Article

JHP

Journal of Health Psychology
2023, Vol. 28(3) 216–229

DOI: 10.1177/13591053221106129
journals.sagepub.com/home/hpq
SAGE

The Pandemic Anxiety Inventory: A validation study

Irvin Sam Schonfeld[1], Tasmyn Prytherch[2], Mark Cropley[2] and Renzo Bianchi[3]

Abstract

The Pandemic Anxiety Inventory (PAI) assesses anxiety symptoms individuals attribute to the presence of a pandemic. We conducted this study of 379 British adults during the COVID-19 pandemic and found that the PAI exhibited excellent reliability and solid criterion validity. Pandemic anxiety was associated with reduced social support, anticipated life changes, financial strain, job loss, economic insecurity, and the hospitalization or death of a close friend or relative. Using correlational and bifactor analyses, we found that the PAI demonstrated solid convergent and discriminant validity. The findings suggest that the PAI can be used in research and clinical practice.

Keywords

construct validity, COVID-19, criterion validity, exploratory structural equation modeling bifactor analysis, Pandemic Anxiety Inventory

In December 2019, an outbreak of SARS-CoV-2, also known as COVID-19, occurred in China and soon spread around the world. By January 17, 2022, health authorities in the United Kingdom reported almost 152,000 deaths from COVID and more than 15,300,000 cases worldwide (GOV.UK, 2022). Also on January 17, 2022, the Centers for Disease Control and Prevention (2022) reported that there had been almost 850,000 COVID-related deaths in the United States and more than 65,000,000 cases.

Research has identified several psychological sequelae of the COVID pandemic and related public health policies (e.g. lockdowns). Notably, the pandemic has been associated with elevated levels of depressive symptoms (Targa et al., 2021), fatigue (Goërtz et al., 2020; Michel et al., 2021), sleep disturbance

[1]The City College and the Graduate Center of the City University of New York, USA
[2]University of Surrey, UK
[3]University of Neuchâtel, Switzerland

Corresponding author:
Irvin Sam Schonfeld, Department of Psychology, The City College and the Graduate Center of the City University of New York, 160 Convent Ave., New York, NY 10031, USA.
Email: ischonfeld@ccny.cuny.edu.

(Wang et al., 2021), reduced life satisfaction (Mei et al., 2022), and excessive alcohol consumption (Tudehope et al., 2021).

The focal concern of this paper is a different set of psychological symptoms, pandemic-related anxiety symptoms. Anxiety can influence behaviors that impede or accelerate the spread of a virus (Taylor et al., 2020). It is therefore important to develop a measure of pandemic-related anxiety. Our aim was to examine the validity of the recently developed Pandemic Anxiety Inventory (PAI). Anxiety is initially a normal psychological response to threat. COVID-19 has been a threat of such great magnitude that it is likely that levels of anxiety in the general population have increased substantially. People have learned that friends and loved ones have gotten sick and gone to hospitals for intensive care. Others have died. The COVID pandemic has led to economic dislocation and financial hardship. Travel to see friends and relatives has been curtailed. Those sickened and people exposed to them have had to quarantine. There is considerable evidence that COVID-19 is related to increased levels of anxiety (Li et al., 2021; Myran et al., 2022; Santabárbara et al., 2021; Xiao et al., 2020).

Existing measures of COVID-related anxiety and the PAI

For research and practice, it would be helpful to have an instrument assessing the extent to which individuals experience anxiety symptoms that they expressly attribute to the pandemic. The Coronavirus Anxiety Scale (CAS), which was developed by Lee (2020) and Lee et al. (2020a, 2020b, 2021), assesses anxiety related to the COVID-19 pandemic. Two other psychological symptom scales that were developed in response to the COVID-19 pandemic are the COVID Stress Scales (CSS; Taylor et al., 2020) and the Fear of COVID-19 Scale (FCV-19S; Ahorsu et al., 2020; Giordani et al., 2022; Sawicki et al., 2022).

The newer PAI differs from existing COVID-related instruments in several ways. The PAI is directed at assessing anxiety symptoms that develop in the context of *any* pandemic, not just the COVID-19 pandemic; the CAS is not. Because pandemics reoccur (Samarasekera, 2021), it is important to have such an instrument available. The CSS was developed to be easily adjusted to work in the context of future pandemics (Taylor et al., 2020).

The CAS covers five anxiety symptoms an individual may experience when exposed to information about the coronavirus. The CSS comprises 36, mostly "worry" items. Given the CSS's length, the instrument can be burdensome to respondents. In contrast to the CAS and the CSS, the PAI and the FCV-19S are in-between, limited to 10 and 7 symptom items, respectively, although the PAI includes two complementary items. The PAI contrasts with the CAS, CSS, and FCV-19S in that the PAI's items are derived directly from the symptoms of generalized anxiety disorder (GAD) found in the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (*DSM-5*; American Psychiatric Association, 2013). We selected these symptoms for two reasons. First, everyone sometimes experiences anxiety; our concern is for anxiety that is excessive. Second, GAD, which is common in high-income countries like the UK and US, is comorbid with other anxiety disorders and mood disorders, interferes with management of home and work life, and adversely affects close relationships (Ruscio et al., 2017). The PAI has a little overlap with symptoms on the other scales. For example, the PAI and the CAS overlap on one symptom, sleep difficulties. The overlap with other COVID-related worry/anxiety scales is limited. The PAI includes symptoms of excessive anxiety, difficulty controlling worry, restlessness, fatigue, cognitive impairment, irritability, muscle tension, and sleep difficulties.

Based on the *DSM-5*, we also included in the PAI two items that complement the symptom items. One complementary item asks the respondent about the extent to which anxiety symptoms affect the individual's functioning. The other complementary item asks about major life changes respondents may be

considering in response to anxiety symptoms they experienced. These items can help a clinician better understand the individual in care.

