yes). *Current allergy* identification was based on report of doctor-diagnosed allergy and a positive response to either “Have you been prescribed medications to treat your allergy (ies)?” or “In the past month, did you take any over-the-counter allergy medication (such as Allegra, Benadryl, Claritin, Clarinex, Sudafed, and Zyrtec)?” (0-No or 1-Yes). *Pain / discomfort* was assessed by a question borrowed from the Canadian Community Health Survey, “Are you usually free of pain or discomfort?”⁷⁵ (0-No or 1-Yes). Those who answered “No” were classified as experiencing pain / discomfort.

Internet addiction was measured using the Young’s Internet Addiction Test (YIAT).⁷⁶ The short version of the YIAT is a self-report instrument consisting of 12 questions with demonstrated high level of consistency, validity, and reliability (Cronbach’s α for this study of .90).⁷⁶ The YIAT uses a Likert scale (1-Does not apply to 5-Very often) to assess the effects of daily internet use. A total score, ranging from 12 to 60, is calculated by adding all items. A score > 30 is suggested as indicative of problematic use, and one > 37 as indicative of pathological use.⁷⁶

Alcohol use. Binge or heavy episodic drinking was assessed using a single item from the Youth Risk Behavior Surveillance System.⁷⁷ Problem drinking was identified with the Alcohol Use Disorders Identification Test total score (AUDIT; range 0–40),⁷⁸ which is a 10-item self-administered measure designed to identify problematic drinking behavior in the last 30-days (Cronbach’s α for this study of .84). An AUDIT score ≥ 8 has

been suggested as cutoff for targeted advice (Zone II), and score ≥ 16 as suggestive of unhealthy use needing counseling (Zones III and above).⁷⁸

Smoking and nicotine dependence were assessed with the Fagerström Test for Nicotine Dependence (FTND). The scale measures quantity of cigarette consumption, compulsion to use, and level of dependence. The FTND is highly reliable, with scores ranging from 0 to 10; the higher the score, the more intense the physical dependence on nicotine (Cronbach’s α for this study of .70).^{79,80} In addition, a binary variable (Smoking 0-No or 1-Yes), was created.

Stress was measured using the Inventory of College Students Recent Life Experiences.⁸¹ The inventory (IDH) is a self-report questionnaire consisting of 49 *daily hassles* rated on a Likert scale (1-Not at all part of my life to 4-Very much part of my life) to estimate the level of stress caused by daily life experiences over the past month. The IDH has shown high levels of consistency, validity, and reliability (Cronbach’s α for this study of .94). Adding all the items yields a total score ranging from 49 to 196; lower scores indicate low level of stress; no clinical cutoff score has been established to designate hazardous levels of daily stress. Most studies with college students report a mean score of around 95, with higher scores for women than men.^{81–84}

Sleep was assessed with the Pittsburgh Sleep Quality Index (PSQI). The PSQI is a standardized, quantitative measure composed of 19 questions grouped into seven components (1: Subjective sleep quality, 2. Sleep latency, 3. Sleep duration, 4. Sleep efficiency, 5. Sleep disturbance, 6. Use of sleep medication, and 7. Daytime dysfunction) that has shown high levels of consistency, reliability, and validity (Cronbach’s α for this study of .683).⁸⁵ The PSQI was scored following the proposed algorithm,⁸⁵ and the global score (0 – 21) was treated as a continuous variable (higher scores indicating worsening problems). A cut-off score > 5 has been recommended for clinical use as indicative of poor quality sleep suggestive of insomnia.⁸⁵

Depression was assessed using the Center for Epidemiologic Studies Depression Scale (CESD), a self-report instrument measuring depressive symptoms during the past week.⁸⁶ The CESD has good test-retest reliability and has been validated in various populations, including adolescents.⁸⁷ A score ≥ 16 effectively identifies individuals with clinically relevant symptoms,⁸⁶ although, to be more conservative, higher scores have been suggested as the indicative cut-off of major depression (Cronbach’s α for this study of .76).^{88,89}

Suicidal Behaviors were measured with the Suicidal Behaviors Questionnaire-Revised (SBQ-R),⁹⁰ which captures different dimensions of suicidality (i.e., suicide ideation, suicide plan, suicide attempt, and likelihood of

committing suicide) using 4 questions: (“Have you ever thought about or attempted to kill yourself?”, “How often have you thought about killing yourself in the past year?”, “Have you ever told someone that you were going to commit suicide, or that you might do it?”, and “How likely is it that you will attempt suicide someday?”). The SBQ-R demonstrates high levels of consistency, validity, and reliability (Cronbach’s α for this study of .833). The questionnaire was scored following Osman’s algorithm to create a total score ranging from 4 to 22.⁹⁰ A total score of ≥ 7 has been proposed as a cut-off point suggesting high risk for suicidal behavior.⁹⁰

