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The COVID-19 anxiety syndrome scale: Development and psychometric properties

Ana V. Nikčević^a, Marcantonio M. Spada^{b,*}

^a Department of Psychology, Kingston University, Kingston upon Thames, United Kingdom

^b Division of Psychology, School of Applied Sciences, London South Bank University, London, United Kingdom



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ABSTRACT

The central aim of our study was to widen the mental health response to the COVID-19 pandemic by developing and evaluating a measure that could be used to identify the presence of anxiety syndrome features associated with COVID-19. In Study 1, a community sample of 292 participants completed the newly developed COVID-19 Anxiety Syndrome Scale (C-19ASS) and results were subjected to a Principal Components Analysis. An 11-item two-factor structure was identified. In Study 2, a community sample of 426 participants completed a battery of questionnaires including the C-19ASS. A Confirmatory Factor Analysis was performed on the C-19ASS. A 9-item two-factor structure was confirmed. Results also indicated that the C-19ASS has acceptable levels of reliability and concurrent validity. The C-19ASS perseveration factor was found to explain an additional 9.3% variance in COVID-19 anxiety, and additional 2.2% variance in work and social adjustment (functional impairment), over and above all other variables. The C-19ASS appears to be a reliable and valid measure of the COVID-19 anxiety syndrome. The implications of these findings are discussed.

Introduction

The Coronavirus (COVID-19) pandemic has been with us since the end of 2019 (World Health Organization, 2020) and has brought profound changes to the way we live. These changes seem to have led to a surge of pandemic-related psychological distress including fear, anxiety, perceived threat, and stress. For example, early findings from China have suggested that more than one quarter of the general population experienced moderate to severe levels of stress and/or anxiety-related symptoms in response to COVID-19 (Qiu et al., 2020; Wang et al., 2020). Additionally, a recent survey in the UK has indicated that during lockdown, anxiety, sleep difficulties, and alcohol consumption may have increased by up to 50% especially in those segments of the population at greater financial and health risk (Allington et al., 2020b). These findings align themselves to those reported during the SARS outbreak (Cheng et al., 2004) and in the 2009 H1N1 pandemic (Rubin et al., 2009; Wheaton et al., 2012).

Current measures of COVID-19 psychological distress

Given the role that pandemic psychological distress appears to be playing in shaping behavior, it is of critical importance to understand the nature and degree of this distress. To date, key measures have

emerged for exploring COVID-19-related fear, anxiety, threat, and stress. The Fear of COVID-19 Scale (Ahorsu et al., 2020) was one of the first measures to tap into fear specific to COVID-19. Though valuable, this measure is unidimensional (i.e., focused on general fear aspects of COVID-19) and its development was based on a relatively limited psychometric evaluation. More recently Lee and colleagues (Lee, 2020a; Lee 2020b; Lee et al., 2020a; Lee et al., 2020b) have developed the Coronavirus Anxiety Scale (CAS). Research has suggested that this measure is highly reliable and valid showing relationships with (amongst various variables) COVID-19 diagnosis, history of anxiety, COVID-19 fear, and functional impairment. The CAS has also demonstrated, importantly, solid discriminatory capability for functional impairment indicating that it is a valid mental health screener for COVID-19 related research and practice.

The Perceived Coronavirus Threat Questionnaire (PCTQ; Conway et al., 2020) is an additional recent measure which taps into threat-related thoughts and worries regarding COVID-19. The measure is still unpublished but has demonstrated good psychometric properties though further research on its predictive validity is warranted. A further recent measure to emerge from the literature is the COVID Stress Scales (CSS; Taylor et al., 2020). The CSS were developed to better understand and assess COVID-19-related distress. A stable 5-factor solution has been identified, corresponding to scales assessing COVID-19 related

* Corresponding author.

E-mail address: spadam@lsbu.ac.uk (M.M. Spada).

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stress and anxiety symptoms. These include danger and contamination fears, fears about economic consequences, xenophobia, compulsive checking and reassurance seeking, and traumatic stress symptoms. The CSS has performed well on various indices of reliability and validity and is clearly a promising measure for gaining a better and wide-ranging understanding of the COVID-19 stress experience. The above measures provide an invaluable resource for gaining a comprehensive understanding of the mental health impact of COVID-19 and all its authors should be commended for their prompt response in the face of this crisis.

The COVID-19 anxiety syndrome

There is a wide literature base that has shown that those suffering from pandemic-related psychological distress tend to exhibit elevated levels of post-traumatic stress, general stress, anxiety, health anxiety, and suicidality (Chong et al., 2004; Wheaton et al., 2012; Wu et al., 2009; Yip et al., 2010) which may last well beyond the course of the pandemic.

The eventual return to some form of 'normal' societal functioning is likely to entail, inevitably, exposure to environments associated with a greater risk of infection, such as public transport, offices, cinemas, and theatres. There may well be many individuals who will find it difficult to return to full 'societal' engagement because of maladaptive forms of coping that will have exacerbated COVID-19 anxiety (Lee, 2020b). In support of this view, very recent research surveying the UK population has indicated that anxiety and worry levels post-lockdown remain considerably higher than pre-lockdown levels and may well affect engagement in both work and social interaction for some time to come (Allington et al., 2020a).

