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# Anxiety sensitivity as a predictor of panic disorder symptoms: a prospective 3-year study

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## ABSTRACT

**Background and Objectives:** Anxiety sensitivity (AS) is the fear of anxiety symptoms, a feature proven to be an important vulnerability factor for anxiety pathogenesis. The aim of this study was to examine whether AS (as well as its factors) predicts the onset of panic disorder symptoms when controlling for the contribution of trait anxiety.

**Design:** We conducted a prospective 3 year follow up study.

**Methods:** The participants, students at the Humanities and Social Sciences in Zagreb ( $N = 1087$ ), completed an Anxiety Sensitivity Index and State-Trait Anxiety Inventory (Trait form) and, after a period of three years, were asked to self-assess criteria for panic disorder (according to the DSM-5).

**Results:** The predictive validity of AS for the onset of panic disorder symptoms, regardless of trait anxiety, was confirmed. Furthermore, the physical concerns dimension of AS was the only significant predictor of panic disorder symptoms. The optimal cutoff score of 25 on the ASI provides poor to moderate accuracy indices in detecting participants who will manifest panic disorder symptoms in the next three years.

**Conclusion:** This study contributes to our current understanding of AS as a prospective risk factor for panic disorder symptoms.

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## KEYWORDS

Anxiety sensitivity; trait anxiety; panic disorder symptoms; prospective validity; prospective study

## Introduction

Anxiety sensitivity (AS) is defined as a fear of anxiety symptoms based on beliefs about the dangerous consequences of three groups of symptoms: physical, psychological and social. People with high AS are afraid that anxiety symptoms lead to undesirable physical (e.g., heart attack), psychological (e.g., madness) and social (e.g., embarrassment) consequences (Reiss & McNally, 1985). AS is believed to heighten anxiety, which in turn makes individuals vulnerable to anxiety pathology and to panic attacks and panic disorder especially (McNally, 2002; Reiss & McNally, 1985).

The association between AS and panic attacks is already well known and has been confirmed through numerous studies. Findings demonstrate that higher levels of AS are associated with a greater intensity and number of panic attacks (Deacon & Abramowitz, 2006; Deacon & Valentiner, 2001; McNally, 2002; Rapee, Brown, Antony, & Barlow, 1992; Schmidt, Mitchell, & Richey, 2008). Longitudinal studies also demonstrate AS to be a predictor of spontaneous panic attacks in adults (Cox, Taylor, Clara, Roberts, & Enns, 2008; Schmidt et al., 2007; Schmidt, Lerew, & Jackson, 1997) and adolescents (Hayward, Killen, Kraemer, & Taylor, 2000; Schmidt et al., 2010; Weems, Hayward, Killen, & Taylor, 2002). Research using the biological challenge method to provoke a physiological state similar to anxiety also confirmed that AS predicts the onset of panic attacks and fearful responding (Schmidt et al., 1997, 2008; Schmidt & Trakowski, 1999; Schmidt, Zvolensky, & Maner, 2006).

Furthermore, cognitive behavioral interventions were found to be effective in decreasing AS and the frequency of panic attacks within one year (Gardenswartz & Craske, 2001; Schmidt et al., 2007). Taken together, these findings clearly suggest that elevated AS is a risk factor for developing panic attacks over time.

Because panic is a core feature of panic disorder, it seems reasonable to conclude that AS is a risk factor for panic disorder in the same way that it is for panic attacks. However, panic attacks can also be experienced by persons without mental disorders or can be a symptom of several other mental disorders. Moreover, research demonstrates that levels of AS, measured using the Anxiety Sensitivity Index (ASI; Reiss, Peterson, Gursky, & McNally, 1986), differ between individuals with panic attacks and those with panic disorder (Norton, Cox, & Malan, 1992). In light of this finding, it is reasonable to argue that the ability of AS to predict panic attacks and panic disorder must be considered separately.

