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Is Anxiety Sensitivity Associated with COVID-19 Related Distress and Adherence among Emerging Adults?

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Citation: Yunus, F.M.; Livet, A.; Mahmoud, A.; Moore, M.; Murphy, C.B.; Nogueira-Arjona, R.; Thompson, K.; Keough, M.T.; Krank, M.D.; Conrod, P.J.; et al. Is Anxiety Sensitivity Associated with COVID-19 Related Distress and Adherence among Emerging Adults? *Psych* **2022**, *4*, 934–951. <https://doi.org/10.3390/psych4040069>

Academic Editor: Mosad Zineldin

Received: 30 October 2022

Accepted: 28 November 2022

Published: 30 November 2022

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Abstract: We investigated whether anxiety sensitivity (AS) is associated with increased distress and adherence to public health guidelines during the COVID-19 pandemic among undergraduates, and whether increased distress mediates the relationship between AS and increased adherence. An online cross-sectional survey was conducted with 1318 first- and second-year undergraduates (mean age of 19.2 years; 79.5% females) from five Canadian universities. Relevant subscales of the Substance Use Risk Profile Scale (SURPS) and the Big Five Inventory-10 (BFI-10) were used to assess AS and neuroticism. Three measures tapped distress: the Patient Health Questionnaire-9 (PHQ-9) for depressive symptoms, the Generalized Anxiety Disorder-7 (GAD-7) for anxiety symptoms, and the Brief COVID-19 Stress Scales (CSS-B) for COVID-19-specific distress. The COVID-19 Adherence scale (CAD) assessed adherence to COVID-19 containment measures. AS was significantly independently associated with higher general distress (both anxiety and depressive symptoms) and higher COVID-19-specific distress, after controlling age, sex, study site, and neuroticism. Moreover, AS indirectly predicted greater adherence to COVID-19 preventive measures through higher COVID-19-specific distress. Interventions targeting higher AS might be helpful for decreasing both general and COVID-19-specific distress, whereas interventions targeting lower AS might be helpful for increasing adherence to public health containment strategies, in undergraduates.

Keywords: personality traits; undergraduate students; COVID-19 pandemic; distress; adherence

1. Introduction

COVID-19 is an infectious respiratory virus which first emerged in Wuhan, China in December 2019 [1]. It spread rapidly across the globe and as of August 2022, more than 591 million cases had been confirmed and more than 6.4 million deaths reported [2]. The COVID-19 pandemic has had a significant impact on the economy, as it led to the loss of many jobs, and it will likely result in long-lasting economic damage domestically and globally [3].

Although the COVID-19 pandemic has had adverse impacts across populations, it has had specific negative impacts on university students. Numerous aspects of student life were disrupted or ceased entirely during early phases of the pandemic, and these disruptions were relatively long-lasting. Most universities across the country moved their classes online, which many students believe had a negative impact on the quality of their education. These changes raised concerns about students' opportunities for academic success and about possible adverse impacts on their future careers due to reduced human connection

and support [4,5]. The large majority of undergraduates are in a developmental phase referred to as “emerging adulthood” (age range 18–25 years), in which social relationships and interactions are crucial [6]. A large aspect of student life normally involves social gatherings, which had to cease to limit spread of the virus [7]. Indeed, the COVID-19 pandemic has had significant negative effects in increasing social isolation and loneliness, both of which are highly correlated with psychological distress [8]. Public health viral containment strategies such as social distancing and lockdowns resulted in a markedly different university experience from previous years.

Concerningly, the prevalence of anxiety and depression has doubled during the COVID-19 pandemic compared to prior to the pandemic [9]. In addition to a rise in the prevalence of anxiety and depressive disorders during COVID-19, the pandemic has increased students’ levels of general distress (i.e., distress not specifically focused on pandemic circumstances) including both anxiety and depressive symptoms. Anxiety symptoms include excessive and persistent worry over a number of topics, such as one’s finances, health, family, employment, and other daily life concerns [10–13], difficulties controlling the worry, and anticipating the worst [10,14]. Depressive symptoms include low mood and a loss of interest in or pleasure from previously rewarding or pleasurable activities [15].

In addition to increases in general distress (both anxiety and depressive symptoms) during the pandemic, many students have been experiencing distress specifically focused on COVID-19 and the associated pandemic circumstances [16]. This COVID-19-specific distress can include fears of becoming infected oneself, fears of a family member or friend becoming infected, or fears of loss of a loved one [17–19]. Apart from elevated general distress, COVID-19-specific distress is directly linked with reduced life satisfaction and increased suicidal ideation [20,21].

However, not all individuals have reacted with general or COVID-19-specific distress to the pandemic. It is, therefore, important to identify individual difference factors that may play a role in susceptibility to increased general and/or COVID-19-specific distress to develop and implement targeted prevention and treatment strategies. There is substantial theory to suggest that anxiety sensitivity (AS) may be one important individual difference factor in predicting increased distress in response to the COVID-19 pandemic [22]. AS entails a fear of arousal related sensations because of beliefs that such sensations may have negative outcomes like physical illness, loss of control, or social censure [23,24]. Moreover, as an anxiety-amplifying factor [25], higher levels of AS may place people at increased risk of experiencing anxiety symptoms, even in pre-pandemic times. This increased risk is likely to be more pronounced during the COVID-19 pandemic given the many uncertainties surrounding the pandemic (e.g., uncertainties surrounding the highly contagious nature of the COVID-19 respiratory virus and/or its severity of symptoms if infected) and uncertainties around its associated containment strategies (e.g., uncertainties surrounding the availability of resources for testing and treatment, and frequently changing public health advice regarding effective containment strategies) [26–28]. AS has also been associated with an increased risk for depression in pre-pandemic times, possibly due to its association with a ruminative or negative response style [29]. Particularly in the context of restrictive social distancing measures where normal social rewards are disrupted, high AS individuals may be a group at particular risk for experiencing more severe depressive symptoms [30]. Finally, those higher in AS may be more susceptible to increased COVID-19-specific distress due to their heightened anxiety surrounding bodily arousal sensations such as shortness of breath [31] given COVID-19 is a highly contagious respiratory illness [31,32].