Procedure

All statistical analyses were performed with SPSS 24 (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp). Two-tailed tests were used throughout, and a $p < 0.05$ was considered statistically significant. A series of binary variables were created by dichotomizing into groups: students with each diagnosis/condition (i.e., asthma, allergy, and pain / discomfort), and one for absence of the condition (0 = No and 1 = Yes). We examined the relationships between the predictors (i.e., asthma, allergy, stress, smoking and drinking, and internet addiction) and the outcomes (i.e., pain / discomfort, sleep quality, depression, and suicidality), using χ^2 test for categorical data, and independent samples t -test for continuous data. Correlation and regression analyses were performed to assess the relationships between the variables of interest. Hierarchical regression was used to evaluate the independent contribution of gender (coded as 0 male and 1 female), asthma, allergy, smoking, alcohol intake, internet addiction, pain / discomfort, sleep, and depression to suicide (the dependent variable). The first variable entered was gender in step 1; then variables asthma and allergy were entered in steps 2 and 3 of the regression; smoking (FTND) and alcohol intake (AUDIT) were entered in steps 4 and 5; internet addiction and stress were entered in steps 6 and 7; pain / discomfort in step 8; sleep quality was entered in step 9; and depression was entered last (step 10). This analysis allowed for evaluation of the separate contribution of each predictor variable while controlling for the effect of the other(s). Path-analytic techniques were then used to specifically test whether sleep quality, pain / discomfort, and depression mediate (via an “indirect effect”) the relationship between gender, asthma and allergy, smoking and drinking, stress, and internet addiction, with suicide. Mediation analysis assumes both causal and temporal relations and has been successfully used to acquire deep understanding of disease pathology and the mechanisms through which variables influence suicidal risk.⁹¹ When performed using strong evidence, prior

theory, and with appropriate context, mediation analysis may provide the basis for future intervention research.⁹¹ Based on evidence from the literature, two models were constructed using AMOS (Analysis of Moment Structures) 24.0.^{92,93} In both models the primary outcome was suicidality as SBQ-R score, a continuous variable. In Model 1 (Figure 1), predictor variables included current asthma and allergy, internet addiction and stress. In turn, pain / discomfort, sleep quality (PSQI) and depression (CESD) were entered as mediators. The participant’s gender was entered as a control variable, as it has been reported as having a moderating effect on stress,^{81–84} depression,^{38–40} and suicide.^{22,59,94} In Model 2 (not shown), smoking (FTND) and alcohol intake (AUDIT) were added as predictor variables. A bootstrap method was utilized to investigate the direct, indirect and total effects between the predictors and outcomes.⁹⁵ The advantage of bootstrapping is that it provides the probability levels for direct, indirect, and total effect.⁹⁵ The models’ goodness of fit was ascertained using χ^2 ($p > .05$, suggesting the absence of meaningful unexplained variance); however, χ^2 is sensitive to sample size, thus we also used the ratio of χ^2 to df (χ^2 / df – where a ratio smaller than 3 is considered indicative of an acceptable data model fit). Furthermore, the Comparative Fit Index (CFI) and the Mean Square Residuals (SRMR) were also used as evidence of model fit. Values greater than .95 for CFI, and less than .08 for SRMR are considered evidence of a well-fitted model, a value of zero indicates perfect fit.⁹⁶

Results

Descriptive statistics and correlations for the variables in this study are shown in Tables 1 and 2. The sample was comparable to the student population in the psychology program, being mostly females (79.8% vs. 75.3% respectively), and Caucasian (58.1% vs. 55.9% respectively). As anticipated, alcohol intake was common, with 70.2% of the students reporting at least one drink in the past month, 39.9% reported at least one event of past-month binge drinking, and 17.4% were identified as engaging in harmful consumption of alcohol (AUDIT score ≥ 8).⁷⁸ Smoking was relatively low, with only 6% of the students reporting current smoking; 3.5% with nicotine dependence per FTND (≥ 5), and only five students reporting a daily consumption of ≥ 10 cigarettes. One hundred forty-four students (15.5%) reported having a lifetime-diagnosis of asthma, and 112 (12.1%) answered positively the asthma medication question (current asthma); 166 (17.9%) reported a diagnosis of allergy, and 124 (13.3%) were either on prescribed or OTC medications for allergy (current allergy). About one fifth of the students (20.9%) had either current asthma or allergy, and 5.8% reported having both, which means that 43.5% of those with ‘current asthma’ also

Table 1. Sample characteristics.

Student Characteristics	N (Percent) N = 929
Females	741 (79.8)
Caucasian	540 (58.1)
30 days $\geq$ 1 drink	652 (70.2)
30 days $\geq$ 1 binge drinking	565 (39.2)
AUDIT score 8 – 15	134 (14.4)
AUDIT score $\geq$ 16	28 (3.0)
Current smokers	56 (6.0)
FTND $\geq$ 5 (Moderate/high)	33 (3.5)
>10 Cigarettes/ day	5 (0.5)
Lifetime asthma	144 (15.5)
Current asthma	112 (12.1)
Diagnosis of allergy	166 (17.9)
Current allergy	124 (13.3)
Hypertension, heart disease and/or diabetes	32 (3.4)
Arthritis	26 (2.8)

reported ‘current allergy’ ($\phi = .348$; $p < .001$). One fifth (20.9%) of the students reported experiencing pain / discomfort. Only 2.8% of the students report a diagnosis of arthritis, and 3.3% report diagnoses of cardiovascular disorders (i.e., hypertension, heart disease, or diabetes). As shown in Table 3, of the students who reported experiencing pain / discomfort ($n = 194$), 38.14% reported current asthma or allergy. Compared to students without asthma or allergy, significantly more students with asthma (19.8% vs. 28.2%, $p = .043$), and more students with allergy (19.3% vs. 31.5%, $p < .003$) reported suffering pain / discomfort and had significantly higher scores on the PSQI, which is indicative of poorer sleep quality (Table 3 – all $p < .05$). The overall mean CESD score was 15.89 (SD = 10.81), with 42.8% of students showing some level of depression (CESD $\geq$ 16), and 18.3% scoring $\geq$ 26, suggestive of severe depression. Students with allergy, and those who experienced pain and discomfort had significant higher scores on the CESD and IDH (Overall mean IDH = 95.43, SD = 23.00), suggestive of more psychological distress (Table 3, $p < .005$). The overall mean SBQ-R score was 6.41 (SD = 2.85), with 37.1% of students reaching scores suggestive