When considering panic disorders, cross-sectional studies have consistently demonstrated a strong, positive relationship with AS (e.g., Deacon & Valentiner, 2001). Although different research designs can provide information about the predictability of AS for panic disorder, longitudinal, prospective studies are the best method to test whether AS is a risk factor for the onset of panic disorder (McNally, 2002). To date, there are only a few such prospective studies, which collectively suggest that AS prospectively predicts the onset of panic disorder. In two studies, AS was demonstrated to be a predictor of panic disorder specifically (Cox et al., 2008; Maller & Reiss, 1992) and of the clinical course of panic disorder (Pérez Benítez et al., 2009). In line with these results, recent findings also suggest that the reduction in AS achieved through cognitive behavioral treatment (CBT) predicts a decrease in panic disorder symptoms (Gallagher et al., 2013). In contrast, however, Plehn and Peterson (2002) found that ASI did not predict later panic disorder. New prospective studies are needed to further investigate the role of AS on development of panic disorder over time.

Panic disorder was operationalized quite different across studies using Panic History Form (Schmidt & Telch, 1997), the Anxiety Disorders Interview Schedule-Revised (Di Nardo, Moras, Barlow, Rapee, & Brown, 1993), or the Structured Clinical Interview for DSM-III-R (Spitzer, Williams, Gibbon, & First, 1992), others used 9 items from the frequently studied 21-item Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988). In line with the work of Plehn and Peterson (2002), who used the DSM-IV criteria for self-assessed panic disorder, the current study also used these criteria. However, the DSM-5 diagnostic criteria for self-assessed panic disorder (American Psychiatric Association, 2013) since minor changes in DSM-5 diagnostic criteria regarding panic disorder were made (Craske et al., 2010).

Perhaps one of the biggest debates in the field of AS research is that concerning its distinction from trait anxiety. To date, research has predominantly argued that AS is different from anxiety as a personality trait (McNally, 1989; McWilliams & Cox, 2001; Reiss, 1997). However, because some researchers continue to state the need for more evidence to support this claim (e.g., Lilienfeld, 1995; Lilienfeld, Turner, & Jacob, 1998), it is still useful to determine whether AS is predictive of panic disorder when controlling for trait anxiety. Presently, there are only a few longitudinal studies assessing trait anxiety and the results are ambiguous. Although it has been hypothesized that AS would contribute to the explanation of panic disorder over and above trait anxiety, some studies have found that AS was a significant predictor of the incidence of anxiety disorders, panic disorder and panic attacks, while trait anxiety did not predict any major outcome variable (Maller & Reiss, 1992; Schmidt et al., 1997; Schmidt, Lerew, & Jackson, 1999; Schmidt et al., 2006). On the other hand, Plehn and Peterson (2002) demonstrated that AS was not a risk factor for the development of panic disorder when controlling for trait anxiety. These inconsistent results suggest the need for further research examining this topic.

Substantial research interest has been given to understanding the subscales of AS. While AS was defined as a unitary construct initially, numerous studies have clearly demonstrated its multidimensional nature with a single higher-order factor (i.e., AS) and a certain number of lower-order factors (e.g., Rodriguez, Bruce, Pagano, Spencer, & Keller, 2004). Although there is still confusion regarding the number of lower-order factors, the majority of studies have reported three-factor solutions

loaded onto a single higher-order factor. These factors describe *physical concerns*, *psychological concerns*, and *social concerns* (e.g., Jurin, Jokic-Begic, & Korajlija, 2012; Rodriguez et al., 2004; Zvolensky, McNeil, Porter, & Stewart, 2001). When testing the divergent validity of these dimensions, research demonstrates that only one AS dimension – physical concerns – is predictive of panic disorder (e.g., Rector, Szacun-Shimizu, & Leybman, 2007; Rodriguez et al., 2004), while both physical and psychological concerns dimensions were found to be predictors of panic attacks (Naragon-Gainey, 2010). Two studies, one following patients with panic disorder (Pérez Benítez et al., 2009) and another testing the effects of CBT on AS in patients with panic disorder (Gallagher et al., 2013), demonstrate the relevance of specific physical sensitivity in predicting outcomes. To our knowledge, however, there is not yet a longitudinal study demonstrating the vulnerability of lower-order AS dimensions on the onset of panic disorder specifically. In accordance with the findings reported by the aforementioned cross-sectional research, we hypothesize that the physical concerns dimension alone will present as a vulnerability dimension for the development of panic disorder symptoms over time.