Indeed, emerging research provides support for a relationship between AS and elevated distress during the COVID-19 pandemic. Several studies have reported that higher AS is directly linked with higher levels of emotional distress—both anxiety and depressive symptoms—associated with the various potentially stressful disruptions caused by the COVID-19 pandemic, including social distancing, financial constraints, and uncertainty [33–37]. AS has also been linked with higher levels of COVID-19-specific distress. For example, a Canadian study found a positive association between AS and increased anxiety and worry

specifically about the COVID-19 pandemic [38]. However, these studies assessed members of the general public of all ages [38–40]. Further research is warranted to assess the relationship between AS and distress during the pandemic in emerging adults (ages 18–25)—the adult demographic most vulnerable to distress during the pandemic [41]. In addition, the extant literature on the relations of AS to distress during the pandemic has failed to compare the pattern of associations of AS (and of the related yet conceptually distinct higher-order trait of neuroticism) with COVID-19-specific distress and general distress. Such a comparison would aid in identifying, if any, the particular association between AS and COVID-19-specific distress, which could aid in the development of pandemic-specific personality targeted programs for improving student mental health.

Studies to date on the links of AS to COVID-19 distress have also not firmly established the specific utility of AS relative to related, but higher-order, traits. It has been proposed that there is a hierarchical structure to personality traits, with broader dimensions having influence over more narrowly defined traits [42]. An example of this is the broader, higher-order trait of neuroticism influencing the more specific and lower order trait of AS [42]. Neuroticism can be defined as a general tendency to experience negative emotions across situations [42], whereas AS involves the more specific tendency to experience anxiety in response to arousal sensations [24]. AS is significantly positively correlated with broader measures of trait neuroticism [43]; therefore, it is important that neuroticism is controlled when determining if the proposed relationships of personality to general and COVID-19-specific distress are unique to AS.

In addition to pandemic-related distress, another important public health issue during the pandemic has been the degree to which people are adhering to public health measures designed to contain viral spread. During earlier phases of the pandemic such measures included social distancing and stay-at-home advisories. Again, just as there have been marked individual differences in pandemic-related distress, there are similarly marked individual differences in adherence. Additionally, again, personality may be useful in identifying those who may be more (or less) adherent to these public health recommendations. AS is a variable that could theoretically be related to adherence to public health COVID-19 containment strategies. Moreover, it is possible that this relation may be in either direction (i.e., increased or decreased adherence). On the one hand, AS may motivate increased adherence behaviour as a way of reducing heightened pandemic-related distress. For example, if a higher AS individual is fearful of contamination by COVID-19, handwashing may provide temporary reduction of their associated anxiety, making future handwashing more likely through the process of negative reinforcement. In fact, elevated anxiety was shown to motivate increased preventive behaviours including washing hands, disinfecting doorknobs, and avoiding social situations during the H1N1 pandemic [44]. High AS individuals, on the other hand, may show decreased adherence during a public health emergency if their heightened levels of distress motivate unhealthy avoidance-based coping. Several past studies have suggested that AS is linked with avoidance of healthy behaviours and engagement in unhealthy coping (e.g., drinking to cope with anxiety [45]) due to the fear of somatic sensations characteristic of high AS [46,47]. Moreover, certain forms of maladaptive coping in high AS students like increased coping drinking and drug use may indirectly lead to disregard for social distancing in young adults [40,45].

It is also possible that AS may contribute to increased or decreased adherence to public health containment strategies by way of its association with specific forms of distress during the pandemic. With respect to anxiety symptoms, several studies have found higher likelihood of adherence to COVID-19 quarantine guidelines among people with elevated anxiety given they are more apprehensive about the future [48,49]. It has also been suggested that it may be fears of contracting COVID-19 (i.e., COVID-19-specific distress) that may explain the links of anxiety with increased adherence to COVID-19 containment guidelines [48]. With respect to general depression, people are less likely to adhere to recommended COVID-19 containment protocols if they are experiencing elevated depression since they have a lack of confidence in the future and a low sense of control [50]

which may make adherence efforts appear futile. Although previous studies have examined personality traits' associations with COVID-19 adherence [51–53], ours is the first study to examine potential mediators of this association where relations of AS to pandemic-specific distress and/or anxiety may mediate increased adherence and where, in contrast, relations of AS to depression may mediate decreased adherence.

We investigated whether the trait of AS is associated with distress (both general and COVID-19-specific) and adherence in emerging adult undergraduate students. Understanding which students are most susceptible to pandemic related distress and non-adherence during the COVID-19 pandemic will allow for the development/evaluation of targeted personality-tailored prevention strategies for mitigating these maladaptive reactions in vulnerable students. We hypothesized that (H1) Higher AS would predict increased general distress (both anxiety and depression) and increased COVID-19-specific distress above-and-beyond other relevant predictors including neuroticism, sex, age, and study site. (H2) Higher AS would be associated with greater adherence to public health strategies through greater COVID-19-specific distress (an indirect effect), consistent with the suggestions of an earlier study [48], rather than through general anxiety or depression.

2. Materials and Methods

2.1. Study Design and Population

We carried out an online cross-sectional survey at five universities in four Canadian provinces (British Columbia, Ontario, Quebec, and Nova Scotia) in the winter of 2021 as a part of the 'UniVenture' study [54]. 'UniVenture' is a research partnership that aims to adapt, test, and begin sharing an effective, sustainable, targeted wellness program to tackle the timely social issue of heavy drinking and other substance misuse on Canadian campuses [16,55]. A total of 1318 Emerging adults aged 18 to 25 years (mean \pm SEM age = 19.2 ± 0.03 years; 79.5% female), who were studying at the first- or second-year undergraduate level at one of the five participating Canadian universities, were enrolled into the study. Individual sites had sample sizes ranging from $n = 127$ to $n = 395$, respectively.