of high risk suicidal behavior (SBQ-R $\geq$ 7); 17.5% of the students reported having thoughts of killing themselves (sometimes to very often) in the past year, 16.5% having a plan, 2.2% having at least one attempt, and 1.5% asserting they will likely kill themselves. Further, compared to students without health issues (i.e., asthma, allergy, or pain / discomfort) students with asthma (6.33 vs. 6.97, $p = .025$), students with allergy (6.27 vs. 7.31, $p = .001$), and students suffering pain / discomfort (6.12 vs. 7.05, $p < .001$) had significantly higher scores on the SBQ-R, which suggests high risk suicidal behavior (Table 2 – all $p < .05$). There were no significant differences in smoking or drinking between students without health issues and those with asthma, allergy, or experiencing pain / discomfort. The mean internet addiction score (YIAT) was 24.46 (SD = 8.20). As shown in Table 2, there were no significant differences in the YIAT scores of students with or without the health conditions (i.e., asthma, allergy, or pain / discomfort). Females reported less drinking (AUDIT $p < .001$), worst sleep quality ($p = .053$), significantly more allergy ($p < .05$), more symptoms of depression ($p < .005$), and stress ($p < .001$), but not smoking, internet addiction, pain / discomfort, asthma or suicidal behaviors ($p > .05$).

Sleep quality

The mean global PSQI score was 7.35 ± 3.34 (median 7, range 0–20) with 68.5% of the participants experiencing poor sleep quality (> 5), and 33.7% reporting extremely poor sleep quality (> 8). Overall, most students reported restricted sleep, and only 25.2% of students reported the recommended eight or more hours of sleep. Perhaps resulting from poor quality sleep, 18.2% of the students reported daytime dysfunction at least once a week. About one-fifth of the students (19.6%) reported taking sleep medication in the previous month (PSQI – Component 6),

Table 2. Correlation matrix for study variables.

	AUDIT	FTND	Allergy	Asthma	Stress	YIAT	Pain	Female	PSQI	CESD	SBQ-R
SBQ-R	0.104 [‡]	0.047	0.125 [‡]	0.071 [*]	0.423 [‡]	0.158 [‡]	0.197 [‡]	0.028	0.315 [‡]	0.517 [‡]	1
CESD	0.071 [*]	0.061	0.105 [‡]	0.045	0.659 [‡]	0.282 [‡]	0.243 [‡]	0.104 [‡]	0.469 [‡]	1	
PSQI	0.120 [‡]	0.069 [*]	0.108 [‡]	0.082 [*]	0.448 [‡]	0.126 [‡]	0.260 [‡]	0.063	1		
Female	0.114 [‡]	-0.015	0.081 [*]	0.057	0.133 [‡]	-0.025	-0.003	1			
Pain	-0.019	0.063	0.101 [‡]	0.070 [*]	0.163 [‡]	-0.035	1				
YIAT	0.062	-0.080 [*]	0.053	0.012	0.332 [‡]	1					
Stress	0.119 [‡]	0.043	0.121 [‡]	0.039	1						
Asthma	0.014	-0.004	0.348 [‡]	1							
Allergy	0.039	-0.013	1								
FTND	0.149 [‡]	1									
AUDIT	1										

CESD – Center for Epidemiological Studies Depression; IDH – Inventory of Daily Hassles; Pain – Pain/discomfort; FTND – Fagerström Test for Nicotine Dependence; AUDIT – Alcohol Use Disorders Identification Test; PSQI – Pittsburgh Sleep Quality Index; SBQ-R – Suicidal Behaviors Questionnaire-Revised; YIAT – Young’s Internet Addiction Test.

[‡] $p < .001$; ^{*} $p < .005$; ^{*} $p < .05$.

Table 3. Comparison between students with asthma, allergies, and pain/ discomfort, and those without the condition for internet addiction, daily hassles, pain and discomfort, sleep, depression, and suicide.

N = 929	Total	Asthma		Allergies		Pain / discomfort	
		Yes (n = 112)	No (n = 817)	Yes (n = 124)	No (n = 805)	Yes (n = 194)	No (n = 735)
Pain/ Disc. % (n)	20.9 (194)	28.2 (35)*	19.8 (159)	31.5 (39)‡	19.3 (155)		
Smoking % (n)	6 (56)	4.5 (5)	6.2 (51)	4.8 (6)	6.2 (50)	8.8 (17)	5.3 (39)
AUDIT Mean (SD)	4.01 (4.47)	4.14 (3.96)	3.99 (4.54)	4.47 (4.39)	3.94 (4.48)	3.86 (4.31)	4.05 (4.52)
IDH Mean (SD)	95.43 (23.00)	98.87 (22.05)	94.96 (23.10)	102.45 (24.92)‡	94.35 (22.52)	102.68 (24.26)†	93.52 (22.29)
PSQI Mean (SD)	7.35 (3.34)	8.04 (3.71)*	7.24 (3.27)	8.26 (3.70)‡	7.21 (3.26)	9.04 (3.64)†	6.90 (3.11)
CESD Mean (SD)	15.89 (10.81)	17.16 (10.52)	15.69 (10.85)	18.79 (11.13)‡	15.44 (10.60)	21.01 (11.61)†	14.53 (10.18)
SBQ-R Mean (SD)	6.41 (2.85)	6.97 (3.07)*	6.33 (2.81)	7.314 (3.29)‡	6.27 (2.75)	7.05 (3.20)†	6.12 (2.68)
YIAT Mean (SD)	24.46 (8.2)	24.74 (7.67)	24.42 (8.27)	25.57 (9.05)	24.29 (8.05)	23.91 (7.94)	24.61 (8.27)

Values for t – test are shown as means and standard deviations, and values for χ^2 as percentages (%) and frequencies (n).