We therefore think it important to identify if a COVID-19 'anxiety syndrome' may be emerging characterized by avoidance, checking, worrying and threat monitoring (combined). In line with research in psychopathology (e.g. Barlow et al., 2014; Hayes, 2004; Wells, 2000) such constellation of maladaptive forms of coping may play a critical role in the perseveration of psychological distress. The COVID-19 anxiety syndrome should therefore be conceptually and psychometrically separate from COVID-19 threat, fear, and anxiety, which assess the nature of the COVID-19 threat experience rather than the response to it. Features of the COVID-19 anxiety syndrome have already been, but only in part, captured by Taylor et al. (2020) in the development of the CSS.

Aims of our study

The central aim of our study was to widen the mental health response to the pandemic by developing and evaluating a brief measure that could be used to reliably identify the presence of anxiety syndrome features associated with COVID-19. In developing our measure, we wanted to tap into additional aspects of maladaptive forms of coping (e.g. avoidance, threat monitoring and worry) that have not been explicitly captured thus far and in a single measure. We hypothesized that this measure would be correlated with established measures of COVID-19 anxiety and perceived threat. We also hypothesized that this measure would: (1) predict COVID-19 anxiety independently of demographics (age, gender and risk status), personality, and perceived COVID-19 threat; and (2) predict work and social adjustment in the new normal independently of demographics (age, gender and risk status), personality, perceived COVID-19 threat, and COVID-19 anxiety.

Study 1: Construction of the COVID-19 anxiety syndrome scale (C-19ASS)

Method

Candidate items C-19ASS

The C-19ASS was constructed by examining the relevant literature (e.g. Barlow et al., 2014; Hayes, 2004; Wells, 2000), noting aspects of the anxiety syndrome identified in other measures (e.g. Taylor et al., 2020), and by consulting experts in the field. The following were the areas identified as potential features constituting the COVID-19 anxiety syndrome: (1) avoidance (e.g. of public transport because of the fear of contracting COVID-19); (2) checking (e.g. of symptoms of COVID-19); (3) worrying (e.g. imagining what could happen to loved ones if they were to contract COVID-19); and (4) threat monitoring (e.g. paying close attention to others displaying possible symptoms of COVID-19).

Items were framed as statements to which participants could respond to on a five-point Likert-type scale to indicate their level of agreement ("1. Not at all", "2. Rarely, less than a day or two", "3. Several days", "4. More than seven days", and "5. Nearly every day"). The items were preceded by a pre-ambule that read as follows:

"A series of statements regarding people's ways of dealing with the threat of coronavirus (COVID-19) are listed below. Please rate the extent to which each statement applies to you over the last two weeks."

Participants and procedure

A convenience sample of 292 participants (99 females; mean age = 37.2 years [SD = 10.9; range 20 to 74 years]) was recruited for this study and completed the preliminary version of the COVID-19 Anxiety Syndrome Scale (C-19ASS) in the first week of June 2020. Participants were required to: (1) be at least 18 years of age; (2) reside in the United States; and (3) consent to participate. Eligibility criteria were minimal to attract a sample that represented a broad range of individuals. The sample reported their ethnic background as follows: 77.4% White, 9.6% Black, 8.6% Asian, 2.7% Mixed Race, and 1.7% Other. 80.1% of the sample were educated at college level, 73.3% were married, co-habiting or in a civil partnership, and 92.4% were employed. Approximately one third of the sample (30.5%) had been tested for COVID-19 while 36.6% perceived themselves to be vulnerable to the disease. 7.2% of the sample reported having experienced bereavement as a consequence of COVID-19.

Participants were recruited using Amazon's Mechanical Turk (MTurk), an internet-based platform that allows individuals to request the completion of jobs (e.g., survey completion) for monetary compensation. Respondents completing surveys through MTurk have been found to produce high quality data and tend to be more demographically diverse than either standard internet samples or undergraduate samples (see Chandler and Shapiro, 2016, for a review).

Recruitment was limited to MTurk workers over 18 years of age and located in the United States. We followed Paolacci and Chandler's (2014) recommendation and sought to improve data quality by restricting MTurk worker approval ratings, as research has found that "catch" questions do not improve data quality above and beyond recruiting MTurk workers with approval ratings above 95% (Peer et al., 2014). Worker specifications in the present study included restricting participation to MTurk workers who had approval ratings above 95%.

Participants were required to provide electronic consent and there was no penalty for withdrawing from the study. Upon completion of the study, participants were debriefed and paid in full. Compensation was US\$1, an amount consistent with the compensation given to MTurk workers completing prior studies of similar length (Buhrmester et al., 2011). The present research was approved by Ethics Committee of Kingston University, London, United Kingdom.

Results

Principal components analysis (PCA)

The 11 original items (ordinal variables) of the C-19ASS were subjected to a principal components analysis (PCA) using SPSS (version 25; IBM Corp, 2017). Assumptions for PCA were met: a linear relationship between the variables was confirmed by examining the correlation matrix (all items were correlated at least 0.03 with at least one other item), the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.88, and the Barlett's test of sphericity was significant (<0.01) suggesting that data was suitable for reduction. The communalities were all above 0.5. The PCA revealed a two factors solution. A parallel analysis confirmed the two-factor solution (Henson and Roberts, 2006). We termed these two factors 'perseveration' (Factor 1) and 'avoidance' (Factor 2).