2.2. Data Collection Tools and Techniques

We used the REDCap (Research Electronic Data Capture) survey tool to collect the data online using the Dalhousie University REDCap server (<https://redcap.its.dal.ca/> (accessed on 24 June 2021)). REDCap is a well-accepted and secure web-based software platform that helps ensure participant privacy and confidentiality as well as allowing for automatic branching logic [56]. A total of five separate projects were created in REDCap—one for each study site—and each site administered their own project. De-identified data were later merged across sites. Various strategies were adopted at each site to reach out to the target population such as direct survey email invitations sent by respective university student affairs units and sharing posts to university student-relevant social media groups. The contents of all recruitment materials covered a broad array of topics such as student's mental health symptoms, personality, substance use, risky behaviour and injury, and COVID-19 experiences among emerging adults transitioning to the university environment (in their first or second year of studies).

A closed-ended structured questionnaire of about 45 min duration was developed and beta-tested prior to survey launch. Given the survey length, participants were permitted to partially respond to the survey and return to complete it at another time. Both French and English versions of the questionnaire were used since the primary language of one study site was French. Each participant provided an online signature to indicate their informed consent before participating. We provided participants with CAD\$15 worth of online gift cards (all sites) or 1 academic credit point (at the three sites using the SONA system to allow students to participate for partial course credit) as compensation for their time. Participants were required to provide their institutional email addresses or to otherwise verify their student identity, to participate. Compensation was provided by email. Data were stored separately from email addresses to preserve participant confidentiality.

2.3. Measures

2.3.1. Substance Use Risk Profile Scale (SURPS)

The Substance Use Risk Profile Scale (SURPS; [43]) is a 23-item questionnaire that is used to assess the four-factor model of personality vulnerability to substance misuse. For the purposes of this study, we used the 5-item AS subscale as the predictor variable in our hypothesis tests. Participants identified to what extent they agreed with each of the items (e.g., “Its frightening to feel dizzy or faint”, “It scares me when I’m unable to focus on a task.”) on a four-point Likert scale ranging from 1 (“strongly disagree”) to 4 (“strongly agree”). Participants’ total AS scores were calculated which involved summing across items. The SUPRS has been validated (concurrent, discriminant, and incremental validity) in several languages and countries [57–59]. In the present sample, the Cronbach’s alpha for the AS scale was 0.67. Given the short length of the scale (i.e., less than 10 items), Cronbach’s alpha > 0.60 is considered an acceptable level of internal consistency [60,61].

2.3.2. Big Five Inventory-10 (BFI-10)

The Big Five Inventory-10 (BFI-10) is a 10-item scale that was used as a brief measure of the Big Five personality traits [62]. For this study, only the two-item Neuroticism scale was used as a control measure in our hypothesis tests. Participants responded to what extent they agreed with each of the items (i.e., “I see myself as someone who is relaxed; . . . handles stress well (reverse-scored item); . . . gets nervous easily.”) on a five-point Likert scale (“strongly disagree” to “strongly agree”). Participants’ mean scores were calculated for the neuroticism subscale. This subscale has established self-peer convergent validity and acceptable internal consistency (Cronbach’s alpha = 0.65 in the current sample) for a short scale [60].

2.3.3. Generalized Anxiety Disorder Scale (GAD-7)

The Generalized Anxiety Disorder (GAD-7) scale [63] is a 7-item scale which was used to assess severity of anxiety symptoms during the COVID-19 pandemic [63]. The GAD-7 served as one of our two general distress outcome measures in the test of H1 and as a mediator variable in the test of H2. It contains items such as “Feeling nervous, anxious, or on edge” which are answered on a scale from zero for “Not at all” to three for “Nearly every day”, in the past month (30 days). The GAD-7 score is calculated by summing the scores across the seven items for a possible total score ranging from 0–21. The GAD-7 possesses excellent internal consistency [Cronbach’s alpha = 0.92 in the validation sample [63] and Cronbach’s alpha = 0.90 in the present sample]. The GAD-7 has also been shown to possess good convergent and discriminant validity [64] and it has been validated with university students in a number of countries and languages [65–67].

2.3.4. Patient Health Questionnaire (PHQ-9)

The Patient Health Questionnaire (PHQ-9) is a 9-item questionnaire which was used to assess severity of depressive symptoms during the COVID-19 pandemic [68]. The PHQ-9 served as one of our two general distress outcome measures in the test of H1 and as a mediator variable in the test of H2. The scale contains items such as “Little interest or pleasure in doing things” which are answered on a scale from zero for “Not at all” to three for “Nearly every day”, in the past month (30 days). The PHQ-9 total score is calculated by summing the scores across the nine items for a possible total score ranging from 0–27. The PHQ-9 has been shown to possess excellent internal reliability ($\alpha > 0.80$; Cronbach’s alpha = 0.88 in the present sample) as well as good construct and criterion-related validity as a measure of depressive symptom severity [68].

2.3.5. COVID Stress Scales-Brief (CSS-B)

The COVID Stress Scales (CSS) were developed several months into the COVID-19 pandemic to assess distress responses specific to the COVID-19 pandemic [69]. The original full scale has a total of 36 items; however, for the purposes of UniVenture, a brief 18-item

version was developed [16] where higher scores indicate higher COVID-19 specific distress. Sample items from the CSS-B are “I am worried about catching the virus”, and “I had trouble sleeping because I was worried about the virus.” Items are responded to on a scale ranging from 1 (Not at all) to 5 (Extremely). The CSS-B shows excellent structural validity in university students [16] and strong internal consistency (Cronbach’s alpha = 0.90 in the present sample). We used the total score (items summed across the 18 items) since it provides a useful measure of overall COVID-19-specific distress and given evidence of a hierarchical structure for the CSS-B where the total score represents the overall COVID-19-specific distress construct [16]. The CSS-B total served as one of our outcome measures in the test of H1 and as a mediator variable in the test of H2.