Hypotheses

We developed several hypotheses bearing on the validity of the PAI. Noting that social support is inversely related to anxiety in many facets of life (Asselmann et al., 2020; Gonzalez-Saenz de Tejada et al., 2017), including COVID-linked anxiety (Gonzalez-Saenz de Tejada et al., 2017; Khoury et al., 2021; Labrague and Santos, 2020; Rückholdt et al., 2021), we hypothesized that scores on the PAI would be inversely related to support. Other criterion-related hypotheses were also based on the anxiety literature. We hypothesized that the PAI would be negatively related to the male sex (García-Fernández et al., 2021), age (Solomou and Constantinidou, 2020; Wittenborn et al., 2020), and financial resources (Racine et al., 2021; Rudenstine et al., 2021). We also hypothesized that the PAI would be associated with COVID-related and non-COVID-related traumatic stress (Lahav, 2020; Masiero et al., 2020) and sleep problems (Jahrami et al., 2021; Wang et al., 2021). From the standpoint of a desire to damper disease-related anxiety, we anticipated that those with higher levels of pandemic-related anxiety would be more likely to consider major life changes (Ferreira et al., 2021; Hedman et al., 2016). In addition, we hypothesized that pandemic-related anxiety symptoms would be related to participants' subjective estimates of how widespread the disease was in their localities.

The methods used to evaluate the PAI in the present study contrast with previous methods used to assess COVID-related anxiety. For example, we assessed the PAI's reliability with McDonald's (1999) omega, a more sophisticated approach to assessing reliability than Cronbach's alpha. We evaluated the question of the unidimensionality of the PAI using confirmatory factor analysis (CFA). As for convergent validity, we anticipated that the PAI would correlate highly with measures of cause-neutral anxiety, everyday functioning, and stress symptoms. We further assessed the PAI's convergent validity, along with discriminant validity, by conducting an exploratory structural equation modeling (ESEM) bifactor analysis (Rodriguez et al., 2016) with a partially specified target rotation (PSTR; Marsh et al., 2014). Two hypotheses regarding convergent and discriminant validity were evaluated vis-à-vis cause-neutral anxiety symptoms. Regarding convergent validity, we hypothesized that the PAI symptom items and cause-neutral anxiety symptom items would load highly on a general factor. Regarding discriminant validity, we hypothesized that, because PAI items assess pandemic-linked anxiety and the cause-neutral items assess anxiety more generally, the PAI and cause-neutral items would load highly ($\geqslant$0.30) on separate bifactors (specific factors). A similar procedure was employed in assessing the convergent and discriminant validity of the recently developed Occupational Depression Inventory (Bianchi and Schonfeld, 2020).

Methods

Participants

A total of 424 individuals were recruited. Eligibility criteria included living in the United Kingdom and being 18 years of age or older. We excluded 28 individuals who did not respond to any of the PAI items, the focal interest of the study. Another nine individuals were excluded because they answered affirmatively to an item asking if they responded randomly to the survey items. An additional eight individuals who failed to respond to the item asking about random responding were excluded.

The final number of participants was 379 (M_{age}=33.21, SD_{age}=12.24) of whom 257 (67.8%) were women and 119 (31.4%) were men; 3 (0.8%) participants did not identify their gender. A total of 319 (84.2%) were White and 60 (15.8%) were Non-White. The median income of the sample was £50,000–£54,000 (the interquartile range was £30,000–£34,000 to £70,000–£74,000). One

hundred eighty respondents (47.5%) were not married or in a relationship and 199 (52.5%) were. Only 3% of the sample did not have at least some college or university training.

Data collection took place online from May to August 2021. Recruitment advertisements detailing study aims and eligibility criteria were publicized on social networking sites (e.g. Facebook, LinkedIn). Qualtrics© XM (Qualtrics, Provo UT, 2020) hosted the survey. An electronic link directed participants to read an information sheet and a consent form. They were asked to provide consent by selecting "I agree to all the above statements (e.g. being age 18 or older) and consent to participate in this research study." After providing consent, participants were directed to complete the questionnaire. Internet surveys are as reliable and valid paper-and-pencil measures (Gosling and Mason, 2015). The study was approved by the human subjects committee at the University of Surrey.

PAI

Two of the authors (ISS and RB) developed the items for the PAI. The items were rationally based on the symptoms described in *DSM-5* for generalized anxiety disorder (American Psychiatric Association, 2013). Respondents were asked to report on symptoms they experienced over the course of the last month ($M = 1.731$; SD = 0.601; Cronbach's alpha = 0.924). Unlike most standard anxiety measures, which present symptom items in a "cause-neutral" manner (e.g. the Hospital Anxiety and Depression Scale), the items in the PAI are worded in such a way as to ask participants if they attribute any symptom to the pandemic (e.g. I felt nervous or anxious or on edge because of the pandemic).[1] Items are rated on a 4-point scale, from 0 ("Never or almost never") to 3 ("Nearly every day"). Participants were instructed to check 0 if they experienced a symptom for a reason they considered unrelated to the pandemic (e.g. relationship problems) or for a reason they could not identify. The items were recoded to range from 1 to 4.

The PAI concludes with two complementary items. One item asks the participant to respond "No," "Yes," or "I don't know" to a question about having considered making major life changes in response to the symptoms mentioned in the main part of the scale. The second item asks respondents to rate the extent to which the symptoms affected their everyday functioning. The response alternatives range from 1 for "Not at all" to 5 for "Very strongly." The PAI can be found in the Supplemental Material.