We then assessed the items as indicators of the latent variables using a Promax rotation adopting kappa = 4. An oblique rotation was chosen as we assumed that there would be a correlation between the factors (as they are supposed to assess different aspects of a single anxiety syndrome construct). It was decided a priori that items that loaded less than 0.4 on either factor would be discarded, as would be items that loaded above 0.4 on both factors. If, however, an item loaded more than 0.4 on only one factor, but the second factor loading was within 0.2 of the loading on the first factor, it would also be discarded. For example, if a factor loaded 0.5 on the first factor, it would be discarded if the loading on the second factor was above 0.3. This figure was used in order to exclude items that influenced both factors. No items met the exclusion criteria. This led to a two-factor solution (eigenvalues of 4.98 and 1.88) of the scores for the selected 11 items, which accounted for 62.3% of the variance and the estimated correlation between the two factors was 0.43 (Table 1 shows the factor loadings of the individual items). The 11-item C-19ASS was confirmed for the second study, where the measurement would be subjected to a confirmatory factor analysis using a new data set.

Study 2: Validation of the C-19ASS

Introduction

In order to validate the C-19ASS we: (1) determined construct validity (by running a Confirmatory Factor Analysis; CFA); (2) examined internal reliability; (3) established concurrent validity by observing whether the two factors of the C-19ASS would correlate significantly with established measures of COVID-19 perceived threat and anxiety; and (4) examined incremental validity by observing (a) whether the C-19ASS would predict levels of COVID-19 anxiety when controlling for key demographics (age, gender and high risk status), personality traits, and COVID-19 perceived threat; and (b) whether the C-19ASS would predict levels of work and social adjustment (functional impairment)

Table 1
Factor loadings from exploratory factor analysis of the COVID-19 Anxiety Syndrome Scale.

	Factor 1	Factor 2
1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19).	0.38	0.78
2. I have checked myself for symptoms of coronavirus (COVID-19).	0.74	0.37
3. I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19).	0.19	0.84
4. I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19).	0.75	0.20
5. I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).	0.26	0.84
6. I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work (such as writing emails, working on word documents or spreadsheets).	0.82	0.22
7. I have researched symptoms of coronavirus (COVID-19) at the cost of off-line social activities such as spending time with friends/family.	0.85	0.29
8. I have avoided talking about coronavirus (COVID-19).	0.63	-0.10
9. I have checked my family members and loved one for the signs of coronavirus (COVID-19).	0.74	0.51
10. I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).	0.72	0.44
11. I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).	0.73	0.52

controlling for key demographics (age, gender and high risk status), personality traits, and COVID-19 perceived threat and anxiety.

Method

Participants

A convenience sample of 426 (166 females; mean age = 38.6 years [SD = 11.2; range 20 to 75 years]) was recruited for this study and completed a battery of questionnaires in the second week of June 2020. Participants were required to: (1) be at least 18 years of age; (2) reside in the United States (see section 5.3 for more detail); and (3) consent to participate. Eligibility criteria were minimal to attract a sample that represented a broad range of individuals. The ethnic background of this sample was as follows: 79.1% White, 9.2% Black, 5.2% Hispanic, 3.3% Asian, 3.1% Mixed Race, and 0.2% Other. The majority of the sample was educated at college level (79.4%), married, co-habiting or in a civil partnership (74.0%), and employed (92.0%). Approximately one third of the sample (30.0%) had been tested for COVID-19 and considered itself to be vulnerable to the disease (34.0%), with 4.7% having experienced a loss as a consequence of COVID-19.

Measures

Big Five Inventory-10 (BFI-10; Rammstedt and John, 2007). This self-report measure includes 10 items, loading on five factors, assessing the Big 5 domains of personality: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. Participants are asked to rate how well statements describe one's personality. The measure is scored using a 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree) and scores range between 2 and 10 for each of the five factors. Higher scores indicate higher levels of a given personality trait. The BFI-10 has demonstrated good reliability and validity across many sample groups (Rammstedt and John, 2007). No Cronbach α was calculated in view of the brevity of this measure and the presence of only two items per factor (e.g. Soto and John, 2017). However, we did calculate the Spearman-Brown coefficient for each factor as suggested by Eisinga et al. (2013). The coefficient was 0.34 for extraversion, 0.46 for agreeableness, 0.48 for conscientiousness, 0.50 for neuroticism, and 0.34 for openness to experience.

Perceived coronavirus threat questionnaire (PCTQ; Conway et al., 2020). This self-report measure includes 6 items, loading on a single factor, assessing the COVID-19 threat perceptions (e.g., "Thinking about the Coronavirus makes me feel threatened") and concerns about contracting illness (e.g. "I am stressed around other people because I worry I will catch the Coronavirus"). The measure is scored using a 7-point Likert scale (1 = Not true of me to 7 = Very true of me) and scores range between 7 and 49. Higher scores indicate higher levels of perceived COVID-19 threat. The PCTQ has demonstrated good reliability with validity still needing to be ascertained (Conway et al.,

Table 2
Means, standard deviations, ranges, and inter-correlations of variables.