2.3.6. COVID-19 Adherence Scale (CAD)

Adherence to the public health restrictions in place at the time of the study were measured with the 6-item COVID-19 Adherence Scale (CAD) [70]. The items in the CAD are as follows: “Since returning to campus this semester/term (i.e., since starting classes), have you (1) Gone out to a restaurant, bar, club, or other places where people gather? (2) Gone to the grocery store or pharmacy? (3) Gone to a friend, neighbour, or relative’s house (that is not your own)? (4) Had more than 10 friends, neighbours, or relatives over to your house? (5) Gone to a family gathering where there were more than 10 people such as a reunion, wedding, funeral, or birthday party? (6) Gone to a gathering of friends where there were more than 10 people such as a party, wedding, or concert?” Each item was answered with a “yes/no” response option and we counted the number of positively endorsed items. For ease of interpretation, we then recoded the non-adherence measure into an adherence measure through reverse coding (i.e., 0 was coded as 6 and 6 was coded as 0, etc.). We used a total score (possible range of 0–6) as our outcome measure in the test of H2. Greater scores indicate higher levels of adherence to the COVID-19 containment measures. While the CAD is an unvalidated author-compiled measure, its items show similarity to items on validated COVID-19 non-adherence measures [40,71] and its items were significantly intercorrelated in the current sample (i.e., Cronbach’s alpha = 0.67 which is acceptable for a short scale), suggesting face and construct validity, respectively.

2.4. Statistical Analysis

SPSS version 27 (Chicago IL) and Jamovi (version 2.0) were used to run the descriptive and inferential statistics. Participants’ demographics characteristics were tabulated in means and percentages by study site. We coded the five study sites numerically as sites 1 through 5 to maintain the confidentiality of the various participating sites. We built multilevel models (MLM) for linear mixed model regression to test our hypotheses. We identified two levels for MLM: the individual level response and the mean of the individual response by site. MLM was carried out if the random variable (study site) explained more than 1% of the variation across sites (i.e., Intra-Cluster Correlation [ICC] > 1%; [72]). Four models were tested for each outcome variable after adjusting for age, biological sex, and neuroticism as fixed effect variables and study site as a random effect variable. Model 0 was the null (unconditional) model where only the random effect of the dependent variable was estimated. Model I involved level one individual data, model II involved the individual means by site, and model III involved a combination of models I and II. Proportional Change in Variance (PCV) and Akaike’s Information Criterion (AIC) were calculated to understand the change in the proportion of variance in the outcome accounted for by the predictor(s) across the different models and to identify better models where lower values represented closer model fit, respectively. Furthermore, we ran generalized mediation analysis to test the indirect effect of SURPS AS on CAD via CSS-B, GAD-7, and PHQ-9, as well as the remaining direct effect of SURPS AS on CAD, after adjusting age, sex, and study site effects. Significance levels were set a priori at $p < 0.05$.

3. Results

A total of 2441 participants started the online survey, of which 2060 completed the survey, with a survey drop-out rate of 15.6%. After the data cleaning, a total of 1318 participants' data were analyzed. Table 1 presents the Mean (\pm SEM) of the study population on key study variables. The mean AS level (13.43) in the current sample was found to be slightly higher than that of an earlier study among undergraduate drinkers (12.2) using the SURPS [43] which may have been due to the COVID-19 pandemic [22]. Controlling for age, sex, and study site, we found that AS, neuroticism, general anxiety, general depression, and COVID-19-specific distress were positively correlated with each other with AS showing stronger relationships than neuroticism with COVID-19-specific distress, and neuroticism showing stronger relationships than AS with general distress (anxiety and depression) (Table 2). COVID-19 adherence was positively correlated with neuroticism, general depression, and COVID-19 specific distress (Table 2).

Table 1. Mean (\pm SEM) of the study population by key study variables.

Variables	Mean (\pm SEM)
Age	19.27 (0.04)
Anxiety sensitivity	13.43 (0.07)
Neuroticism	3.37 (0.02)
COVID-19-specific distress	11.80 (0.25)
General distress—Anxiety	9.87 (0.15)
General distress—Depression	11.05 (0.17)
COVID-19 adherence	2.46 (0.04)
Sex	N (%)
Male	270 (20.5)
Female	1046 (79.4)

Table 2. Correlations between independent and dependent variables.

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Anxiety sensitivity	—					
(2) Neuroticism	0.44 **	—				
(3) COVID-19 specific distress	0.29 **	0.12 **	—			
(4) General distress—anxiety	0.37 **	0.51 **	0.30 **	—		
(5) General distress—depression	0.27 **	0.35 **	0.26 **	0.72 **	—	
(6) COVID-19 adherence	0.04	0.07 *	0.19 ***	0.05	0.06 *	—

Controlling for 'Age', 'Sex', and 'Study Site' * $p < 0.05$, ** $p < 0.001$.

Table 3 shows hypothesis testing of the relationship of AS with general distress in separate analyses for anxiety and depressive symptoms. The null models (model 0) for both anxiety and depressive symptoms revealed that less than 1% variation in each of these outcome variables was attributable to study site; therefore, MLMs were not necessary. Model I suggested a sex effect, with females scoring significantly higher in both anxiety [$\beta = 0.97$ (0.29; 1.65)] and depressive symptoms [$\beta = 1.61$ (0.77; 2.45)] compared to males. While controlling neuroticism, sex, age and study site, AS was associated with higher levels of general distress, as hypothesized, both for anxiety [$\beta = 0.35$ (0.24; 0.45)] and depressive symptoms [$\beta = 0.32$ (0.19; 0.45)]; however, neuroticism showed stronger effects than AS on both measures of general distress: $\beta = 2.43$ (2.14; 2.73) for anxiety symptoms and $\beta = 1.84$ (1.47; 2.20) for depressive symptoms.