In terms of the predictive validity of the ASI, we were also interested to determine the degree of accuracy with which the ASI can predict panic disorder symptoms over time. To do so, we calculated accuracy indices: sensitivity, specificity, and positive and negative predictive values. In order to test the vulnerability of high AS on psychopathology, numerous studies have used a categorical approach, allocating participants into high and low AS groups according to different cut-off scores. While some researchers have used median as a cut-off score (e.g., Fluharty, Attwood, & Munafò, 2016), others have divided their samples into terciles (Donnell & McNally, 1990) or quartiles (e.g., Schmidt et al., 1997). Still others have used the mean plus or minus one standard deviation for dividing subjects into high and low AS groups, respectively (Kashdan, Zvolensky, & McLeish, 2008; Schmidt et al., 1997). Maller and Reiss (1992) used a cut-off score of 23 on the ASI to define the high AS group but provided no statistical explanation. According to the mean results of a clinical population, Peterson and Plehn (1999) suggested that the cut-off score on the ASI for anxiety problems should be 25 and for panic disorder 30, although this was never statistically tested.

In light of these insufficient and inconsistent results, further exploration of the role of AS and its dimensions in the prospective prediction of the emergence of panic disorder (when controlling for trait anxiety) is still needed. Therefore, the aim of this study was to examine the predictive validity of AS on the onset of panic disorder when controlling for trait anxiety. In addition, it aimed to explore which of the three AS dimensions presents as a vulnerability factor for the development of panic disorder over time. By using an optimal cut-off score, we also aimed to examine the accuracy of the ASI in detecting those at risk for developing panic disorder over a three-year period. To do so, we conducted a prospective study in which participants without a history of mental and physical disorders were initially asked about AS and trait anxiety (Time 1) and, three years later, were asked about the onset of panic disorder symptoms (Time 2). We expected that AS would be a significant predictor of the development of panic disorder symptoms when controlling for trait anxiety and that the physical concerns dimension would represent the largest contribution to the onset of panic disorder symptoms.

## Materials and method

### Participants

The study sample consisted of 423 female and 98 male students aged between 19 and 35 years at Time 1 ( $M_{\text{female}} = 21.2$ ;  $SD_{\text{female}} = 1.62$ ;  $M_{\text{male}} = 21.0$ ;  $SD_{\text{male}} = 1.86$ ). Data on other demographic characteristics were collected since statistical reports imply high demographic homogeneity (Croatian Bureau of Statistics, 2013). The population in Croatia is predominantly (90.45%) Croatian nationality, (86.28%) Catholics, Whites and students are mostly not married and without children, living in the capital of Croatia.

## Instruments

The ASI (Reiss et al., 1986) is a self-report measure of fear of different anxiety symptoms. On a 4-point scale (where 0 is very little and 4 is very much), subjects indicate the degree of aversion to different anxiety symptoms described in 16 items. The total score is the sum of scores on individual items and ranges between 0 and 64. The scale consists of three lower-order factors: physical concerns, psychological concerns and social concerns. The physical concerns subscale includes 8 items (4, 6, 7, 8, 9, 10, 11 and 14) and refers to the fear of physical symptoms related to anxiety (e.g., "It scares me when my heart beats rapidly"). The psychological concerns subscale contains six items (2, 3, 12, 13, 15 and 16) relating to the fear of mental manifestations of anxiety (e.g., "When I am nervous, I worry that I might be mentally ill"). Finally, the social concerns subscale consists of 2 items (1 and 5) referring to the fear of publicly observable anxiety symptoms (e.g., "It is important to me not to appear nervous."). Internal consistency coefficients for total ASI, physical, psychological and social concerns subscales were .89, .86, .80 and .45, respectively and inter-scale correlations were  $r_{\text{physical-psychological}} = .56, p < .01$ ;  $r_{\text{physical-social}} = .14, p < .01$ ;  $r_{\text{psychological-social}} = .17, p < .01$ . In this study, participants completed the translated and validated Croatian version of the ASI (Jurin et al., 2012).

The State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1999) was developed for the assessment of two related but logically different constructs, trait and state anxiety. Because the present research was primarily interested in more stable differences in anxiety, only the subscale for trait anxiety was used. This scale consists of 20 statements in which respondents evaluate their general level of anxiety on a 4-point scale (1 – never to 4 – always). In this study, the scale demonstrated high reliability ( $\alpha = .94$ ).