Three items assessing cause-neutral anxiety

The survey included three cause-neutral anxiety items ($M = 1.792$; SD = 0.623; Cronbach's alpha = 0.796). Two items (e.g. "I found myself becoming agitated") came from the Depression, Anxiety & Stress Scales (Antony et al., 1998; Lovibond and Lovibond, 1995). The third, "I dreaded things I had to do," was a slight variation of an item from Goldberg's (1972) 140-item General Health Questionnaire. The items were worded with a minimum of overlap with the wording of the PAI items. The response alternatives ranged from "Did not apply to me" (1) to "Applied to me very much or most of the time" (4).

Social support

To assess social support, we used Schonfeld's (2001) 8-item abridged version of Cohen et al.'s (1983) Interpersonal Support List (e.g. "When I have some free time, I often meet or talk on the telephone or the Internet with friends"). Items were scored from "Definitely true" (1) to "Definitely false" (4). One item, "If I needed a lift very early in the morning, I would have a hard time finding someone to take me," was reverse scored. We made a slight change from dollars to pounds in an item that asked about having a friend who, in an emergency, could provide the respondent a loan. The scale assesses perceived support rather than received support. A problem with measures of received support is

that such measures are confounded with the incidence of stressors (Schonfeld, 1991). Finally, we recoded the entire scale such that higher scores represented more support ($M = 3.227$; SD = 0.485; Cronbach's alpha = 0.786).

Stress

We assessed (with slight changes in punctuation) symptoms of stress using Elo et al.'s (2003) validated single-item scale ($M = 2.760$; SD = 1.040). The item reads as follows: "Stress means a situation in which a person feels tense, restless, nervous, or anxious, or is unable to sleep at night because his or her mind is troubled all the time. Do you feel this kind of stress these days?" The response alternatives on this Likert scale ranged from "Not at all" (1) to "Very much" (5).

COVID-related questions

To better understand participants' experience of the COVID-19 pandemic, we presented a series of mostly Yes-No questions to the participants. The questions concerned whether the individual had the disease, was hospitalized for the disease (only five were, too few for analyses), had been vaccinated against COVID-19, whether a close friend or relative had the disease or had been hospitalized with COVID-19, whether a close friend or relative died from COVID-19, or experienced any other type of trauma. In addition, the participants were asked to provide their own estimate of how widespread COVID-19 was in the area in which they lived. Response choices ranged from "Not widespread at all" (1) to "Very widespread" (4).

Sleep and fatigue

Participants were posed two global, single-item scales. With the Sleep Quality Scale (SQS), participants rated the quality of their sleep over the past 7 days (Snyder et al., 2018). The SQS is a validated scale that ranges from "Terrible" (0) to "Excellent" (10) ($M = 5.730$; SD = 2.010). Their fatigue was assessed with Van Hooff et al.'s (2007) validated, single-item scale ("How fatigued do you currently feel?"). Response alternatives ranged from "Not at all" (1) to "Extremely" (5) ($M = 2.820$; SD = 1.100).

Other life stresses related to COVID-19

Finally, participants were asked three Yes-No questions about the personal impact of the pandemic. The questions asked if they experienced financial strain, job loss, and job insecurity.

Data analysis

To study the criterion and convergent validity of the PAI, Pearson correlation coefficients for continuous variables were calculated. For criterion validity purposes, *t*-tests and one-way ANOVAs were used to examine the relation of several categorical variables to mean scores on the PAI. We used Mplus 8.1 (Muthén and Muthén, 2018) to conduct the CFA required to calculate the PAI's omega reliability coefficient and to check model fit.

ESEM bifactor analysis (Marsh et al., 2014) was employed to evaluate the convergent and discriminant validity of the PAI symptom items vis-à-vis the three cause-neutral anxiety items. All items were treated as ordinal here and in the CFA. We employed a PSTR, with an oblique bifactor rotation, hypothesizing that items on both scales would load highly on a general anxiety factor. However, because the PAI assesses pandemic-attributed anxiety symptoms in contrast to the three cause-neutral anxiety symptoms, we specified two bifactors, one for the PAI items and the other for the cause-neutral items. We expected a degree of discriminant validity would be evident by virtue of the loadings on the bifactors. Bifactors are orthogonal to the general factor.

Results

Table 1 presents the correlations involving the PAI and other continuous measures. The table indicates that the PAI was highly related to the three-item, cause-neutral anxiety scale; the

stress symptoms measure; and the measure of everyday functioning. The PAI was also related to reduced sleep quality and increased fatigue. Older individuals and individuals with greater financial resources tended to experience lower levels of pandemic-related anxiety symptoms. As shown in the note under Table 1, the correlation of the PAI with either sleep quality or fatigue was barely affected when either a sleep item or a fatigue item was deleted from the PAI scale score.

Table 2 displays *t*-test findings bearing on binary categorical variables as well as the relevant effect sizes (a rule-of-thumb with Cohen's *d* suggests that $d = 0.20$ represents a small effect, $d = 0.50$, a medium effect; and $d = 0.80$, a large effect). The table indicates that women had a higher mean PAI than men, with a medium effect size. Individuals who were neither married nor in a relationship had a marginally higher mean PAI than their counterparts who were married or in a relationship. Racial differences in mean PAI were not significant. The mean PAI was highly related to the individual considering major life changes; the effect size was commensurately large. Mean PAI was significantly related to financial strain, job insecurity, and losing one's job; effect sizes were medium. Having had COVID was not significantly related to a higher mean PAI score.

Although having a close friend or relative with COVID was not significantly related to an elevated mean PAI, having a close friend or relative who was hospitalized with COVID or having a close friend or relative who died from COVID was related to an elevated mean PAI, with effect sizes ranging from small to large. In addition, individuals who experienced other types of trauma also showed a significantly higher mean PAI, with a small-to-medium effect size. These other types of trauma included being unable to see relatives living a distance away, breakup of a relationship, bereavements, diagnosis with a serious disease other than COVID (e.g. cancer), death of a close friend or relative, etc.