Table 3. Factors associated with General Distress: Anxiety (GAD-7) and Depression (PHQ-9).

Characteristics	General Distress—Anxiety (GAD-7) #		General Distress—Depression (PHQ-9) ##	
	Model 0 ^a	Model I ^b	Model 0 ^a	Model I ^b
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Individual level				
Age		0.09 (−0.10; 0.30)		0.13 (−0.12; 0.38)
Sex				
Male		Ref		Ref
Female		0.97 (0.29; 1.65) *		1.61 (0.77; 2.45) **
Anxiety sensitive		0.35 (0.24; 0.45) **		0.32 (0.19; 0.45) **
Neuroticism		2.43 (2.14; 2.73) **		1.84 (1.47; 2.20) **
Measure of variation				
Variance (SD)	0.03 (0.17)	0.29 (0.54)	0.21 (0.46)	0.28 (0.53)
ICC (%)	0.00	1.31	0.52	0.81
PCV (%)	Ref	−866.66	Ref	−33.33
Model fit statistics				
AIC	8352	7596.37	8658.87	8129.31

^a Model 0 (Null model) was fitted without determinant variables. ^b Model I is the final model adjusted for both individual-level and individual-level mean by site variables. * $p < 0.05$; ** $p < 0.001$ # Dependent variable: General distress—anxiety measured by the General Anxiety Disorder scale (GAD-7); Fixed effect variables: age and sex; Random effect variable: study site. ## Dependent variable: General distress—depression measured by the Patient Health Questionnaire (PHQ-9); Fixed effect variables: age and sex; Random effect variable: study site.

Table 4 presents the MLM regression for COVID-19-specific distress with study site as the random effect variable and AS as a fixed effect variable, after adjusting for age, biological sex, study site, and neuroticism. In the null model (Model 0), study site explained 6.87% of the variance in COVID-19-specific distress which justified the MLM. Model III revealed the best fitting model since AIC (9125.82) was the lowest compared to other models. Adjusted results indicated that AS was significantly associated with increased COVID-19 specific distress [$\beta = 0.91$ (0.72; 1.11)], as hypothesized. However, neuroticism was not significantly related to COVID-19-specific distress when controlling AS [$\beta = -0.05$ (−0.59; 0.48)]. Furthermore, after including AS and the covariates, ICC values showed that variation across study sites explained a relatively small proportion of the variance in COVID-19-specific distress (1.5% according to the ICC value for Model III as compared to 6.87% in Model 0 [the null model]). As shown by the PCV, individual- and individual mean-level factors at the site level together accounted for 81.39% of the variance in estimates of COVID-19-specific distress across study sites.

Table 5 displays the results of the parallel mediation analysis model to explain the hypothesized link of AS to COVID-19 adherence where anxiety symptoms, depressive symptoms, and COVID-19-specific distress served as simultaneous potential mediators in a single model. With respect to anxiety and depressive symptoms, while AS was significantly positively linked with each potential general distress mediator (path |a|), we did not find a unique effect of either general distress indicator to COVID-19 adherence (path |b|), nor did we find a significant indirect effect (paths |ab|) of AS to COVID-19 adherence through either potential general distress mediator. With respect to COVID-19-specific distress as a potential mediator, we found that AS was significantly positively linked with COVID-19-specific distress (path |a|) and that COVID-19-specific distress was significantly positively linked with COVID-19 adherence (path |b|). Moreover, a significant indirect effect (path |ab|) was found for the positive relation of AS to COVID-19 adherence through COVID-19-specific distress. This is consistent with the possibility that AS significantly

increased COVID-19-specific distress, which subsequently significantly increased COVID-19 adherence. Moreover, the direct effect (path |c|) of AS to COVID-19 adherence was not significant suggesting full mediation through increased COVID-19-specific distress.

Table 4. Factors associated with COVID-19-Specific Distress.

Characteristics	Model 0 ^a β (95% CI)	Model I ^b β (95% CI)	Model II ^c β (95% CI)	Model III ^d β (95% CI)
Individual level				
Age		0.34 (−0.03; 0.73)	0.52 (0.13; 0.91) *	0.37 (0.19; −0.11)
Sex				
Male		Ref	Ref	Ref
Female		1.19 (−0.05; 2.43)	2.34 (1.11; 3.56) **	1.21 (−0.03; 2.45)
Anxiety sensitivity		0.91 (0.72; 1.11) **	-	0.91 (0.72; 1.11) **
Neuroticism		−0.05 (−0.59; 0.48)	-	−0.05 (−0.59; 0.48)
Individual level (mean by site)				
Anxiety sensitivity (mean by site)			8.00 (4.67; 11.33) *	7.29 (3.31; 11.26)
Neuroticism (mean by site)			24.84 (10.02; 39.67)	27.06 (9.23; 44.89)
Measure of variation				
Variance (SD)	6.18 (2.49)	5.28 (2.30)	0.68 (0.82)	1.15 (1.07)
ICC (%)	6.87	6.61	0.82	1.5
PCV (%)	Ref	14.56	8.89	81.39
Model fit statistics				
AIC	9590.86	9131.93	9544.38	9125.82

^a Model 0 (Null model) was fitted without determinant variables. ^b Model I is adjusted for individual-level variables only. ^c Model II is adjusted for Individual-level mean by site variables only. ^d Model III is the final model adjusted for both individual-level and individual-level mean by site variables. * $p < 0.05$; ** $p < 0.001$ Dependent variable: COVID-19-specific distress (CSS-B); Fixed effect variables: age and sex; Random effect variable: study site.