CESD – Center for Epidemiological Studies Depression; IDH – Inventory of Daily Hassles; Pain/disc – Pain/discomfort; PSQI – Pittsburgh Sleep Quality Index; SBQ-R – Suicidal Behaviors Questionnaire-Revised; YIAT – Young's Internet Addiction Test; SD – Standard Deviation.

† $p < .001$; ‡ $p < .005$; * $p < .05$.

and 9.3% reported taking sleep medication at least once a week. Most participants reported some sleep disturbances (97.0%); 19.6% reported loud snoring, and 8.3% long pauses between breaths at least once a month, both suggestive of sleep apnea. Regarding scores on the seven PSQI components, students with health issues (i.e., asthma, allergy, or pain / discomfort) reported experiencing significantly more sleep disturbances ($p < .001$) than their counterparts who did not experience the health conditions.

Unadjusted regression analyses

A series of linear regression analyses was performed in order to evaluate the associations among the outcome variables and the predictors; they are summarized in Table 4. Our analyses demonstrated that suicidal behavior was significantly associated with all the predictors (i.e., Asthma,

Allergies, AUDIT, YIAT, IDH, Pain/Discomfort, PSQI, and CESD) with exception of gender and smoking. Then, with exception of asthma and smoking, all other variables (i.e., Gender, Allergies, AUDIT, YIAT, IDH, Pain / Discomfort, and PSQI) were significantly associated (all $p < .05$) to depression. Sleep quality was significantly associated with all the predictors (i.e., Asthma, Allergies, smoking, AUDIT, YIAT, IDH, Pain/Discomfort, PSQI, and CESD) with the exception of gender. And finally, only asthma ($p < .05$), allergies ($p < .005$), and daily hassles ($p < .001$) were significantly associated to pain / discomfort.

Multi-variate hierarchical regression analysis

On the first step of the hierarchical regression (Table 4), being female was not significantly associated to suicidal behavior ($\beta = .024$, $p = .401$). In Step 2, controlling for

Table 4. Unadjusted and hierarchical multiple regression analysis for suicidal behaviors. Within each step, the variables are entered in the order listed. That is, gender first, followed by *asthma*, *allergies*, then *FTND*, *AUDIT*, *YIAT*, *IDH*, *pain/ discomfort*, *PSQI* and finally *CESD*. By entering gender first, the analysis controls for this factor, and by entering CESD last, the unique variance accounted for by this variable is estimated (Step 10).

β Standardized Regression Coefficients															
Unadjusted by Outcome					Hierarchical – SBQ-R Outcome										
Predictor	SBQ-R	CESD	PSQI	Pain	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	
Female	.027	.103‡	.064	.005	.028	.024	.017	.017	.029	.032	.027	.021	.023	.032	
Asthma	.073*	.046	.081*	.071*		.072*	.034	.035	.035	.036	.030	.026	.021	.029	
Allergies	.125†	.105‡	.108‡	.102‡			.112‡	.112‡	.107‡	.099‡	.066*	.055	.053	.048	
FTND	.034	.049	.071*	.059				.050	.035	.049	.026	.018	.015	.003	
AUDIT	.106‡	.071*	.120†	-.017					.098‡	.087*	.045	.052	.043	.051	
YIAT	.158†	.282†	.126†	-.002						.151†	.018	.030	.031	-.005	
IDH	.424†	.657†	.448†	.162†							.405†	.380†	.330†	.126‡	
Pain	.197†	.244†	.260†									.129†	.105‡	.063*	
PSQI	.315†	.468†											.124†	.047	
CESD	.515†													.391†	
Adjusted R ²					.000	.004	.014	.015	.023	.045	.183	.198	.209	.287	
R ² change						.004	.010	.000	.009	.021	.139	.015	.011	.076	

CESD – Center for Epidemiological Studies Depression; IDH – Inventory of Daily Hassles; Pain – Pain/discomfort; FTND – Fagerström Test for Nicotine Dependence; AUDIT – Alcohol Use Disorders Identification Test; PSQI – Pittsburgh Sleep Quality Index; SBQ-R – Suicidal Behaviors Questionnaire-Revised; YIAT – Young's Internet Addiction Test.

† $p < .001$; ‡ $p < .005$; * $p < .05$.

Table 5. Regression coefficients for Model 1 for the relationships between asthma, allergies, internet addiction; stress due to daily hassles; pain/ discomfort, sleep quality, depression, and suicidal behaviors; including standardized specific direct, indirect, and total effects. Significant effects are in bold.