Panic disorder symptoms were self-assessed using the DSM-5 diagnostic criteria for panic disorder (American Psychiatric Association, 2013). Participant responses regarding each diagnostic criteria were coded in a binary fashion to indicate the presence or absence of each criterion. The criteria were: (1) presence of panic attacks (five or more panic attacks in the past three years = 1; less than five panic attacks = 0); (2) frequency of panic attacks (1 = at least several times a month; 0 = once a month or less); (3) number of symptoms of panic attacks (1 = four or more; 0 = less than four); (4) fear of new panic attacks (1 = yes, 0 = no); (5) substance abuse related to the experience of panic attacks (1 = no substance abuse related to panic attacks; 0 = substance abuse related to panic attacks). Participants needed to meet all five criteria (coded as 1) in order to be classified as having panic disorder symptoms. Participants who did not meet one or more of the panic disorder criteria were coded as 0.

## Procedure

The study was conducted at two time points with an interval of three years. The first phase was conducted in March 2011 with a convenience sample of  $N = 1189$  students at the Faculty of Humanities and Social Sciences in Zagreb. Using a paper and pencil method, participants completed the ASI and STAI-T and provided information about their gender, age and the presence of self-assessed psychological disorders ("Do you have any psychological disorder/s? If yes, state which one.") and chronic physical illnesses ("Do you have any chronic physical illness/es? If yes, state which one."). Participants who reported a psychological disorder and/or a chronic physical illness ( $n = 103$ ; 8.7%) were excluded from the study. Participants were asked to provide contact information (e-mail address) if they were willing to be contacted again for future research. The second phase of data collection (Time 2) was conducted in June 2014. Here, individuals who took part in the initial phase of the study were sent an e-mail invitation to participate in a survey hosted at a commercial site specializing in online research. To link the repeated measures, participants were asked to again provide their e-mail address. While a total of 572 students decided to participate in this second phase (48% drop out), only 521 (423 women and 98 men) completed the list of diagnostic criteria for self-assessed panic disorder. This research was approved by an Ethics Committee of the Department of Psychology at the Faculty of Humanities and Social Sciences.

## Plan of analysis

All statistical analysis was conducted using SPSS, version 20.0. After presenting descriptive data, the final sample ( $N = 521$ ) was compared to the drop-out sample ( $N = 566$ ) on all relevant independent variables (STAI-T, ASI, gender) by using logistic regression analysis. Multiple imputation analysis was performed for handling missing data related to the outcome variable (panic disorder symptoms). All variables included in the regression model were included in the multiple imputation process, in addition to age as an auxiliary variable. In order to improve the power of analysis, the number of imputations used was  $m = 100$  (Graham, Olchowski, & Gilreath, 2007; Schlomer, Bauman, & Card, 2010). Namely, all analyses were conducted 100 times and the results presented represent the average across the 100 estimations. This was followed by two logistic regression analyses; the first aimed to test the predictive validity of the ASI for panic disorder symptoms when controlling for gender and STAI-T, while the second analysis aimed to test the predictability of the three ASI dimensions for the onset of panic disorder symptoms. For further predictive validity analysis of the ASI, a Receiver Operating Characteristics (ROC) analysis was conducted for the optimal cut-off score, which was selected based on the highest achieved sum of sensitivity and specificity. Positive and negative predictive values were also calculated. However, this analysis was performed on the observed data.

## Results

### Preliminary and descriptive analyses

To ensure that the final sample ( $N = 521$ ) is comparable to the drop out sample, we conducted a logistic regression analysis. Results show that AS (OR = 0.997, 95% CI [0.983, 1.012],  $p > .05$ ; ( $M_{\text{final}} = 21.63$ ,  $SD = 9.20$  and  $M_{\text{drop-out}} = 21.53$ ,  $SD = 9.42$ ) and Trait anxiety (OR = 0.998, 95% CI [0.983, 1.012] 0.983–1.012,  $p > .05$ ;  $M_{\text{final}} = 43.29$ ,  $SD = 9.38$  and  $M_{\text{drop-out}} = 43.37$ ,  $SD = 9.28$ ) are not significant predictors of (final or drop out) group belonging. In other words, participant from final sample did not statistically significantly differ from those who drop out after first research wave on both variables. Only gender was significant predictor of group membership (OR = 0.611, 95% CI [0.460, 0.813],  $p < .001$ ). Compared to 23% of male participants in the final sample there was slightly more men (29%) in the drop out sample.