Table 5. Mediation of AS to COVID-19 adherence link through general distress (anxiety and depressive symptoms) and COVID-19-specific distress.

Predictor	Mediator	Indirect Effect [β (95% CI)]	Path b (Unique Effect of the Mediator on COVID-19 Adherence)		Direct Effect [β (95% CI)]
		Path a (Effect of AS on Mediator)	Path ab (Indirect Effect)	Path c (Effect of AS to COVID-19 Adherence)	
Anxiety Sensitivity	COVID-19- specific distress	0.99 (0.81; 1.16) *	0.02 (−0.03; −0.01) *	0.02 (−0.03; −0.01) *	0.01 (−0.02; 0.05)
	Anxiety symptoms	0.81 (0.70; 0.91) *	0.01 (−0.01; 0.02)	0.01 (−0.01; 0.02)	
	Depressive symptoms	0.70 (0.58; 0.82) *	0.00 (−0.02; 0.01)	0.00 (−0.01; 0.01)	

Dependent variable: COVID-19 adherence * $p < 0.001$.

4. Discussion

We investigated the relationship of AS to three indices of distress during the COVID-19 pandemic and whether they play mediating roles in explaining the hypothesized positive link between AS and adherence to COVID-19 public health measures. We found that AS was significantly positively associated with greater levels of both general (anxiety and depression) and COVID-19-specific distress during the pandemic, after controlling age, sex,

study site, and neuroticism. We also found that AS indirectly predicted greater COVID-19 adherence as mediated through greater COVID-19-specific distress after adjusting for age, sex, and study site and general distress mediators.

We improved upon the extant literature in several ways: controlling for the effects of the higher-order trait of neuroticism when examining links of AS to indices of distress during the pandemic, examining these issues in emerging adult undergraduates where distress during the pandemic is particularly prevalent, and examining both general (anxiety and depressive symptoms) and COVID-19-specific distress as outcomes in a single study. We found that AS is a strong positive predictor of concurrent anxiety symptoms, depressive symptoms, and COVID-19-specific distress, even after controlling for neuroticism and biological sex. Neuroticism and female sex showed independent effects in predicting higher anxiety and depressive symptoms, but not COVID-19-specific distress. These independent positive relationships between neuroticism and indicators of general distress, in the form of anxiety and depressive symptoms, have been supported by several earlier pre-pandemic studies [73,74]. Others have studied the relation of AS to each form of distress (general anxiety, general distress, COVID-19-specific distress) during the pandemic [33–37] but we are the first to establish that AS predicts concurrent levels of each form of distress during the COVID-19 pandemic when controlling the related trait of neuroticism.

The associations between AS and increased general anxiety and depression are consistent with prior pre-pandemic research as well as research conducted during the COVID-19 pandemic. For instance, AS is significantly linked with both post-traumatic stress disorder and generalized anxiety disorder in non-pandemic times [75]. In pre-pandemic research, AS has been shown to be a vulnerability factor for the development of anxiety disorders [75]. This may be due to the strong associations those high in AS tend to make between physical arousal sensations and catastrophic consequences like physical illness [76]. Misconstruing harmless physical sensations as signs of serious illness—namely the highly infectious respiratory disease of COVID-19—may have contributed to high AS students' increased anxiety symptoms during the pandemic [77]. Other studies found relationships between AS and general depression—particularly those studies assessing lower-order facets of AS. AS cognitive concerns (a lower order facet of AS involving fear of cognitive dyscontrol and a fear of mental incapacitation when experiencing anxiety) have been shown to be associated with increased depression symptom severity in clinically depressed individuals [30,78,79] and with depressed mood in non-clinical samples [80]. Our findings extend this prior research linking AS with indices of general distress—both anxiety and depressive symptoms—to the context of the COVID-19 pandemic.

We also found that students higher in AS suffer from COVID-19-specific distress to a greater extent than other students. The construct of COVID-19-specific distress includes worries around contracting the virus, post-traumatic stress disorder symptoms like difficulties sleeping and concentrating, worries around the health of the self and loved ones, concerns about the potential of reduced access to supplies during the pandemic, COVID-related xenophobia, and reassurance seeking behaviours with respect to the pandemic [69]. Our findings are consistent with other studies showing a link of AS to COVID-19-specific distress [38,81] and extend those prior findings from community samples to university students. Similarly, a prior study found that AS was related to greater COVID-19 related worries; their findings suggested it was the physical concerns dimension of AS in particular (i.e., beliefs that physical arousal sensations like difficulties breathing are signs of serious illness) that predicted greater COVID-19-specific distress [39]. They speculated that those with elevated AS physical concerns may be more likely to misinterpret harmless bodily sensations as signs of COVID-19 infection.

Similar to AS, we found that neuroticism was significantly linked with increased general distress in the form of both anxiety and depressive symptoms. This is not just due to measurement overlap as the BFI-10 neuroticism scale taps a personality trait that involves susceptibility to negative emotions whereas the PHQ-9 and GAD-7 tap anxiety and depressive symptoms that include negative emotions but also other symptoms of distress

(e.g., difficulties concentrating, appetite changes, sleeping difficulties for the PHQ-9). Our results are in line with earlier evidence regarding the relationship between neuroticism and both anxiety and depressive symptoms. For example, neuroticism has been associated with increased anxiety symptoms among adolescents and heightens risk for the development of an anxiety disorder [82,83]. Furthermore, other studies support the claim that individuals high in neuroticism are more prone than others to emotional distress including states of both anxiety and sadness [84–87]. Although the relationship between neuroticism and general distress (anxiety and depression) is well established, the present findings extend this result to the context of the COVID-19 pandemic and show such relations even after controlling for the influence of the lower-order trait of AS [88].