We also found that mean scores on the PAI were related to how widespread the participant

Table 1. Correlations among pandemic anxiety inventory and other continuously measured factors.

	PAI	Cause-neutral anxiety	Stress symptoms	Pandemic affected everyday functioning	Social support	Sleep quality	Fatigue	Age
Cause-neutral anxiety	0.686***							
Stress symptoms	0.526***	0.542***						
Everyday functioning	0.771***	0.611***	0.445***					
Social support	−0.201***	−0.171***	−0.052	−0.196***				
Sleep quality	−0.215***	−0.211**	−0.346***	−0.224***	0.185***			
Fatigue	0.317***	0.358***	0.495***	0.280***	−0.085t	−0.498***		
Age	−0.187**	−0.291***	−0.157**	−0.073	0.123*	−0.018	−0.063	
Income	−0.147**	−0.205***	−0.039	−0.117*	0.310***	0.100t	−0.056	0.232***

PAI is the pandemic anxiety inventory. Cause-neutral anxiety represents the scale comprising three cause-neutral anxiety items. We recalculated the PAI–Sleep Quality correlation after deleting the one sleep item from the PAI. The correlation was reduced to −0.207. We recalculated the PAI–Fatigue correlation after deleting the one fatigue item from the PAI. The correlation was 0.307.

***$p < 0.001$. **$p < 0.01$. *$p < 0.05$. $t < 0.10$.

Table 2. Mean scores of different groups on the pandemic anxiety inventory.

	n	*M*	*SD*	*ES*	*t*	*p*
Men	119	1.564	0.512	−0.402	−3.997*v*	0.001
Women	257	1.805	0.611			
Neither married nor in a relationship	180	1.794	0.597	0.198	1.931	0.06
Married or in a relationship	199	1.675	0.601			
White	319	1.712	0.610	−0.208	−1.481	*ns*
Non-White	60	1.837	0.547			
COVID did not lead to considering major life changes	259	1.572	0.502	−0.859	−6.830*v*	0.001
COVID led to considering major life changes	94	2.088	0.668			
Did not experience financial strain	314	1.680	0.556	−0.502	−3.112*v*	0.01
Experienced financial strain	65	1.982	0.740			
Job not insecure	256	1.630	0.543	−0.523	−4.202	0.001
Job insecure	75	1.944	0.654			
Did not lose job	287	1.681	0.585	−0.352	−2.366	0.02
Lost job	52	1.892	0.636			
Did not have COVID	233	1.693	0.626	−0.197	−1.584	0.12
Had COVID	91	1.811	0.543			
Friend or relative did not have COVID	87	1.706	0.603	−0.059	−0.481	*ns*
Friend or relative did have COVID	283	1.741	0.605			
Friend or relative not hospitalized with COVID	256	1.681	0.578	−0.293	−2.545	0.02
Friend or relative was hospitalized with COVID	108	1.857	0.659			
Friend or relative did not die from COVID	324	1.682	0.556	−0.660	−3.346 *v*	0.01
Friend or relative died from COVID	47	2.079	0.785			
Other trauma—No	311	1.690	0.556	−0.386	−2.409 *v*	0.02
Other trauma—Yes	68	1.922	0.752			

v indicates that, based on a test of homogeneity of variance, we did not assume equal variances in the two groups in the *t*-test. ES = effect size.

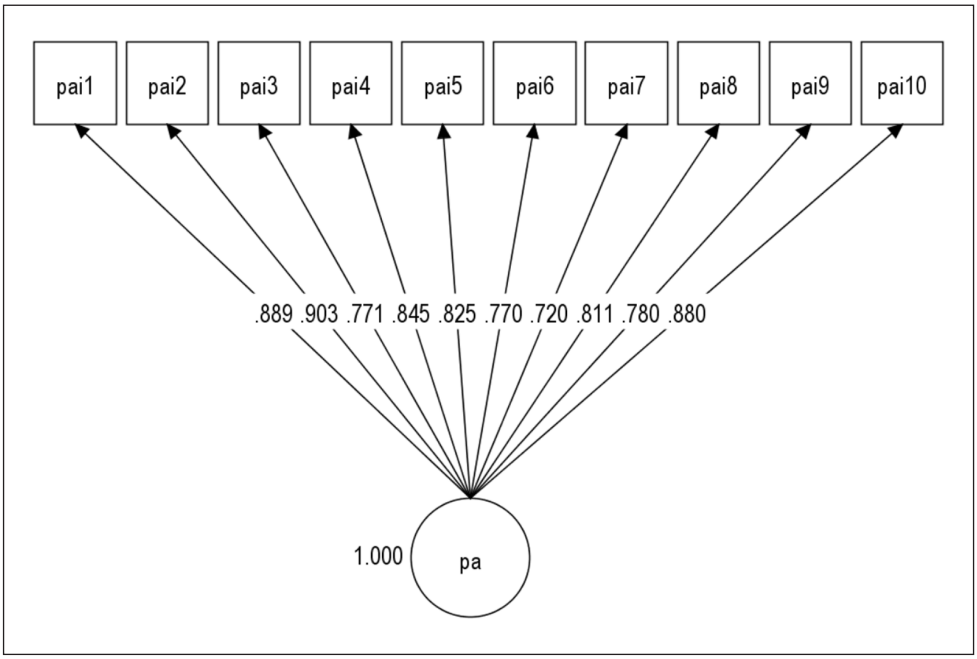

Figure 1. Standardized factor loadings of the pandemic anxiety inventory items on the latent pandemic anxiety factor.