	X	SD	Range	2	3	4	5	6	7	8	9	10	11
1. BFI-10-Ext	5.3	1.9	2–10	0.24**	0.30**	−0.23**	0.66**	−0.08	−0.41**	−0.26**	−0.02	−0.21**	−0.41**
2. BFI-10-Agr	6.9	1.9	2–10		0.38**	−0.29**	0.28**	−0.03	−0.32**	−0.02	0.13*	0.03	−0.38**
3. BFI-10-Con	7.6	1.8	3–10			−0.45**	−0.40**	−0.07	−0.61**	−0.19**	−0.17**	−0.08	−0.55**
4. BFI-10-Neu	5.2	2.0	2–10				−0.25**	0.28**	0.34**	0.13**	0.03	0.11*	0.38**
5. BFI-10-Ope	7.0	1.8	2–10					0.01	−0.37**	−0.10	0.18**	0.02	−0.35**
6. PCTQ	26.0	7.8	6–42						0.17**	0.39**	0.47**	0.48**	0.23**
7. CAS	5.3	5.7	0–20							0.49**	−0.01	0.37**	0.79**
8. C-19ASS-P	12.2	6.2	0–24								0.45**	0.94**	0.52**
9. C-19ASS-A	8.2	3.2	0–12									0.73**	0.02
10. C-19ASS	20.5	8.2	0–36										0.41**
11. WSAS	15.9	11.7	0–40										

Note: BFI-10-Ext = Big Five Inventory-10-Extraversion; BFI-10-Agr = Big Five Inventory-10-Agreeableness; BFI-10-Com = Big Five Inventory-10-Conscientiousness; BFI-10-Neu = Big Five Inventory-10-Neuroticism; BFI-10-Ope = Big Five Inventory-10-Openness; PCTQ = Perceived Coronavirus Threat Questionnaire; CAS = Coronavirus Anxiety Scale; C-19ASS-P = COVID-19 Anxiety Syndrome Scale-Perseveration; C-19ASS-A = COVID-19 Anxiety Syndrome Scale-Avoidance; C-19ASS = COVID-19 Anxiety Syndrome Scale; WSAS = Work and Social Adjustment Scale.

n = 426.

* p < .05.

** p < .01.

2020). In the current study the PCTQ had a Cronbach $\alpha = 0.84$.

Coronavirus anxiety scale (CAS; Lee, 2020a). This self-report measure includes 5 items, loading on a single factor, assessing physiologically based symptoms that are aroused with COVID-19 related information and thoughts (e.g., “I felt dizzy, lightheaded, or faint, when I read or listened to news about the Coronavirus”). Participants are asked to rate how frequently they experience each anxiety symptom. The measure is scored using a 5-point time anchored scale (0 = Not at all to 4 = Nearly every day over the last 2 weeks) and scores range between 0 and 20. Higher scores indicate higher levels of a COVID-19 anxiety. The CAS has demonstrated good reliability and validity in a recent validation study (Lee et al., 2020b). In the current study the CAS had a Cronbach $\alpha = 0.94$.

Work and social adjustment scale (WSAS; Mundt et al., 2002). An adapted version of Mundt et al. (2002) WSAS was used to measure functional impairment. Participants were asked to rate five items of WSAS, using a 9-point severity scale (0 = Not at all to 8 = Very severely) with the following preamble: “Thinking about the COVID-19 pandemic and the way it may have impacted your mental health please look at each statement below and rate the extent to which the following items apply to you.” Higher scores indicate higher levels of a functional impairment. WSAS scores ≥ 21 suggest moderately severe or worse psychopathology. Therefore, using this cut score, 41.6% of the sample were classified as functionally impaired due to their fear or anxiety over COVID-19. In the current study the WSAS had a Cronbach $\alpha = 0.93$.

COVID-19 anxiety syndrome scale (C-19ASS; Nikčević and Spada). The C-19ASS as developed in Study 1 of the current article was employed.

Procedure

This followed the same structure as in Study 1.

Results

Confirmatory Factor Analysis (CFA)

A CFA was performed on the data obtained from the participants using a robust weighted least squares estimation (WLSMV). Analysis was conducted using lavaan in R (R Core Team, 2013; Rosseel, 2012). We defined the latent variables as perseveration and avoidance and the 11 items as congeneric indicators of the latent variables. We utilized

five indices to evaluate the fit of the model: a Chi-square measure of fit, the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI; also known as the Non-Normed Fit Index), the Standardized Root Mean Square Residual (SRMR) and the Root Mean Square Error of Approximation (RMSEA).