Results presented in Table 1 indicate that 11% ( $n = 46$ ) of female and 10.2% ( $n = 10$ ) of male students with no history of psychological disorders at Time 1 experienced symptoms of panic disorder over the subsequent three year period. Mean values of AS and trait anxiety measures in the group without panic disorder symptoms were similar to those obtained in a non-clinical Croatian sample of 580 females ( $M_{\text{ASI}} = 20.7$ ,  $SD_{\text{ASI}} = 10.45$ ;  $M_{\text{STAI-T}} = 39.9$ ,  $SD_{\text{STAI-T}} = 9.53$ ) and 404 males ( $M_{\text{ASI}} = 17.7$ ,  $SD_{\text{ASI}} = 9.12$ ;  $M_{\text{STAI-T}} = 37.7$ ,  $SD_{\text{STAI-T}} = 8.16$ ) (Jurin et al., 2012) as to ASI norms (Peterson & Reiss, 1992). However, the ASI results for the group with panic disorder symptoms are notably lower than those reported in previous meta-analysis ( $M = 36.41$ ; with 95% CI [35.95, 36.88];  $N = 2246$ ) (Naragon-Gainey, 2010). Female participants with panic disorder symptoms scored higher on the

**Table 1.** Descriptive statistics and statistical differences of AS and trait anxiety among females and males with and without panic disorder symptoms on the observed data.

	Gender	Onset of panic disorder symptoms	<i>N</i>	<i>M</i>	<i>SD</i>	<i>t</i> -test (Cohen's <i>d</i> )
ASI	female	yes	46	27.9	8.73	4.25** (0.67)
		no	377	21.9	9.00	
	male	yes	10	20.7	6.80	1.36
		no	88	17.5	7.17	
STAI-T	female	yes	46	48.9	10.81	3.99** (0.47)
		no	376	43.2	8.81	
	male	yes	10	40.2	8.21	1.83
		no	88	45.3	9.02	

Note: ASI, Anxiety Sensitivity Index; STAI-T, State Trait Anxiety Inventory- Trait.

\*\* $p < .001$ .

ASI (moderate to large effect size) and STAI-T (moderate effect size) in comparison with those without panic disorder symptoms. Amongst males, no statistically significant differences in ASI and STAI-T levels were found between those with and without symptoms of panic disorder. Correlations between predictors were moderate ( $r_{\text{males}} = .50$ ;  $p < .001$ ;  $r_{\text{females}} = .51$ ;  $p < .001$ ).

### Predicting panic disorders at 3-year follow-up

Logistic regression analysis demonstrates that AS is a significant predictor of the onset of panic disorder symptoms when controlling for gender and trait anxiety (Table 2). With each increase in ASI score, the risk for developing symptoms of panic disorder increases 1.52 times. In other words, a 6-point difference in the ASI scores observed between groups with and without panic disorder symptoms would be expected to make the group with a higher result on the ASI 9.1 times more vulnerable to developing panic disorder symptoms over the next three years.

Logistic regression analysis also demonstrated that only the physical concerns dimension of AS significantly predicted the onset of panic disorder symptoms over time (Table 2). The odds ratio indicates that students' risk for developing panic disorder symptoms is 1.36 times higher with every single-point increase on the physical concerns subscale.

### ROC analysis

A ROC analysis was also conducted in order to determine the predictive validity of the ASI. Here, there was a statistically significant difference from the area under the curve (AUC) with an AUC value of 0.68. The optimal balance between sensitivity (67%) and specificity (65%) was achieved for a cutoff score of 25 on the ASI. These results present only poor to moderate ASI accuracy for discriminating between those that will develop panic disorder symptoms from those that will not experience any panic disorder symptoms over the next three years. The positive predictive value (or the probability that high AS subjects with an ASI score  $\geq 25$  will develop panic disorder symptoms over time) was 58% and the negative predictive value (the probability that low AS subjects with an ASI score  $< 25$  will not develop panic disorder symptoms over time) was 66%. While both predictive values are low, they do indicate that it is possible to predict panic disorder symptoms using this categorization better than by chance. Using this cut-off score, 17% of high AS individuals ( $n = 32$ ) developed panic disorder symptoms over time in comparison to 7% ( $n = 23$ ) of individuals in the low AS group.