believed the virus to be in his or her local area: Group 1 ("Not at all"), $M=1.445$ (SD=0.506, $n=60$); Group 2 ("Somewhat widespread"), $M=1.660$ (SD=0.528, $n=181$); Group 3 ("Quite widespread"), $M=1.881$ (SD=0.633, $n=93$); and Group 4 ("Very widespread"), $M=2.093$ (SD=0.687, $n=45$). The eta^2 for the widespread variable was 0.101, corresponding to a medium-to-large effect. The differences were significant, F (3, 375)=14.062, $p<0.001$. Tukey post hoc tests indicated that the means of Group 1 and 2 were significantly ($p<0.05$) different from the means of Groups 3 and 4. We, however, found no significant mean PAI differences among individuals who had gone unvaccinated ($M=1.671$, SD=0.590, $n=63$), had one vaccination ($M=1.798$, SD=0.640, $n=122$), or had two vaccinations ($M=1.709$, SD=0.579, $n=194$), F(2, 376)=1.184.

The CFA results indicate that the model fit for the 10 PAI symptom items loading on latent Pandemic Anxiety was satisfactory (RMSEA=0.074; CFI=0.990; TLI=0.988; SRMR=0.031). Figure 1 displays a diagram with the standardized loadings. Using the CFA results, the reliability of the PAI was calculated and found to be excellent, with omega equal to 0.954. The omega result implies that PAI scores correlated with the underlying factor 0.977.

For purposes of studying the convergent and discriminant validity of the PAI, we ran an ESEM bifactor analysis of the 10 PAI symptom items and the 3 cause-neutral anxiety items. Using PSTR, we modeled a general factor and two bifactors, one for the PAI items and one for the cause-neutral items. The results, which are in Table 3, show a general factor on which all items loaded highly and two bifactors on which the items on the two scales secondarily loaded and differentiated themselves (RMSEA=0.050, CFI=0.995, TLI=0.991; SRMR=0.020). More than half the PAI items loaded >0.30 on the first bifactor; all the cause-neutral items loaded >0.30 on the second.

Table 3. Loadings from the ESEM bifactor analysis with partially specified target rotation of the PAI items and the three cause-neutral anxiety items.

10 PAI and 3 cause-neutral anxiety items	General factor	Pandemic anxiety bifactor	Cause-neutral anxiety bifactor
1. Nervous/anxious	0.655	0.632	−0.009
2. Can't control worry	0.649	0.686	−0.021
3. Restless	0.736	0.267	−0.002
4. Fatigue	0.843	0.252	−0.046
5. Concentration/memory problems	0.757	0.331	0.027
6. Irritable/easily annoyed	0.774	0.175	0.081
7. Muscle tension	0.730	0.229	−0.136
8. Sleep difficulties	0.759	0.310	0.004
9. Fear something awful will happen	0.601	0.475	0.112
10. Can't relax	0.739	0.478	0.010
Dread	0.511	−0.013	0.582
Agitation	0.772	−0.162	0.496
Panic	0.635	0.212	0.526

Discussion

The general aim of the study was to examine the psychometric and structural properties of the PAI. Several findings emerged to indicate that the PAI is a valid instrument. First, the PAI, as reflected in the coefficients alpha or omega, was highly reliable. Second, regarding criterion validity, the PAI, as hypothesized, was related to fatigue, considerations for a major life change, and beliefs about how widespread the virus was in the respondent's locality. The PAI was related, in the expected direction, to social support, being female, financial strain, job insecurity, job loss, hospitalization and death of someone close, and other traumatic events (García-Fernández et al., 2021; Gonzalez-Saenz de Tejada et al., 2017; Khoury et al., 2021; Lahav, 2020; Masiero et al., 2020; Racine et al., 2021; Rückholdt et al., 2021; Rudenstine et al., 2021; Solomou and Constantinidou, 2020; Wang et al., 2021; Wittenborn et al., 2020).

Third, the PAI, as per the CFA, demonstrated high factorial validity and showed unidimensionality. Fourth, regarding convergent validity, correlational evidence indicated that the PAI had high zero-order correlations with measures of cause-neutral anxiety, everyday functioning, and stress symptoms. The ESEM bifactor analysis took a granular approach to convergent validity, demonstrating that the PAI items and cause-neutral anxiety symptom items had solidly high loadings on the general factor. The PAI and cause-neutral items, however, also showed a degree of discriminant validity with distinct patterning in their loadings on the two specified bifactors.

The PAI compares favorably with the CAS, CSS, and FCV-19S as a measure of psychological symptoms. Unlike the research on the aforementioned instruments, we examined the relationship of the pandemic-related anxiety symptoms to social support and a host of other factors; these factors included a variety of traumatic events (Masiero et al., 2020), such as the COVID-related hospitalization of a close friend or relative and death of a close friend or relative.

We examined income and job loss. Although we used different methods, our results, like that of Taylor et al. (2020), indicate that personal economic instability is related to higher pandemic-linked psychological symptoms. According to the Resolution Foundation (2021), in the UK, where the present study was conducted, the safety net during the COVID-19 pandemic was not as sturdy as the safety net in neighboring countries like France or Germany; the living standards in British households

suffered commensurately more. Our study and the study by Taylor et al. (2020) highlight the importance of having in place a financial safety net to mitigate the economic dislocation a pandemic can cause. The research on the PAI also underlines the importance of having supportive others in one's life during a pandemic. Psychological support is potentially more helpful than instrumental support (Zysberg and Zisberg, 2022).

A finding supportive of the validity of the PAI is that scores on the instrument varied with the magnitude of respondents' estimates of the extensiveness of the pandemic in their local communities. Although we were unable to assess the health authorities' more objective assessments of the prevalence of the pandemic in the respondents' localities, it would be of interest to assess the realism of local residents' subjective estimates.