Outcome	Predictor	β	SE	CR	p	Standardized Effects				Total
						Direct	p	Indirect	p	
Pain/disc	← Asthma	.049	.041	1.186	.236	.041	—	0	.298	.041
Pain	← Allergy	.083	.041	2.013	.044	.070	—	0	.067	.070
Pain	← Stress	.003	.001	4.687	<.001	.152	—	0	.001	.152
PSQI	← Asthma	.431	.3	1.436	.151	.044	.299	.008	.112	.052
PSQI	← Allergy	.237	.302	.784	.433	.024	.053	.013	.264	.037
PSQI	← Stress	.061	.004	13.501	<.001	.416	.001	.028	.001	.445
PSQI	← Pain	1.532	.239	6.396	<.001	.186	—	0	.001	.186
PSQI	← YIAT	-.003	.012	-.267	.790	-.008	—	0	.864	-.008
CESD	← Gender	.639	.641	.996	.319	.024	—	0	.248	.024
CESD	← Asthma	—	—	—	—	—	.066	.014	.066	.014
CESD	← Allergy	.140	.757	.185	.853	.004	.066	.015	.481	.019
CESD	← Stress	.244	.013	18.584	<.001	.519	.001	.103	.001	.621
CESD	← Pain	2.983	.650	4.589	<.001	.112	.001	.036	.001	.148
CESD	← YIAT	.117	.033	3.539	<.001	.089	.846	-.002	.002	.087
CESD	← PSQI	.623	.087	7.146	<.001	.192	—	0	.001	.192
SBQ-R	← Gender	-.277	.199	-1.395	.163	-.039	.229	.009	.345	-.03
SBQ-R	← Asthma	.204	.247	.823	.411	.024	.056	.011	.282	.035
SBQ-R	← Allergy	.425	.249	1.706	.088	.051	.247	.014	.084	.064
SBQ-R	← Pain	.419	.204	2.059	.039	.060	.001	.067	.001	.127
SBQ-R	← IDH	.017	.005	3.601	<.001	.139	.001	.271	.001	.410
SBQ-R	← YIAT	-.002	.01	-.151	.880	-.004	.003	.033	.447	.028
SBQ-R	← PSQI	.046	.028	1.66	.097	.054	.001	.074	.001	.128
SBQ-R	← CESD	.101	.01	9.928	<.001	.383	—	0	.001	.383

CESD – Center for Epidemiological Studies Depression; Stress – Inventory of Daily Hassles; Pain – Pain/discomfort; PSQI – Pittsburg Sleep Quality Index; SBQ-R – Suicidal Behaviors Questionnaire-Revised; YIAT – Young's Internet Addiction Test.

β – Estimate; CR – Critical Ratio, SE – standard error; p – significance level. Dashes represent empty cells or no information because the path was not tested in the model.

gender, having asthma has a significant impact on suicidal behaviors ($\beta = .072$, $p = .029$), which explains less than 1% of the variance. On the third step, controlling for gender and having asthma, having allergies ($\beta = .112$, $p = .001$) independently contributed to suicidal behaviors, accounting for 1.4% of the variance. In Step 4, controlling for gender, asthma, and smoking, having allergies ($\beta = .112$, $p = .001$) independently contributed to suicidal behaviors, accounting for only 1.4% of the variance. In Step 5, controlling for gender, asthma, and smoking, having allergies ($\beta = .107$, $p = .002$) and drinking alcohol ($\beta = .098$, $p = .003$) independently contributed to suicidal behaviors, accounting for 2.3% of the variance. In Step 6, controlling for gender, asthma, and smoking, having allergies ($\beta = .099$, $p = .004$), drinking alcohol ($\beta = .087$, $p = .008$), and being addicted to the internet ($\beta = .151$, $p < .001$) independently contributed to suicidal behaviors, accounting for 4.4% of the variance. When daily hassles was entered in Step 7, only having allergies ($\beta = .066$, $p = .040$), and being stressed ($\beta = .405$, $p < .001$) independently contributed to suicidal behavior, accounting for 18.3% of the variance. In Step 8, when pain / discomfort was introduced, only stress ($\beta = .380$, $p < .001$), and pain / discomfort ($\beta = .129$, $p < .001$) independently contributed to suicidal behaviors accounting for 19.8% of the variance. In Step 9, three variables significantly contribute to suicidal behavior: stress ($\beta = .330$, $p < .001$), pain /

discomfort ($\beta = .105$, $p = .001$), and poor sleep quality ($\beta = .124$, $p < .001$), accounting for 20.9% of the variance. In the last step, controlling for gender, asthma, allergy, smoking and drinking, internet addiction, and sleep, only stress ($\beta = .126$, $p = .001$), pain / discomfort ($\beta = .063$, $p = .032$), and depression ($\beta = .391$, $p < .001$), independently contributed to suicidal behavior, accounting for a total of 28.7% of the variance.

Mediation analysis

Regression coefficients for Model 1 and a summary of direct, indirect, and total effects identified in the model are reported in Table 5. Being female had only minor non-significant effects on depression or suicidal behavior. As shown in Table 5, pain / discomfort was significantly impacted by allergies ($\beta = .070$, $p < .05$), and stress ($\beta = .152$, $p < .001$), and it was pain / discomfort that had a direct impact on sleep quality ($\beta = .186$, $p < .001$), depression ($\beta = .112$, $p < .001$), and suicidal behavior ($\beta = .039$, $p < .05$). In addition to being affected by pain / discomfort, sleep quality was impacted by stress, directly ($\beta = .416$, $p < .001$) and indirectly ($\beta = .028$, $p = .001$). Similarly, sleep ($\beta = .192$, $p < .001$), stress (direct effects, $\beta = .416$, $p < .001$ and indirect effects, $\beta = .028$, $p = .001$), and pain (direct effects, $\beta = .112$, $p < .001$ and indirect effects, $\beta = .036$, $p = .001$, respectively) had a significant impact on depression. Depression was also affected