### Discussion

Using a prospective methodology, the current study replicated and extended existing research examining AS as a risk factor for the development of panic disorder symptoms. The findings presented

**Table 2.** AS as a predictor of panic disorder symptoms when controlling for gender and trait anxiety and AS dimensions as predictors of panic disorder symptoms using multiple imputations.

	OR	95% CI
Model 1, Global ASI		
Gender	1.61	0.81, 3.24
ASI	1.52*	1.13, 2.04
STAI-T	1.45*	1.07, 1.96
Model 2, ASI Subscales		
Gender	1.49	0.75, 2.97
physical concerns	1.41*	1.05, 1.76
psychological concerns	1.33	0.97, 1.82
social concerns	1.15	0.89, 1.49

Note: OR, odds ratio, CI, Confident Interval.

\* $p < .05$ . Gender was coded 1 for men and 2 for women, The dependent variable in this analysis is panic disorder symptoms coded so that 0 = don't have a panic disorder symptoms and 1 = have a panic disorder symptoms.

here support existing findings indicating that AS is a risk factor for anxiety pathology (Cox et al., 2008; Maller & Reiss, 1992; Schmidt et al., 1997, 1999, 2007, 2010) and for panic disorder symptoms in particular. As theorized, the results suggest that individuals exhibiting high AS perceive various symptoms of anxiety as a sign of imminent personal harm and, as a result, experience elevated levels of anxiety. In addition, they are at increased risk for experiencing repeated panic attacks and developing more severe pathological deviations defined as panic disorder symptoms. Together, these findings suggest this cognitive trait to be more relevant from a clinical perspective than it previously seemed. The odds ratio of 1.52 for panic disorder symptoms was similar but somewhat lower to that achieved in previous research for anxiety disorders (1.9) (Schmidt et al., 2006) and panic attacks (2.0 or 2.6) (Schmidt et al., 1999, 2006).

In the present study, trait anxiety was evaluated in light of the ongoing debate regarding the distinctiveness of AS and trait anxiety (Lilienfeld, 1995; McNally, 1989) and ambiguous prospective results. The present study confirmed that, when controlling for gender, students who have an intensive fear of anxiety symptoms belong to an at-risk group for the onset of panic disorder symptoms regardless of their proneness to experience anxiety. While this contradicts the results of Plehn and Peterson (2002), it is largely consistent with studies indicating that AS, but not trait anxiety, was a significant predictor of the incidence of anxiety disorders, panic disorder and panic attacks (Maller & Reiss, 1992; Schmidt et al., 1997, 1999, 2006). However, in the current study, we found both AS and trait anxiety to be significant predictors of panic disorder symptoms. In light of the fact that AS and trait anxiety are moderately related constructs ( $r = 0.5$ ), these results indicate that their contribution to the occurrence of panic disorder symptoms stems from a common but also unique part of the variance of both of these personality traits. Furthermore, their independent contribution to panic disorder symptoms supports the notion that AS and trait anxiety are different constructs. Also, it would be important to assess other personality dimensions like neuroticism and extraversion and other vulnerability factors such as perceived control in order to obtain a clear comprehension about the specific role of AS when controlling other vulnerability factors.