Limitations

The study has at least four limitations. First, we relied on a convenience sample that is unlikely to be representative of the UK population. For instance, the sample overrepresented individuals who had some college or more education. It would be helpful to have individuals with more diverse socioeconomic backgrounds. We also recommend that the PAI be translated and studied in different national groups, including countries, regions, and localities in which the prevalence of the pandemic varies. While variations in pandemic-related anxiety among national groups are likely, measurement invariance analysis could help estimate the extent to which the PAI has a similar structure, or meaning, across such groups (see Bianchi et al., 2022). Second, the study was cross-sectional, thus preventing an assessment of test-retest reliability and temporal relationships among the variables of interest. A third limitation is that we could not learn why a small number of participants declined to identify their gender. We did not include a non-binary category, an underrepresented group. Fourth, some of our criterion variables were single-item scales. By using several single-item scales, we could cover many characteristics that multi-item scales cover at the cost of being more burdensome to respondents (Bowling, 2005). Although multi-item measures are generally desired (Fisher et al., 2016), single-item scales have greater reliability and validity than are often credited to them (Mõttus et al., 2019). For example, a single-item scale assessing self-rated health is a good indicator of overall health and predicts mortality (DeSalvo et al., 2006; Idler and Benyamini, 1997).

Conclusions

CFA and ESEM bifactor results underline the structural and psychometric validity of the PAI and its potential for use in research and clinical practice. The instrument is reliable. The results show evidence of criterion validity vis-à-vis important variables, including fatigue, consideration of a major life change, beliefs about the local prevalence of the virus, the hospitalization or death of someone close, and other traumatic events. The PAI's inverse relation to social support suggests that support can be helpful in reducing pandemic-related anxiety symptoms as long as the support is perceived to be available. The relation of pandemic-linked anxiety to financial strain, job insecurity, and job loss is also consistent with the idea that an improved economic safety net would help individuals whose financial situation has been harmed by the pandemic.

One future application of the PAI would involve a study of the relation of pandemic-linked anxiety symptoms to fluctuations in the incidence, prevalence, and mortality rates of a pandemic disease (cf. Sønderskov et al., 2021; Vistisen et al., 2022), including during the period when a disease first emerges as a pandemic threat (e.g. Ebola virus disease) and during surges and times when the incidence of a pandemic disease recedes. Given our having found that pandemic-related anxiety was related to the respondents' estimates of the prevalence of COVID-19 in their localities, it would be helpful to study PAI scores in relation to both subjective and objective estimates of

the prevalence of a pandemic in individuals' localities.

In addition to its research applications, the PAI can be used by clinicians concerned about the impact of a pandemic on the mental health of their patients. A clinician can use the PAI to identify patients with excessive levels of COVID-related anxiety, get an idea of the impact of symptoms on their daily functioning and plans for making life changes, and then help them gain a sense of control within the pandemic context (e.g. by emphasizing the usefulness of protective measures such as vaccinations). The clinician can also encourage patients to reach out to friends and family members perceived as supportive.

Authors' note

The paper is dedicated to the memory of Charles Steven (Charley) Kleinberg.

Data sharing statement

The current article is accompanied by the relevant raw data generated during and/or analysed during the study, including files detailing the analyses and either the complete database or other relevant raw data. These files are available in the Figshare repository and accessible as Supplemental Material via the SAGE Journals platform. Ethics approval, participant permissions, and all other relevant approvals were granted for this data sharing.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

Irvin Sam Schonfeld https://orcid.org/0000-0002-6182-894X
Renzo Bianchi https://orcid.org/0000-0003-2336-0407

Note

1. Having respondents make causal attributions is often seen in clinical research and practice. A diagnosis of some mental disorders (e.g. posttraumatic stress disorder and acute stress disorder) requires causal attributions (American Psychiatric Association, 2013). In national surveys (e.g. the *Stress in America*™ survey; American Psychological Association, 2015), respondents are often asked to make causal attributions regarding sources of stress. The PAI is structured in that vein.

References

Ahorsu DK, Lin C-Y, Imani V, et al. (2020) The fear of COVID-19 scale: Development and initial validation. *International Journal of Mental Health and Addiction* 20: 1537–1545.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing.

American Psychological Association (2015) *Stress in America*™*: Paying With Our Health*. Washington, DC: Author.

Antony MM, Bieling PJ, Cox BJ, et al. (1998) Psychometric properties of the 42-item and 21-item versions of the depression anxiety stress scales in clinical groups and a community sample. *Psychological Assessment* 10(2): 176–181.

Asselmann E, Kunas SL, Wittchen H-U, et al. (2020) Maternal personality, social support, and changes in depressive, anxiety, and stress symptoms during pregnancy and after delivery: A prospective-longitudinal study. *PLoS One* 15(8): e0237609.

Bianchi R, Manzano-García G, Montañés Muro P, et al. (2022) Occupational depression in a Spanish-speaking sample: Associations with cognitive performance and work-life characteristics. *Journal of Work and Organizational Psychology* 38(1): 59–74.

Bianchi R and Schonfeld IS (2020) The Occupational Depression Inventory: A new tool for clinicians and epidemiologists. *Journal of Psychosomatic Research* 138: 110249.

Bowling A (2005) Just one question: If one question works, why ask several? *Journal of Epidemiology and Community Health* 59(5): 342–345.

Carmassi, C., Pedrinelli, V., Dell'Oste, V., Bertelloni, C. A., Grossi, C., Gesi, C., Cerveri, G., & Dell'Osso, L. (2021). PTSD and Depression in Healthcare Workers in the Italian Epicenter of the COVID-19 Outbreak. *Clinical Practice and Epidemiology in Mental Health*, *17*, 242–252. doi:10.2174/1745017902117010242

Centers for Disease Control and Prevention (2022) COVID data tracker. Available at: https://COVID.cdc.gov/COVID-data-tracker/#datatracker-home (accessed 18 January 2022).