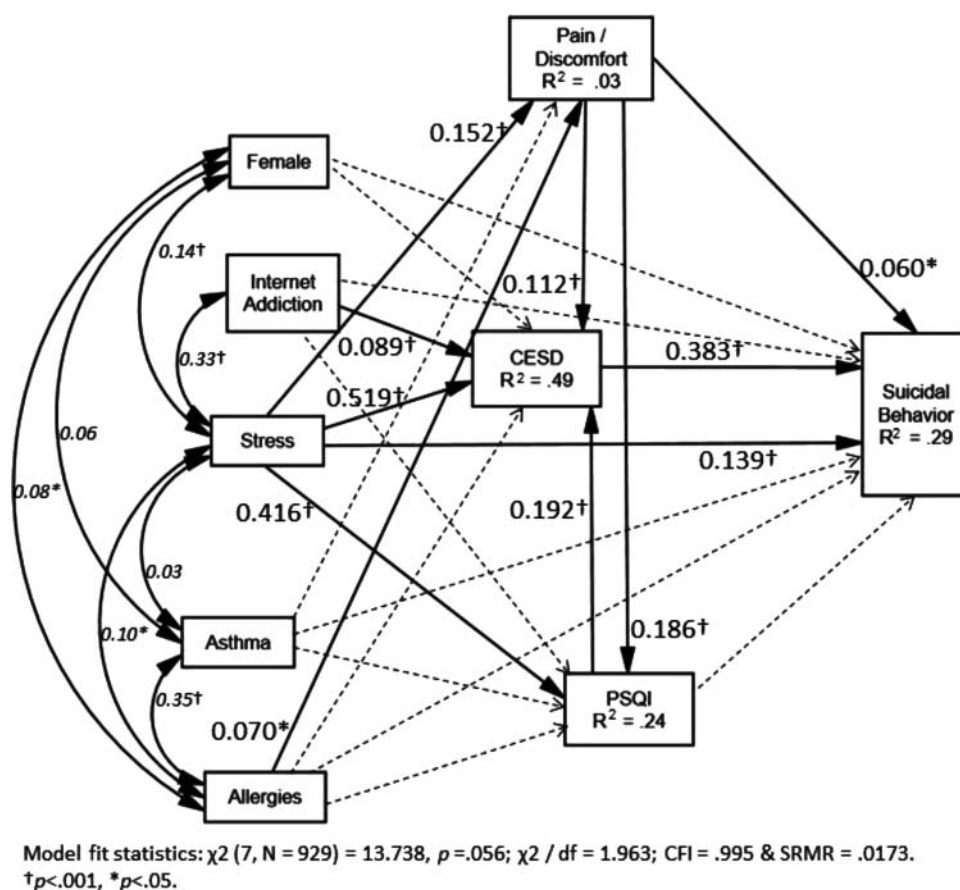


Figure 1. Path diagrams for the direct effects of gender, internet addiction, stress, asthma, and allergies on pain/discomfort, sleep quality, depression, and lastly suicidal behaviors. For clarity, only values of standardized direct effect coefficients are included. Numbers next to path lines are standardized regression coefficients. Numbers in italics are correlations between the observed exogenous variables (i.e., gender, internet addiction, stress, asthma and allergies). Paths in solid lines with numeric values represent statistically significant relations ($\dagger p < .001, * p < .05$). Paths in dotted lines are not statistically significant. Numbers inside outcome variable boxes show the percentage of variance accounted for by the model (R^2).

CESD – Center for Epidemiological Studies Depression; PSQI – Pittsburg Sleep Quality Index.

* $p < .05$; $\dagger p < .001$.

significantly by internet addiction ($\beta = .089, p < .05$). In the end (Table 5), four factors had a significant impact on suicidal behavior, namely stress, pain/discomfort, depression and sleep quality. The two most important factors predicting suicidal behavior were depression (direct effect of $\beta = .383, p < .001$) and stress (total effect of $\beta = .410, p = .001$, direct $\beta = .139, p < .001$ and indirect effects $\beta = .271, p = .001$). Pain/discomfort had a total effect of $\beta = .127, p = .001$ (direct effects, $\beta = .060, p = .039$ and indirect effects, $\beta = .067, p = .001$), and sleep quality had significant indirect ($\beta = .074, p = .001$) and total effects ($\beta = .128, p = .001$). Although allergies appeared to have some effects on sleep (indirect, $\beta = .013, p = .053$), depression (indirect, $\beta = .015, p = .066$), and suicidal behavior (direct, $\beta = .051, p = .088$ and total $\beta = .064, p = .084$), these did not reach a significant level (all, $p > .05$).

The factor analysis revealed good fit of the first, more parsimonious model (Figure 1), with $\chi^2 (7, N = 929) = 13.738, p = .056$; $\chi^2 / df = 1.963$, CFI = .995, SRMR = .0173, and Akaike Information Criterion (AIC) 107.74. Model 1 explained 29% of the variance in suicidal behavior, 48.7% of the variance in depression, 3.4% of the variance in pain/discomfort, and 23.9% of the variance in sleep quality. Model 2 (not shown), which included all the predictors in Model 1 plus smoking and drinking as predictors of suicidality, explained almost the same amount of variance as Model 1 (i.e., 29.6% suicidal behavior, 49.4% depression, 4.1% pain, and 24.8% sleep quality) but did not fit the data well, as indicated by a significant $\chi^2 (7, N = 929) = 33.33, p < .001$; $\chi^2 / df = 3.030$. Contrary to expectations, neither smoking nor drinking had a significant impact on suicidality. Further, based on the three indices (CFI = .985, SRMR = .0249,

and AIC = 165.33), Model 1 fits the data best (i.e., a reduced AIC, a higher CFI, and lower SRMR).