The initial 11-item CFA assumed a covariance between the latent variables and resulted in a mixed fit: the chi-square test was significant ($\chi^2 = 111.58$, $df = 43$, $p > .001$) and the $\chi^2/df = 2.59$. This model generated a CFI of 0.95, a TLI of 0.937, a SRMR of 0.044 and an RMSEA of 0.061 (90% C.I. = 0.047 – 0.075). Parameter estimates were reviewed, and modification indices were calculated to generate a more parsimonious measure. Together these suggested a re-specified model, resulting from the removal of 2 items (#7, 8), which demonstrated a cross-loading on the opposite factor. The re-specified model retained the covariances between latent variables and good fit of the data was demonstrated on each of the measures of fit. The chi-square test was no longer significant ($\chi^2 = 30.44$, $df = 26$, ns), and the resulting $\chi^2/df = 1.17$ suggests acceptable fit (Byrne, 2001). This new model also yielded the following results: CFI of 0.99, TLI of 0.99, SRMR of 0.026 and RMSEA of 0.020 (90% C.I. = 0.000 – 0.045), demonstrating construct validity. Based on these results, the C-19ASS was confirmed as having two correlated factors, perseveration (C-19ASS-P; 6 items) and avoidance (C-19ASS-A; 3 items).

Cronbach's alpha (Cronbach, 1951) was calculated using jamovi, which utilizes the psych package for R (R Core Team, 2013; The jamovi project, 2019). Both the C-19ASS-P (6 items; $\alpha = 0.86$) and the COVID-19ASS-A (3 items; $\alpha = 0.77$) demonstrated acceptable levels of reliability.

Data preparation and correlation analyses

Table 2 shows the means, standard deviations, ranges, and inter-correlations for all the study variables. A series of Kolmogorov-Smirnov tests of normality were conducted on the data, which suggested that all measurements were normally distributed. This was confirmed by an inspection of skewness and kurtosis coefficients. As a result, a series of Pearson Product-Moment correlation analyses were conducted on the data. These revealed that: (1) the C-19ASS-P was positively correlated with the PCTQ and CAS; (2) the C-19ASS-A was positively correlated with the PCTQ but not with the CAS; (3) the C-19ASS-P was negatively correlated with the BFI-10-Ext and BFI-10-Con, and positively correlated with the BFI-10-Neu; (4) the C-19ASS-A was negatively correlated with the BFI-10-Con, and positively correlated with the BFI-10-Agr and BFI-10-Ope; and (5) the C-19ASS-P, but not the C-19ASS, was positively

correlated with the WSAS.

The data also showed that the PCTQ and CAS were positively correlated. In addition, the CAS was negatively correlated with all the BFI-10 factors with the exception of BFI-10-Neu where a positive correlation was observed. The PCTQ was only positively correlated with the BFI-10-Neu. The WSAS was negatively correlated to all BFI-10 factors with the exception of BFI-10-Neu where a positive correlation was observed. A positive correlation was also observed between the WSAS and the PCTQ and CAS. Finally, in a separate analysis, age was found to be negatively correlated with WSAS ($r = -0.15$; $p = .02$) but not CAS, high risk status positively correlated with both WSAS ($r = -0.32$; $p = .001$) and CAS ($r = -0.32$; $p = .001$), and gender not correlated with either variable.

The absence of any correlation above 0.9 supported the contention that problematic multicollinearity would unlikely to be a problem in the regression analyses below. Histograms and normality plots suggested that the residuals were normally distributed. Plots of the regression-standardized residuals against the regression standardized predicted values suggested that the assumptions of linearity and homoscedasticity were met. Additionally, the Durbin-Watson test suggested that the assumption of independent errors was tenable.

Hierarchical linear regression analyses

Two hierarchical linear regression analyses were conducted to determine whether the C-19ASS-P would explain additional variance in CAS and WSAS beyond other correlated variables. In the first hierarchical linear regression analysis (see Table 3) CAS was the dependent variable and the predictor variables were entered in the following order: high risk status, BFI-10 factors found to be correlated with the dependent variable, PCTQ, and C-19ASS-P (only this factor was entered as C-19ASS-A was not correlated with the dependent variable). This order was chosen to test whether the C-19ASS-P could predict CAS when controlling for all these variables. Results indicated that C-19ASS-P contributed an additional 9.3% variance to that explained by all other variables. The final equation in Table 3 indicates that high risk status, BFI-10-Ext, BFI-10-Agr, BFI-10-Con and C-19ASS-P were the only significant predictors of CAS.

In the second hierarchical linear regression analysis (see Table 4) WSAS was the dependent variable and the predictor variables were entered in the following order: age and high risk status, BFI-10 factors found to be correlated with the dependent variable, PCTQ, CAS, and C-19ASS-P (only this factor was entered as C-19ASS-A was not correlated with the dependent variable). This order was chosen to test whether the C-19ASS-P could predict WSAS when controlling for all these variables. Results indicated that C-19ASS-P contributed an additional 2.2% variance to that explained by all other variables. The final equation in Table 4 indicates that high risk status, BFI-10-Agr, BFI-10-Neu, CAS and C-19ASS-P were the only significant predictors of WSAS.

Discussion

The central aim of our study was to widen the mental health response to the COVID-19 pandemic by developing and evaluating a brief measure that could be used to reliably identify the presence of anxiety syndrome features associated with COVID-19 as we enter a period of graded easing of lockdown and new normal across Anglosphere countries.