Subscale level analysis revealed that physical concerns was the only AS dimension predicting the occurrence of panic disorder symptoms over a three-year period in a non-clinical sample with no history of mental disorders. Specifically, students who feared that anxiety symptoms would lead to catastrophic physical consequences, but not to embarrassment or madness, belonged to a group at risk for the development of panic disorder symptoms over the next three years. These findings are consistent with those of cross-sectional studies demonstrating that the fear of physical symptoms has the strongest association with anxiety symptoms and panic disorder (Naragon-Gainey, 2010). It is similarly with the results of a longitudinal study demonstrating that the physical concerns dimension was the only predictor of the course of panic disorder in a clinical sample (Pérez Benítez et al., 2009). Prospective research with non-clinical populations predominantly indicates that, in addition to physical concerns, psychological concerns are a relevant predictor of the onset of panic attack. This difference across subscales in the prediction of the onset of panic and the onset of panic disorder symptoms adds to existing knowledge concerning the specific sensitivities of the ASI in the psychopathogenesis of anxiety (Naragon-Gainey, 2010). However, given the poor psychometric characteristics of the social concerns subscale, subscale prediction of panic disorder symptoms should be interpreted prudently. The optimal cut-off score of 25 on the ASI was determined to produce the highest sum of sensitivity and specificity ( $AUC = 0.68$ ). Categorization according to this cut-off score indicates poor to moderate ability of the ASI to distinguish between individuals who will and who will not develop panic disorder symptoms. Results also suggest that there is 58% chance that high AS individuals will develop panic disorder symptoms and a 66% chance that low AS subjects will not develop such symptoms. Although this cut-off score is the same as that proposed by Peterson and Plehn (1999), use of this score does not provide enough accuracy for the detection of individuals who will develop panic disorder symptoms over the next three years. Instead, the accuracy in terms of the ROC curve ( $AUC$ ) should be

higher than 0.7 (Šimundić, 2009), which would increase the potential of the ASI to recognize subjects that will develop panic disorder symptoms. As such, we might conclude that a high score on the ASI is not a diagnostic marker of future panic disorder symptoms. However, the result indicating that 17% participants in the high AS group developed panic disorder symptoms over time while only 7% in the low AS group developed such symptoms supports the argument that AS is a risk factor for developing panic disorder symptoms over time. In consideration of the fact that the ASI is a measure of a personality trait and was not conceptualized nor designed as a diagnostic or triage instrument, the results presented here are not surprising. Indeed, they suggest that the ASI should be used in combination with other measures of vulnerability traits in order to better explain the variance in the onset of panic disorder.

### **Limitations**

The present findings must be considered in light of few limitations. Firstly, the research was conducted using a non-clinical convenience sample made up of male and female university students. As such, it offers limited generalization to different age and educational level groups. In addition, the number of females in the sample is significantly greater than the number of male participants. In light of the well-established gender differences in AS levels (Telch, Lucas, & Nelson, 1989), future research should consider conducting separate analyses for men and women. Secondly, the small size of the group experiencing panic disorder symptoms limited the statistical power of the reported analysis. Although the results at the subscale level are consistent with previous studies, interpretation of the predictability of social concerns dimension for panic disorder symptoms should be made very tentatively due to the weak psychometric characteristics of this subscale. In this study, we used self-reported estimations of the DSM-5 diagnostic criteria for panic disorder to measure this variable (American Psychiatric Association, 2013). Although Schmidt et al. (1999) argue that self-reported criteria have been shown to be just somewhat less reliable than structured interviews to diagnose a panic disorder, use of a gold standard for diagnosing panic disorder, such as the Structured Clinical Interview for DSM-5 or The Mini International Neuropsychiatric Interview, would have been more ideal. Finally, a further limitation is posed by the fact that the presence of mental disorder among participants at baseline was assessed using only one question. Instead, clinical interview should have been implemented at both time points in order to exclude subjects with mental disorders at Time 1 and to exclude those with comorbid diagnosis at Time 2.

### **Conclusion**

The current study contributes to our current understanding of AS as a prospective risk factor for panic disorder symptoms in young adults, regardless of trait anxiety. The role of specific personality traits as well as even more specific sub-factors on psychopathogenesis seem to be of great importance and should be further explored. This study, conducted in a country representing a non-Western society, also contributes to establishing the cross-cultural reliability of these findings. Future studies should consider a cross-lagged design in order to determine whether panic disorder influences AS or AS influences panic disorders, or whether this influence occurs in both directions. Furthermore, in light of research demonstrating the effectiveness of cognitive-behavioral interventions for reducing AS (Gallagher et al., 2013) and lowering the risk of developing a panic disorder over a 6 month period among individuals with history of a single panic attack (Gardenswartz & Craske, 2001), it would be interesting to prospectively investigate whether reducing AS similarly reduces the risk for developing panic disorder symptoms over a longer period of time.

### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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