However, only AS and not neuroticism was associated with COVID-19-specific distress in our multivariate models, showing a unique link of AS with worries and concerns specific to the pandemic. Why neuroticism is linked with general distress but does not incite COVID-19-specific distress remains unclear. This distinction was observed because we included both measures of general distress and COVID-19-specific distress in a single study and because we included neuroticism as a covariate in all our models. We are the first, to our knowledge, to examine the link of neuroticism to COVID-19-specific distress. One Canadian study reported that neuroticism negatively correlated with the mental health of adults during the COVID-19 pandemic [89] but they did not examine COVID-19-specific distress, in particular. Another study carried out in Italy concluded that neuroticism plays a major role in COVID-19 pandemic coping behaviours because the feeling of being bored is positively linked with higher neuroticism [90]. A likely reason for our not finding a relationship between neuroticism and COVID-19-specific distress could be because unlike these other studies [90,91], our study controlled for AS. Therefore, our results are suggesting that prior findings of neuroticism being linked to pandemic-related distress may be better accounted for by the more specific trait of AS. Additionally, AS might be a better construct than neuroticism for predicting concurrent COVID-19-specific distress since the signs and symptoms of COVID-19 are widespread in daily life (e.g., coughing, upset stomach) and AS may intensify these signs and symptoms to the point where people may see them as catastrophic, resulting in more overall symptoms and related functional impairment [92].

Our results also suggest that AS is indirectly associated with more adherence to COVID-19 public health preventive measures by way of its association with greater COVID-19-specific distress. It is possible that those individuals characterized by higher AS are disproportionately more likely to experience distress relating to the pandemic, motivating these individuals to adhere more strongly to public health guidelines as a way of temporarily alleviating their pandemic-specific distress. This is corroborated by previous findings where those characterized by higher AS levels engaged in more preventive behaviours during a previous pandemic [44]. We add to this prior work in two important ways: generalizing the findings from the H1N1 to the COVID-19 pandemic and identifying a mechanism to explain the AS-to-increased adherence link (i.e., via greater pandemic-specific distress) [44]. Interestingly, we did not find a significant mediation effect of either general anxiety or general depression in explaining the link of AS to increased adherence to COVID-19 public health measures in our simultaneous mediator model, even though AS was positively associated with both general anxiety and general depression. A likely reason for this is that COVID-19-specific distress has a unique impact on COVID-19 adherence behaviour since specific worries and concerns about the pandemic (e.g., worries about contracting the virus) are theoretically more likely than general (unfocused) distress to motivate behaviours like adherence to public health measures to contain viral spread. This possibility could be studied further in future longitudinal research and may be helpful in future intervention efforts.

Our study shows how students in the emerging adult phase of development are responding to the pandemic and to the public health containment strategies put in place in their communities and universities to prevent the spread of the virus. The possible reason for site differences on COVID-19-specific stress and COVID-19 adherence are likely to be

related to different infection rates and associated pandemic restrictions across sites, both at the provincial and university level as discussed in other papers from the UniVenture dataset [16,55]. For instance, Thibault et al. (2022) reported on these site effects for COVID-19-specific distress in this same sample, showing that the mean scores of COVID-19-specific distress were highest at sites where COVID-19 infection rates were highest and COVID-19-related public health restrictions were strongest during the time of data collection (i.e., between February and April 2021) [16,93]. Interestingly, our null models indicated that there were small and non-significant site differences for general distress, with site explaining only 0.8% (in the case of depressive symptoms) and 1.31% (in the case of anxiety symptoms) of the variance in general distress scores. In contrast, site explained a significant 6.87% of the variance in the case of COVID-19-specific distress. The results suggested that more attention should be given to interventions for managing students' COVID-19-specific distress in provinces where COVID-19 infection rates are higher, and provincial and university-based restrictions are stricter. Our results also indicate that those students with higher levels of AS are more vulnerable than other students to experiencing both general distress (i.e., anxiety and depression symptoms) and COVID-19-specific distress. Thus, our results are consistent with prior calls for the need for personality-specific interventions targeted towards higher AS individuals during pandemic times that would help them manage their increased susceptibility to distress [38].

An earlier Canadian study advised adopting personality-appropriate mental health services during the COVID-19 pandemic [89]. Our results suggest that targeting AS, as opposed to the higher-order trait of neuroticism, may be most helpful for reducing both general and COVID-19-specific distress in university students. A personality-targeted intervention called PreVenture might be helpful in this regard given it has an arm which targets higher AS individuals. PreVenture is an evidence-based program which trials have shown to reduce alcohol misuse, risky motives for drinking, emotional distress, and behavioural problems, and to prevent multiple medical service usage among both adolescents and adults [94–98]. It is also important to note that even though high AS individuals are indirectly showing increased adherence behaviours, it is at the cost of increased distress about the pandemic. Prolonged distress during the pandemic may manifest in maladaptive behaviours, including increased drinking [40]. By reducing the heightened general distress being experienced by high AS students, adherence can be maintained while promoting general mental well-being. However, it is important to be aware that reducing COVID-19-specific distress may result in reduced COVID-19 adherence. Public health needs to find a balance of instituting sufficient worry and concern about the pandemic in emerging adults that they will be sufficiently adherent to slow viral spread, but not incur so much distress in vulnerable individuals like high AS individuals that they are suffering psychologically and turning to other maladaptive behaviours like coping drinking. Such suffering may have longer term physical and mental health costs for both the individual and society.

Our study also suggests that lower AS students might be experiencing abnormally low levels of COVID-19-specific distress, which could result in decreased adherence to public health containment measures, placing them and the community at risk of COVID-19 infection. Findings may thus aid in the development and evaluation of interventions which can be targeted to individual differences in personality for tackling both distress and non-adherence.