The end results of EFA and CFA yielded a 9-item measure that assesses the presence of perseverate thinking (6 items) and avoidance (3 items) relating to the postulated COVID-19 anxiety syndrome. The final version of the C-19ASS demonstrated a good fit for the data and acceptable levels of reliability.

A series of Pearson Product-Moment correlation analyses were conducted on the data. These revealed that: (1) the C-19ASS-P was positively correlated with the COVID-19 perceived threat and COVID-

19 anxiety; and (2) the C-19ASS-A was positively correlated with the COVID-19 perceived threat but not with the COVID-19 anxiety. These findings broadly support concurrent validity of our new measure. In addition, the C-19ASS-P was found to be negatively correlated with the extraversion and conscientiousness, and positively correlated with the neuroticism. The C-19ASS-A was found to be negatively correlated with the conscientiousness, and positively correlated with the agreeableness and openness. These findings indicate that the Big 5 personality traits play a role in the COVID-19 anxiety syndrome. With respect to C-19ASS-P, it would appear that high extraversion and conscientiousness are protective factors, and high neuroticism a vulnerability factor. With respect to C-19ASS-A, high conscientiousness is a protective factor with high agreeableness and openness vulnerability factors. Finally, C-19ASS-P, but not C-19ASS-A, positively correlated with functional impairment.

The data also showed that COVID-19 perceived threat and COVID-19 anxiety were positively correlated providing further concurrent validity for both constructs. In addition, COVID-19 anxiety was negatively correlated with all personality traits with the exception of neuroticism where a positive correlation was observed. This finding is the first to suggest that COVID-19 anxiety is related to aspects of personality, broadly in line with what one would expect it to be: all factors being protective with the exception of neuroticism. COVID-19 perceived threat was only positively correlated with the neuroticism, again in line with what would be expected.

Functional impairment was negatively correlated to all personality traits, with the exception of neuroticism, where a positive correlation was observed. A positive correlation was also observed between functional impairment and COVID-19 perceived threat and anxiety. The latter finding confirms (Lee et al., 2020a; Lee et al., 2020b) observations of the link between the COVID-19 anxiety and functional impairment and provides evidence that COVID-19 perceived threat also contributes to functional impairment. Finally, age was found to be negatively correlated with functional impairment but not COVID-19 anxiety, high risk status positively correlated with both functional impairment and COVID-19 anxiety, and gender not correlated with either variable. The latter finding, in particular, appears to be highly predictable in view of the health threat posed by COVID-19.

Furthermore, results from two hierarchical linear regression analyses indicated C-19ASS-P explained an additional 9.3% variance in COVID-19 anxiety, and additional 2.2% variance in work and social adjustment (functional impairment), over and above all other variables. These results, taken together, indicate that the C-19ASS may be an independent measure of a developing anxiety syndrome relating to COVID-19. Our findings also suggest the importance of personality traits in predicting both the C-19ASS-P, the COVID-19 anxiety and functional impairment, providing early insights into this area. It would appear that broadly speaking extraversion, agreeableness, openness and conscientiousness are protective factors and that neuroticism is a vulnerability factor.

An unexpected finding was that the C-19ASS-A was not correlated with either the COVID-19 anxiety or the functional impairment (but was with the COVID-19 perceived threat). A possible explanation for this is that lockdown has not been fully eased and that many workers have not returned to full time face to face interactions. A return to a greater face to face interaction (e.g. use of public transport) may bring to increases in anxiety and resultant avoidance. Further research will need to ascertain the relevance of the C-19ASS-A.

Our findings align themselves to important emerging research in the field of COVID-19 psychological distress. For example, items on the C-19ASS-P tap into obsessive thinking and other forms of perseveration (worry) which may lead, as Lee (2020b) has recently suggested, to an escalation of obsessional thinking about COVID-19 and the associated emergence of clinical anxiety and maladaptive coping (e.g. addictive behaviours). Other items of the C-19ASS-P tap into constructs which have been found to be of central importance in COVID-19 psychological

Table 3
High risk status and scores on the BFI-10 factors, the PCTQ, and the C-19ASS-P as predictors of scores of the CAS.