Comment

The existence of a functional association between allergic disease, depression, and suicidality is widely recognized. Following a network perspective,³³ we developed a parsimonious, evidence-based, model to evaluate the causal pathways linking allergic disease and suicidal behavior, while accounting for multiple potential contributing factors (i.e., stress, internet addiction, sleep quality, pain/discomfort, and depression) among emerging adults. This study suggests that a complex relationship exists between psychological distress (i.e., stress, depression, and suicidal behavior) and allergic disease that involves multiple modulating factors like internet addiction, sleep quality, and experiencing frequent pain/discomfort. To our knowledge, our exploratory study is the first attempt at identifying potential factors involved in the relation between allergic disease and suicidal behavior through multivariate data modeling. Consistent with the diathesis-stress models, we found that individuals experiencing stress were more likely to exhibit suicidal behavior.^{34,35} In addition, our results show multiple contributing factors associated with suicidal behavior including experiencing pain / discomfort, poor sleep quality, and concurrent depression.³⁴ Our findings suggest that asthma and allergy may not be a primary cause of higher incidence of suicidal behaviors, but may instead be associated with other high risk factors, such as stress, pain / discomfort, poor quality sleep, and depression, in increasing suicidality. Although some significant effects of allergies were observed on pain / discomfort, their effects on sleep quality, depression, and suicidal behavior was not statistically significant. It is possible that replicating the study with a clinical population experiencing more severe AR symptoms might yield different results.

By using the International Study of Asthma and Allergies in Childhood Questionnaire to identify children with asthma and linking these data to the national mortality database, researchers in Korea found that the risk of committing suicide was more than twice as high for teens (11-16 years of age) with current asthma.⁹⁷ In the adjusted analysis, three of the symptoms (exercise wheezing, night cough, and severe wheezing) frequently experienced by patients with moderate/severe AR⁹⁸ remained significantly associated with suicide risk.⁹⁷ Two important points should be made regarding potential co-morbidities in the Korean study: 1) Although AR became non-significant in the adjusted analysis, the fact that so many patients experienced symptoms commonly

associated to AR, suggests the possibility of AR under-diagnosis; 2) although a sensitivity analysis of how depression at baseline might have influenced their results was performed, no actual depression data were used.⁹⁷ Evidence of the importance of depressive symptomatology was recently reported by Steinberg et al.,¹² who found that teens with asthma were more likely to report suicide ideation than students without asthma; however, after controlling for confounders including 'sadness' as a proxy for depression, the association was no longer significant. Because the interaction between contributing factors is complex, studying the individual relationships between these variables appears to be insufficient. For example, the unadjusted analyses we conducted first, showed that allergy, pain / discomfort, and sleep quality were all significantly associated with depression. Similar to Audino's findings,¹⁴ before considering the impact of stress, pain / discomfort, sleep, and depression, asthma and allergy (possible rhinitis) appeared to be independent contributors to suicide. However, results from the multivariate analysis that followed suggest a multifactorial effect of stress, pain / discomfort, possibly associated with nighttime symptoms of allergy, which may impact sleep quality, and hence increase symptoms of depression and ultimately the risk for suicidal behaviors.¹²

Emerging evidence suggests that chronic inflammation can be the underlying physiological mechanism linking many of these conditions including ADz, stress, pain / discomfort, and depression. Research exploring the underlying factors linking inflammatory processes to behavioral outcomes suggests that inflammatory processes and social behavior regulate one another; that is, there is evidence that exposure to social stressors increases inflammation. Specifically, socially isolated individuals tend to have increased levels of inflammation, and in turn show greater inflammatory responses to other acute stressors.⁹⁹ Accordingly, findings from a recent study treating severely suicidal patients with low dose buprenorphine, a partial opioid agonist known to have anti-inflammatory properties,¹⁰⁰ showed significant improvement in scores of depression and suicidality.¹⁰¹ Further research is necessary to confirm these relationships.

The transition to adulthood requires emerging adults to assume responsibilities known to impact their own well-being that include disease management, self-regulation of substances use, and management of work and sleep routines. Choices in these areas have implications for the long-term health and well-being of young adults, for whom the prevalence of many of the predisposing and precipitating factors for suicidal behaviors have increased over the last decades. University counseling centers are reportedly overwhelmed by increases in both

the number of students seeking mental health services, and the severity of their presenting conditions.^{102–104} In a recent survey, 73.1% of the directors of University Counseling Centers indicated an increase in the severity of students' mental health problems and related behaviors. In 2014, students' self-rated emotional health dropped to the lowest level ever.¹⁰³ At the same time, 62% of college students say they have experienced "overwhelming anxiety" in the last year and 40.2% that they have felt so depressed "that it was difficult to function."¹⁰⁵ Further, ratings of emotional health are worst among students with learning disabilities (LD).¹⁰³ Students with LD are attending college at higher rates than ever.^{103,106} It is estimated that 67% of students with LD identified in high school are enrolled in post-secondary education;¹⁰⁷ however, only about 24% of young adults who received special education services in high school inform the school of their need for services in postsecondary education settings.¹⁰⁷

For young adults, college is a time for exploration, a phase of normative, time-limited heavy drinking.¹⁰⁸ Findings in our study show drinking patterns comparable to those obtained in a national survey, with most students reporting past-month drinking (70.2% vs. 63.2%), and more than one-third (39.9% vs. 35%) reporting past-month binge drinking.¹⁰⁹ The college cultural environment provides an acceptable context for high volume drinking; a permissive context in which drinking is not necessarily associated to negative consequences. Barnett et al., for example, noted the heterogeneous trajectories in binge-drinking behavior among college students, and the fact that most of them report positive as well as negative consequences of drinking.¹¹⁰ In fact, positive consequences were reported by almost all drinkers (96.6%); where "having a good time" and "feeling less stressed" were the most commonly reported positive consequences.¹¹⁰ This mixed experience among drinkers may be one reason why drinking in this population does not show a relationship with suicidal behaviors.