Several possible limitations of the current study should be acknowledged and considered in the interpretation of the results. First, due to the cross-sectional nature of the study design, we are unable to establish causal relationships between AS and general anxiety, general depression, and COVID-19-specific stress or between COVID-19-specific distress and COVID-19 adherence. Longitudinal studies are needed in future to test temporality. Second, although the study captures variation in COVID-19-specific distress and adherence among undergraduate students from across Canada (covering from east to west coast universities), generalizability of the results cannot be ensured since the study sample was

not representative of Canadian undergraduates (e.g., preponderance of females, all first- and second-year students). Nonetheless, females are overrepresented in the Canadian undergraduate population [99] and first- and second-year university students may have been experiencing the most pandemic-related disruptions to their usual university experience [100]. Additionally, sampling bias is less likely to occur since the study advertised broader aspects of the survey topics in the recruitment materials including, but not limited to, substance use, mental health, COVID-19 stress, academic engagement and achievement, and personality among emerging adults transitioning to the university environment (in their first or second year of studies).

Future research may consider using a multidimensional AS scale like the ASI-3 [31] if there are additional waves of COVID-19 or during predicted future pandemics since our use of the SURPS to measure AS did not allow us to examine links of specific AS components (physical, social, and cognitive concerns) to the distress outcomes or to adherence [101]. It is a future direction to know which dimension(s) of AS is (are) most predictive of general and COVID-19-specific distress during this or future pandemics in university students to further refine our knowledge on which students are most in need of intervention and which aspects of AS we most need to target in intervention. Future research could also examine which components of COVID-19-specific distress most motivate increased adherence. For example, fear of contracting COVID-19 oneself might be more motivating of adherence than some other components. It remains to be determined the optimal level of COVID-19-specific distress that is needed to motivate effective adherence yet not tip into pathological outcomes like suicidality and reduced life satisfaction that are established outcomes of COVID-19-specific distress [20,21]. Furthermore, future studies may wish to include a longer measure of neuroticism than the brief two-item neuroticism scale from the BFI-10 (e.g., Neuroticism Scale) [102]. Nonetheless, the BFI neuroticism scale used in the present study did have adequate internal consistency for a short scale which was similar to the internal consistency of the SURPS AS measure in the present study. Moreover, its brief format allowed us to measure neuroticism without overly burdening our participants with an excessively long battery. We also acknowledge the CAD measure was an unvalidated, author-compiled measure of adherence (albeit with face and construct validity in the present sample); therefore, future research may want to replicate using a validated adherence scale. However, it is important to note that exact replication may not be possible as public health recommendations have changed over the course of the pandemic and thus measures of adherence have had to quickly evolve over time.

5. Conclusions

AS was associated with higher general distress (both anxiety and depressive symptoms) and COVID-19-specific distress among Canadian emerging adult undergraduates even after controlling the effects of age, sex, study site, and neuroticism. Our results further suggest that higher COVID-19-specific distress has a distinct mediating effect in explaining the link of AS to higher COVID-19 adherence, that general distress (both anxiety and depressive symptoms) does not have. Our results may help pave the way to the development/evaluation of personality-targeted interventions for reducing general and pandemic-specific distress that are being experienced more intensely by higher AS university students, while helping them maintain appropriate levels of adherence to public health measures for viral containment. Our results may also stimulate the future development of personality-targeted interventions for lower AS students to help improve their adherence to such public health containment measures.

Author Contributions: Conceptualization and methodology, S.H.S., M.D.K., K.T., M.T.K., R.N.-A., A.L. and P.J.C.; formal analysis, F.M.Y., A.L., A.M. and S.H.S.; writing—original draft preparation, F.M.Y., A.L., A.M., M.M., C.B.M. and S.H.S.; writing—review and editing, S.H.S., M.D.K., K.T., M.T.K., R.N.-A., A.L. and P.J.C. All authors have read and agreed to the published version of the manuscript.

Funding: The study received funding from a Social Sciences and Humanities Research Council (SSHRC) Partnership Grant [Grant#: 895-2019-1021; PI Stewart], and a Canadian Institutes of Health Research (CIHR) COVID Mental Health Grant [Award# 202010PJK; PI Stewart]. FMY's work on the project was supported through the Mitacs Accelerate Post-Doctoral Fellowship program in collaboration with Injury Free Nova Scotia. PJC is supported through a CIHR Tier 1 Canada Research Chair in Preventative Mental Health and Addiction. SHS is funded through a CIHR Tier 1 Canada Research Chair in Addictions and Mental Health.

Institutional Review Board Statement: We received ethical approval from research ethics boards at Dalhousie University (REB# 2019-4925), Université de Montréal (Ref# CERSES-20-012-P), St. Francis Xavier University (Ref# 24051), York University (Ref# e2020-076), and the University of British Columbia-Okanagan Campus (Ref# H19-02708).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data is contained within the article. Deidentified data is available from the corresponding author upon reasonable request and pending appropriate ethical approval.

Acknowledgments: We acknowledge the support from the UniVenture Consortium that includes researchers and project staff from the five university data collection sites and academic outcome partners at University of Victoria. Specifically, we would like to share our sincere thanks to Karen Stewart-Kirk, Laura Lambe, Stephanie Cooper, Marion Audet, Nora Fripp, Naama Kronstein, Vanessa Morris, Philippe Pétrin-Pomerleau, Cassidy Wallis, Katherine Rose, Ramin Rostampour, Paweena Sukhawathanakil, and Allyson Hadwin. We are thankful to our UniVenture partners (Student Affairs Units from the five respective sites, Nova Scotia Health Authority-Research Methods Unit (NSHA-RMU), SPOR Support Units (each region), the Canadian Research Initiative in Substance Misuse (CRISM), the Canadian Centre on Substance Use and Addiction (CCSA), the Mental Health Commission of Canada (MHCC), and Injury Free Nova Scotia (IFNS) for their continued support of the project.

Conflicts of Interest: The authors have no conflict of interest to disclose.

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