Cohen S, Kamarck T and Mermelstein R (1983) A global measure of perceived stress. *Journal of Health and Social Behavior* 24(4): 385–396.

DeSalvo KB, Bloser N, Reynolds K, et al. (2006) Mortality prediction with a single general self-rated health question. A meta-analysis. *Journal of General Internal Medicine* 21(3): 267–275.

Elo A-L, Leppänen A and Jahkola A (2003) Validity of a single-item measure of stress symptoms. *Scandinavian Journal of Work Environment & Health* 29(6): 444–451.

Ferreira FO, Lopes-Silva JB, Siquara GM, et al. (2021) Coping in the covid-19 pandemia: How different resources and strategies can be risk or protective factors to mental health in the Brazilian population. *Health Psychology and Behavioral Medicine* 9(1): 182–205.

Fisher GG, Matthews RA and Gibbons AM (2016) Developing and investigating the use of single-item measures in organizational research. *Journal of Occupational Health Psychology* 21(1): 3–23.

García-Fernández L, Romero-Ferreiro V, Padilla S, et al. (2021) Gender differences in emotional response to the COVID-19 outbreak in Spain. *Brain and Behavior* 11(1): e01934.

Giordani RCF, Zanoni da Silva M, `Muhl C, et al. (2022) Fear of COVID-19 scale: Assessing fear of the coronavirus pandemic in Brazil. *Journal of Health Psychology* 27: 901–912.

Goërtz YMJ, Van Herck M, Delbressine JM, et al. (2020) Persistent symptoms 3 months after a SARS-CoV-2 infection: The post-COVID-19 syndrome? *ERJ Open Research* 6(4): 00542–02020.

Goldberg DP (1972) *The Detection of Psychiatric Illness by Questionnaire*. London: Oxford University Press.

Gonzalez-Saenz de Tejada M, Bilbao A, Baré M, et al. (2017) Association between social support, functional status, and change in health-related quality of life and changes in anxiety and depression in colorectal cancer patients. *Psycho-oncology* 26(9): 1263–1269.

Gosling SD and Mason W (2015) Internet research in psychology. *Annual Review of Psychology* 66(1): 877–902.

GOV.UK (2022) Coronavirus (COVID-19) in the UK. Available at: https://coronavirus.data.gov.uk/ (accessed 18 January 2022).

Hedman E, Lekander M, Karshikoff B, et al. (2016) Health anxiety in a disease-avoidance framework: Investigation of anxiety, disgust and disease perception in response to sickness cues. *Journal of Abnormal Psychology* 125(7): 868–878.

Idler EL and Benyamini Y (1997) Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior* 38(1): 21–37.

Jahrami H, BaHammam AS, Bragazzi NL, et al. (2021) Sleep problems during the COVID-19 pandemic by population: A systematic review and meta-analysis. *Journal of Clinical Sleep Medicine* 17(2): 299–313.

Khoury JE, Atkinson L, Bennett T, et al. (2021) COVID-19 and mental health during pregnancy: The importance of cognitive appraisal and social support. *Journal of Affective Disorders* 282: 1161–1169.

Labrague LJ and Santos JAA (2020) COVID-19 anxiety among front-line nurses: Predictive role of organisational support, personal resilience and social support. *Journal of Nursing Management* 28(7): 1653–1661.

Lahav Y (2020) Psychological distress related to COVID-19 – The contribution of continuous traumatic stress. *Journal of Affective Disorders* 277: 129–137.

Lee S, Lee J, Yoo S, et al. (2021) The psychometric properties of the stress and anxiety to viral epidemics-6 items: A test in the U.S. general population. *Frontiers in Psychiatry* 12: 746244.

Lee SA (2020) Coronavirus anxiety scale: A brief mental health screener for COVID-19 related anxiety. *Death Studies* 44: 393–401.

Lee SA, Jobe MC, Mathis AA, et al. (2020a) Incremental validity of coronaphobia: Coronavirus anxiety explains depression, generalized anxiety, and death anxiety. *Journal of Anxiety Disorders* 74: 102268.

Lee SA, Mathis AA, Jobe MC, et al. (2020b) Clinically significant fear and anxiety of

COVID-19: A psychometric examination of the coronavirus anxiety scale. *Psychiatry Research* 290: 113112.

Li Y, Scherer N, Felix L, et al. (2021) Prevalence of depression, anxiety and post-traumatic stress disorder in health care workers during the COVID-19 pandemic: A systematic review and meta-analysis. *PLoS One* 16(3): e0246454.

Lovibond SH and Lovibond PF (1995) *Manual for the Depression Anxiety & Stress Scales*, 2nd edn. Sydney: Psychology Foundation.

Marsh HW, Morin AJ, Parker PD, et al. (2014) Exploratory structural equation modeling: An integration of the best features of exploratory and confirmatory factor analysis. *Annual Review of Clinical Psychology* 10: 85–110.

Masiero M, Mazzocco K, Harnois C, et al. (2020) From individual to social trauma: Sources of everyday trauma in Italy, the US and UK during the covid-19 pandemic. *Journal of Trauma & Dissociation* 21(5): 513–519.

McDonald RP (1999) *Test Theory: A Unified Treatment*. Mahwah, NJ: Lawrence Erlbaum Associates.

Mei S, Yuan T, Liang L, et al. (2022) Effect of family stress on life satisfaction among female workers during the COVID-19 epidemic in China: Exploring the roles of anxiety symptoms and age. *Journal of Health Psychology* 27: 1484–1497.

Michel JS, Rotch MA, Carson JE, et al. (2021) Flattening the latent growth curve? Explaining within-person changes in employee well-being during the COVID-19 pandemic. *Occupational Health Science* 5: 247–275.