Coefficients ^a		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
Model		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	17.813	0.943		18.897	0.000	15.960	19.666
	High risk status	-4.503	0.546	-0.372	-8.244	0.000	-5.576	-3.429
R = 0.372; R ² = 0.138; R ² Change = 0.136; p = .000								
2	(Constant)	29.457	1.626		18.117	0.000	26.261	32.654
	High risk status	-2.768	0.441	-0.229	-6.284	0.000	-3.634	-1.903
	BFI-10-Ext	-0.704	0.145	-0.229	-4.854	0.000	-0.990	-0.419
	BFI-10-Agr	-0.151	0.120	-0.049	-1.257	0.210	-0.387	0.085
	BFI-10-Con	-1.430	0.136	-0.459	-10.513	0.000	-1.698	-1.163
	BFI-10-Neu	0.124	0.115	0.043	1.076	0.282	-0.102	0.349
	BFI-10-Ope	0.072	0.153	0.023	0.474	0.636	-0.228	0.373
R = 0.692; R ² = 0.479; R ² Change = 0.340; p = .000								
3	(Constant)	28.345	1.694		16.734	0.000	25.015	31.674
	High risk status	-2.645	0.442	-0.218	-5.983	0.000	-3.513	-1.776
	BFI-10-Ext	-0.676	0.145	-0.220	-4.659	0.000	-0.961	-0.391
	BFI-10-Agr	-0.163	0.120	-0.053	-1.358	0.175	-0.398	0.073
	BFI-10-Con	-1.446	0.136	-0.464	-10.660	0.000	-1.712	-1.179
	BFI-10-Neu	0.050	0.119	0.018	0.422	0.673	-0.184	0.284
	BFI-10-Ope	0.036	0.153	0.011	0.232	0.816	-0.265	0.336
	PCTQ	0.061	0.027	0.083	2.226	0.027	0.007	0.115
R = 0.696; R ² = 0.485; R ² Change = 0.006; p = .027								
4	(Constant)	24.264	1.594		15.226	0.000	21.131	27.396
	High risk status	-2.217	0.403	-0.183	-5.500	0.000	-3.010	-1.425
	BFI-10-Ext	-0.350	0.136	-0.114	-2.578	0.010	-0.617	-0.083
	BFI-10-Agr	-0.250	0.109	-0.081	-2.295	0.022	-0.464	-0.036
	BFI-10-Con	-1.256	0.125	-0.403	-10.084	0.000	-1.500	-1.011
	BFI-10-Neu	0.121	0.108	0.042	1.116	0.265	-0.092	0.333
	BFI-10-Ope	-0.127	0.140	-0.041	-0.910	0.364	-0.402	0.148
	PCTQ	-0.031	0.027	-0.042	-1.172	0.242	-0.084	0.021
	C-19ASS-P	0.324	0.034	0.351	9.575	0.000	0.257	0.390
R = 0.760; R ² = 0.578; R ² Change = 0.093; p = .000								

n = 426.

Note: BFI-10-Ext = Big Five Inventory-10-Extraversion; BFI-10-Agr = Big Five Inventory-10-Agreeableness; BFI-10-Con = Big Five Inventory-10-Conscientiousness; BFI-10-Neu = Big Five Inventory-10-Neuroticism; BFI-10-Ope = Big Five Inventory-10-Openness; PCTQ = Perceived Coronavirus Threat Questionnaire; C-19ASS-P = COVID-19 Anxiety Syndrome Measure-Perseveration.

distress, including safety behaviours (Lee et al., 2020; Taylor et al., 2020) and excessive online information searching (Jungmann and Witthöft, 2020).

The clinical benefits of being able to identify the COVID-19 anxiety syndrome (avoidance, worry, checking and threat monitoring) may be of use during the current health crisis (Asmundson and Taylor, 2020). For example, interventions aimed at interrupting worry (e.g. Metacognitive Therapy; Wells, 2000), reducing checking and avoidance (e.g. graded exposure and response prevention; Barlow et al., 2014) and recalibrating attention (e.g. attention training technique; Wells, 2000) may serve to weaken the COVID-19 anxiety syndrome and possibly reduce the longer-term occurrence of psychological distress typically linked to pandemic events such as post-traumatic stress, general stress, anxiety, health anxiety, and suicidality (Chong et al., 2004; Lee, 2020b; Wheaton et al., 2012; Wu et al., 2009; Yip et al., 2010).

Limitations and directions for further research

There are several limitations that should be considered in the interpretation of these conclusions. First, data was solely based on self-report questionnaires, which may be subject to social desirability, self-report errors and poor recall. Future research could use more objective measures in order to ascertain the individual experience the COVID-19 anxiety syndrome (e.g. attentional bias). Second, this study used a cross sectional design, which does not allow for causal inferences. It remains

unknown at present whether features of the COVID-19 anxiety syndrome are causal to COVID-19 anxiety or epiphenomenal. Third, the participants in this study may not have been representative of the general population. There was a disproportionately higher level of male participants and the sample was overwhelmingly Caucasian. However, systematic research on MTurk has demonstrated that MTurk participants are at least as diverse as typical internet and traditional methods, and the data derived from this source are of high quality (Buhrmester et al., 2011). A larger sample size might have been able to correct for this.

Conclusions

Despite these above limitations, we believe that the C-19ASS is measure that could prove useful in better understanding a developing COVID-19 anxiety syndrome and its impact on COVID-19 anxiety and functional impairment. It appears the C-19ASS demonstrates acceptable levels of reliability and validity contributing, independently of existing measures, to our growing understanding of the mental health impact of COVID-19.

Table 4
Age, high risk status, and scores on the BFI-10 factors, the PCTQ, the CAS, and the C-19ASS-P as predictors of scores on the Work and Social Adjustment Scale.