Over the past two decades cigarette smoking has declined¹¹¹ and the pattern of light use became more prevalent,¹¹¹ becoming the predominant form of tobacco use among young adults aged 18–29.¹¹² Consistently, we found a very low prevalence of smoking (6%), with most smokers (5.5%) smoking less than 10 cigarettes daily (i.e., light smokers). Although, non-daily or light smoking was previously considered a transient behavior, it now appears to be a stable consumption pattern strongly related to social activities for college students.¹¹³ There is some evidence suggesting that social smoking (i.e., smoking primarily in social contexts) is becoming an

acceptable practice to gain peer acceptance among college students.¹¹³

The number of children and youth in the United States with chronic health conditions increased dramatically in the past decades.¹¹⁴ It has been estimated that 18% of young adults between 18 to 44-years have at least two co-morbid physical conditions,¹¹⁵ and that 5.7% suffer co-morbid physical and mental health disorders.¹¹⁶ Estimates of lifetime asthma in American young adults, one of the most common comorbid conditions in this age group,¹¹⁷ is 15.6%, comparable to our own estimates (15.5%).³ Multi-morbidity is associated with reduced quality of life and worse health outcomes,^{117–119} and it likely increases the risk for suicidality. This is of great concern given the high proportion of our students who reported suffering either asthma and/or allergy (20.9%), pain / discomfort (20.9%), and poor quality sleep (68.5%, PSQI > 5). Students with allergy, and those who experienced pain and discomfort had significant more psychological distress (i.e., worst scores of depression, stress, and suicidal behaviors). The evidence suggests that during this period of susceptibility due to inadequate sleep, a cascade of negative health events can be triggered, including obesity, depression, and suicidal behavior.¹²⁰ Consistent with this expectation, 42.8% of the students reported experiencing significant depression symptomatology (CESD $\geq$ 16). The high rate of self-reported symptoms of depression in our students was similar to that reported by children and adolescents (42.8% vs. 20 – 50%) in epidemiological studies;¹²¹ and similar to the estimates obtained with the CESD in college populations (36.8%, 95% CI, 35.2–38.4).¹²² Providing counseling services to this at-risk population should be a priority, given that patients suffering depression have more than 15-times increased risk for suicide.²² Although most patients ($\geq$ 85%) with depression will have suicidal ideation, only a third will make an attempt sometime during adolescence or young adulthood, and, 2.5% – 7% will commit suicide by young adulthood.³² No effective model is currently available to predict suicide in clinical practice; however, improved recognition and understanding of the participating clinical, social, and psychological factors may facilitate the detection of high-risk individuals, and may help improve the delivery of suicide prevention interventions. Given the multifactorial and catastrophic nature of suicide, identifying every contributing factor that might aid in preventing it is paramount. Our findings highlight the need to provide effective integrated care focused on improving the quality of life of young adults with multiple risk factors and multi-morbidities, including allergic conditions.

Conclusions

Our results are consistent with recent studies showing that insomnia, chronic pain, and depression, frequently co-occur and are mutually interacting conditions.^{45,47} Also consistent with previous evidence, we found that patients with allergies (possible AR) experience poor quality sleep,^{6,20} and have significantly higher rates of depression,²⁰ and suicidality.^{22–25} Our findings suggest that asthma and allergy may not be a primary cause of higher incidence of suicidal behaviors but, as our path analysis suggests, may instead exacerbate other risk factors, such as stress, pain / discomfort, poor quality sleep, and depression, and indirectly increase suicidality.³⁴ Although the mechanisms underlying these relationships remain elusive, there is evidence suggesting that inflammatory processes may be a common factor. Inflammation is considered a hallmark feature of pain,⁴⁹ ADz,^{123,124} and it was recently proposed as being the underlying mechanism linking poor sleep quality and psychiatric disorders,¹²⁵ including depression and concomitant suicide.^{34,125,126}

Limitations

Certain limitations should be kept in mind when interpreting the results of this study. Although we developed a parsimonious, evidence-based, model to evaluate the causal pathways linking allergic disease and suicidal behavior in our account of multiple potential contributing factors (i.e., stress, internet addiction, sleep quality, pain/discomfort, and depression), this study did not examine the full range of health problems prevalent in student populations. Also, although mediation analysis assumes both causal and temporal relations, the proposed mediation pathways require further testing with prospective studies on a clinical population with asthma and comorbid AR. Only prospective studies can establish the true nature of the associations and symptom dynamics between allergic disease and suicidality, provide a more accurate perspective on the dynamic interactions between conditions (i.e., poor quality sleep, pain / discomfort, and depression), and determine whether these interactions increase the risk for suicidal behavior among patients with allergic disease. Our study was based on self-report and is, hence, susceptible to bias. Also, the instruments used to screen for depression and suicidality have been validated, but the scores do not constitute a diagnosis. Another potential limitation is that these instruments have not yet been validated specifically for use in a Web-based survey. However, the questions were presented on the screen in the same layout as they appear in the self-administered paper mode, and other types of instruments have been shown to produce similar results online,

compared with paper. The respondents in our sample may differ from the full student population along dimensions that are important to this study. For example, students with mental health problems may have been more likely to enroll in a study about College Student's Health Behavior than other students because they have a vested interest in the topic. Alternatively, such students may be less motivated to participate because of their mental health problems. In addition, we did not collect detailed information on current symptoms of ADz; therefore, the possibility that our findings might be due to other extraneous variables or chance remains. Finally, the sample was drawn from one program at a single university. Students in this institution might not be representative of colleges and universities in general, thus limiting the generalizability of the present findings. Further, the fact that the study participants are college students limits the generalizability of our findings. The issues investigated in this study may look quite different in young adults not attending college, and might be also different in other age-groups; since it is possible that age-related paths and trajectories may modify these relationships.

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