Mõttus R, Sinick J, Terracciano A, et al. (2019) Personality characteristics below facets: A replication and meta-analysis of cross-rater agreement, rank-order stability, heritability, and utility of personality nuances. *Journal of Personality and Social Psychology* 117(4): e35–e50.

Muthén LK and Muthén BO (2018) *Mplus User's Guide*, 8th edn. Los Angeles, CA: Muthén & Muthén.

Myran DT, Cantor N, Rhodes E, et al. (2022) Physician health care visits for mental health and substance use during the COVID-19 pandemic in Ontario, Canada. *JAMA Network Open* 5(1): e2143160.

Racine N, Hetherington E, McArthur BA, et al. (2021) Maternal depressive and anxiety symptoms before and during the COVID-19 pandemic in Canada: A longitudinal analysis. *The Lancet Psychiatry* 8(5): 405–415.

Resolution Foundation (2021) UK households suffered Covid-19 income losses greater than those seen in France or Germany – and have taken on more debt in response. Available at: https://www.resolutionfoundation.org/press-releases/uk-households-suffered-covid-19-income-losses-greater-than-those-seen-in-france-or-germany-and-have-taken-on-more-debt-in-response/ (accessed 11 February 2022).

Rodriguez A, Reise SP and Haviland MG (2016) Evaluating bifactor models: Calculating and interpreting statistical indices. *Psychological Methods* 21(2): 137–150.

Rückholdt M, Tofler GH, Randall S, et al. (2021) Psychological responses and coping behaviour of visiting family members during and following unplanned hospital admission. *Journal of Clinical Nursing* 30(23-24): 3528–3538.

Rudenstine S, McNeal K, Schulder T, et al. (2021) Depression and anxiety during the COVID-19 pandemic in an urban, low-income public university sample. *Journal of Traumatic Stress* 34(1): 12–22.

Ruscio AM, Hallion LS, Lim CCW, et al. (2017) Cross-sectional comparison of the epidemiology of DSM-5 generalized anxiety disorder across the globe. *JAMA Psychiatry* 74(5): 465–475.

Samarasekera U (2021) CEPI prepares for future pandemics and epidemics. *The Lancet Infectious Diseases* 21(5): 608.

Santabárbara J, Lasheras I, Lipnicki DM, et al. (2021) Prevalence of anxiety in the COVID-19 pandemic: An updated meta-analysis of community-based studies. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* 109: 110207.

Sawicki AJ, Żemojtel-Piotrowska M, Balcerowska JM, et al. (2022) The fear of COVID-19 scale: Its structure and measurement invariance across 48 countries. *Psychological Assessment* 34: 294–310.

Schonfeld IS (1991) Dimensions of functional social support and psychological symptoms. *Psychological Medicine* 21(4): 1051–1060.

Schonfeld IS (2001) Stress in 1st-year women teachers: The context of social support and coping. *Genetic Social and General Psychology Monographs* 127(2): 133–168.

Snyder E, Cai B, DeMuro C, et al. (2018) A new single-item sleep quality scale: Results of psy-

chometric evaluation in patients with chronic primary insomnia and depression. *Journal of Clinical Sleep Medicine* 14(11): 1849–1857.

Solomou I and Constantinidou F (2020) Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: Age and sex matter. *International Journal of Environmental Research and Public Health* 17(14): 4924.

Sønderskov KM, Dinesen P. T P. T, et al. (2021) Variation in psychological well-being and symptoms of anxiety and depression during the COVID-19 pandemic: Results from a three-wave panel survey. *Acta Neuropsychiatrica* 33(3): 156–159.

Targa AD, Benítez ID, Moncusí-Moix A, et al. (2021) Decrease in sleep quality during COVID-19 outbreak. *Schlaf & Atmung* 25(2): 1055–1061.

Taylor S, Landry CA, Paluszek MM, et al. (2020) Development and initial validation of the COVID stress scales. *Journal of Anxiety Disorders* 72: 102232.

Tudehope L, Lee P, Wiseman N, et al. (2021) The effect of resilience on the relationship between perceived stress and change in alcohol consumption during the COVID-19 pandemic in Queensland, Australia. *Journal of Health Psychology* 27(12): 2696–2713.

Van Hooff MLM, Geurts SAE, Kompier MAJ, et al. (2007) "How fatigued do you currently feel?" Convergent and discriminant validity of a single-item fatigue measure. *Journal of Occupational Health* 49(3): 224–234.

Vistisen HT, Santini ZI, Sønderskov KM, et al. (2022) The less depressive state of Denmark following the second wave of the COVID-19 pandemic. *Acta Neuropsychiatrica* 34: 163–166.

Wang Y, Jiang P, Tang S, et al. (2021) Left superior temporal sulcus morphometry mediates the impact of anxiety and depressive symptoms on sleep quality in healthy adults. *Social Cognitive and Affective Neuroscience* 16(5): 492–501.

Wittenborn AK, Lachmar EM, Huerta P, et al. (2020) Global epidemiology, etiology, and treatment: Depressive and anxiety disorders across the lifespan. In: Wampler KS, Rastogi M and Singh R (eds) *The Handbook of Systemic Family Therapy: Systemic Family Therapy and Global Health Issues*, vol. 4. New York, NY: Wiley Blackwell, pp.245–265.

Xiao H, Zhang Y, Kong D, et al. (2020) Social capital and sleep quality in individuals who self-isolated for 14 days during the coronavirus disease 2019 (COVID-19) outbreak in January 2020 in China. *Medical Science Monitor* 26: e923921.

Zysberg L and Zisberg A (2022) Days of worry: Emotional intelligence and social support mediate worry in the COVID-19 pandemic. *Journal of Health Psychology* 27(2): 268–277.