Coefficients ^a		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
Model		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	39.356	2.914		13.505	.000	33.628	45.085
	Age	-0.226	.048	-0.215	-4.707	.000	-0.320	-0.131
	High risk status	-8.893	1.130	-0.360	-7.871	.000	-11.114	-6.672
R = 0.384; R ² = 0.147; R ² Change = 0.147; p = .000								
2	(Constant)	50.712	3.841		13.203	.000	43.162	58.262
	Age	-0.074	.041	-0.071	-1.796	.073	-0.155	.007
	High risk status	-4.940	.977	-0.200	-5.053	.000	-6.861	-3.018
	BFI-10-Ext	-1.503	.314	-0.240	-4.789	.000	-2.120	-0.886
	BFI-10-Agr	-0.536	.259	-0.085	-2.067	.039	-1.045	-0.026
	BFI-10-Con	-2.270	.295	-0.357	-7.707	.000	-2.849	-1.691
	BFI-10-Neu	.633	.248	.108	2.558	.011	.147	1.120
	BFI-10-Ope	.270	.329	.042	.823	.411	-0.376	.916
R = 0.650; R ² = 0.422; R ² Change = 0.275; p = .000								
3	(Constant)	46.715	3.977		11.747	.000	38.898	54.531
	Age	-0.063	.041	-0.061	-1.556	.120	-0.144	.017
	High risk status	-4.482	.975	-0.181	-4.596	.000	-6.399	-2.565
	BFI-10-Ext	-1.418	.311	-0.226	-4.557	.000	-2.029	-0.806
	BFI-10-Agr	-0.578	.256	-0.092	-2.255	.025	-1.082	-0.074
	BFI-10-Con	-2.328	.291	-0.366	-7.987	.000	-2.901	-1.755
	BFI-10-Neu	.400	.254	.069	1.575	.116	-0.099	.900
	BFI-10-Ope	.153	.327	.024	.469	.639	-0.489	.795
	PCTQ	.198	.059	.131	3.359	.001	.082	.313
R = 0.662; R ² = 0.438; R ² Change = 0.015; p = .001								
4	(Constant)	8.155	3.815		2.138	.033	.656	15.654
	Age	-0.065	.031	-0.062	-2.057	.040	-0.126	-0.003
	High risk status	-0.893	.780	-0.036	-1.145	.253	-2.427	.640
	BFI-10-Ext	-0.495	.246	-0.079	-2.013	.045	-0.977	-0.012
	BFI-10-Agr	-0.357	.198	-0.057	-1.807	.072	-0.746	.031
	BFI-10-Con	-0.360	.253	-0.057	-1.427	.154	-0.857	.136
	BFI-10-Neu	.332	.196	.057	1.695	.091	-0.053	.716
	BFI-10-Ope	.105	.251	.016	.417	.677	-0.389	.599
	PCTQ	.115	.046	.076	2.525	.012	.026	.205
	CAS	1.362	.080	.667	16.940	.000	1.204	1.520
R = 0.817; R ² = 0.660; R ² Change = 0.230; p = .000								
5	(Constant)	9.048	3.694		2.449	.015	1.787	16.310
	Age	-0.058	.030	-0.056	-1.918	.056	-0.118	.001
	High risk status	-0.906	.755	-0.037	-1.201	.230	-2.390	.577
	BFI-10-Ext	-0.277	.241	-0.044	-1.148	.251	-0.750	.197
	BFI-10-Agr	-0.487	.193	-0.078	-2.528	.012	-0.866	-0.108
	BFI-10-Con	-0.442	.245	-0.070	-1.807	.072	-0.924	.039
	BFI-10-Neu	.421	.190	.072	2.215	.027	.047	.794
	BFI-10-Ope	-0.066	.245	-0.010	-0.271	.787	-0.548	.416
	PCTQ	.026	.047	.017	.546	.586	-0.067	.118
	CAS	1.163	.086	.570	13.528	.000	.994	1.332
C-19ASS-P	.356	.066	.189	5.428	.000	.227	.485	
R = 0.830; R ² = 0.682; R ² Change = 0.022; p = .000								

n = 426.

Note: BFI-10-Ext = Big Five Inventory-10-Extraversion; BFI-10-Agr = Big Five Inventory-10-Agreeableness; BFI-10-Con = Big Five Inventory-10-Conscientiousness; BFI-10-Neu = Big Five Inventory-10-Neuroticism; BFI-10-Ope = Big Five Inventory-10-Openness; PCTQ = Perceived Coronavirus Threat Questionnaire; CAS = Coronavirus Anxiety Scale; C-19ASS-P = COVID-19 Anxiety Syndrome Scale-Perseveration.

COVID-19 Anxiety Syndrome Scale (C-19ASS)

(Nikčević & Spada, 2020)

A series of statements regarding people's ways of dealing with the threat of coronavirus (COVID-19) are listed below. Please rate the extent to which each statement applies to you **over the last two weeks**.

Not at all = 0

Rarely, less than a day or two = 1

Several days = 2

More than 7 days = 3

Nearly every day = 4

1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)^b

2. I have checked myself for symptoms of coronavirus (COVID-19).

3. I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19).

4. I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19).

5. I have avoided touching things in public spaces because of the

fear of contracting coronavirus (COVID-19).

6. I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work (such as writing emails, working on word documents or spreadsheets).

7. I have checked my family members and loved one for the signs of coronavirus (COVID-19).

8. I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).

9. I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).

Factor 1: 2, 4, 6, 7, 8, 9.

Factor 2: 1, 3, 5.

Author statement

Contributors

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

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Authors AVN and MMS have contributed to all aspects of the manuscript.

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