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RESEARCH ARTICLE

Validity and reliability of the COVID-19 Anxiety Syndrome Scale in Canadian dentists

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Abstract

Background: The COVID-19 pandemic has resulted in a high level of mental health problems for the population worldwide including healthcare workers. Several studies have assessed these using measurements for anxiety for general populations. The COVID-19 Anxiety Syndrome Scale (C-19ASS) is a self-report measure developed to assess maladaptive forms of coping with COVID-19 (avoidance, threat monitoring and worry) among a general adult population in the United States. We used it in a prospective cohort study of COVID-19 incidence rates in practising Canadian dentists. We therefore need to ensure that it is valid for dentists in French and English languages. This study aimed to evaluate the validity of the C-19ASS in that population.

Methods: Cross-sectional data from the January 2021 monthly follow-up in our prospective cohort study were used. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed.

Results: The results of EFA revealed a 2-factor structure solution that explained 47% of the total variance. The CFA showed a good model fit on the data in both English and French languages. The Cronbach's alpha indicated acceptable levels of reliability. Furthermore, the C-19ASS showed excellent divergent validity from the Generalized Anxiety Disorder-7 (GAD-7) scale.

Conclusions: The C-19ASS is valid and reliable instrument to measure COVID-19-related anxiety in English and French among Canadian dentists.

Practical implications: This validated measure will contribute to understanding of the mental health impact of the pandemic on dentists in Canada and enable the dental regulatory authorities and organizations to intervene to help dentists.

KEYWORDS
anxiety, Canada, COVID-19 Anxiety Syndrome Scale, dentists, reliability, validity

1 | INTRODUCTION

The COVID-19 outbreak was declared as a public health emergency of international concern by the World Health Organisation (WHO) on 30 January 2020 and characterized as a pandemic on 11 March 2020 (WHO, 2020). In addition to high rates of infection across the world, the novel coronavirus 2019 (COVID-19) pandemic has negatively influenced the mental health of populations worldwide due to uncertain prognoses, looming severe shortages of resources for testing and treatment, imposition of public health measures, large and growing financial losses and conflicting messages from health authorities (Pfefferbaum & North, 2020). A study by the Centers for Disease Control and Prevention (CDC) in the United States found that trends in anxiety and depression symptoms were consistent with trends in the number of COVID-19 cases reported weekly (Stephenson, 2021). Nikčević et al. modelled the contribution of the Big Five personality traits, health anxiety and COVID-19 psychological distress to generalized anxiety and depressive symptoms among participants from United States during the COVID-19 pandemic. The results showed that health anxiety, COVID-19 anxiety and anxiety syndrome played a mediating role in the relationship between the Big Five personality traits and generalized anxiety and depression symptoms (Nikčević et al., 2021).

The COVID-19 pandemic has resulted in a high level of mental health problems for healthcare workers. They have reported symptoms of depression, anxiety, poor sleep quality and insomnia during the pandemic (Giardino et al., 2020). Medical personnel in China suffered from traumatic stress (73.4%), depression (50.7%), generalized anxiety (44.7%) and insomnia (36.1%) (Liu et al., 2020). Healthcare providers are particularly vulnerable to suffering from anxiety during the pandemic, given their risk of exposure to the virus, concern about infecting and caring for their colleagues and families, shortages of personal protective equipment (PPE) and longer work hours.

A strong potential for SARS-CoV-2 transmission exists in dental settings during the delivery of aerosol generating procedures (AGPs) (Estrich et al., 2020). A range of studies in various countries (the United States, Israel, Hong Kong, China, Turkey, Italy, Saudi Arabia, Pakistan, Poland, Brazil) have found significant impacts of the COVID-19 pandemic on dental professionals with the latter reporting elevated levels of stress, concerns, fear and anxiety owing to increased risk of infection and substantially increased infection protocols (Ahmed et al., 2020; Bsoul & Loomer, 2021; De Stefani et al., 2020; Duruk et al., 2020; Estrich et al., 2020; Moraes et al., 2020; Nelson et al., 2020; Shacham et al., 2020; Tysiąc-Miśta & Dziedzic, 2020; Wang et al., 2020; Wong et al., 2004; Wu et al., 2021, 2020). A cross-sectional study to assess anxiety among 650 dental professionals from 30 countries during the pandemic reported that 87% of participants were afraid of getting infected with COVID-19 from either a patient or a co-worker, and 90% were anxious while treating a coughing patient or one suspected to be infected with COVID-19 (Ahmed et al., 2020). Many dentists in Canada reported increased work-related stress as their tasks increased significantly during the pandemic (Wu et al., 2021). They were more anxious due to high occupational risk of infection, feared becoming the next SARS-CoV-2 victim, being an asymptomatic spreader and infecting their family members (Wu et al., 2021).

Key Practitioner Message

- Exploratory and confirmatory factor analyses revealed a 2-factor structure of the COVID-19 Anxiety Syndrome Scale in this sample.
- The Pearson correlation analyses support the convergent validity of C-19ASS with the Generalized Anxiety Disorder-7 scale.
- In terms of divergent validity, the C-19ASS measures specifically COVID-19-related anxiety, which is different from Generalized Anxiety Disorder.
- The C-19ASS has the potential for assessing COVID-19-related anxiety in dentists practising in Canada.

Several studies have used validated instruments for measuring anxiety among general population (Doerr et al., 1998; Heaton et al., 2007; Tluczek et al., 2009). Given that COVID-19-related stress and anxiety among health professionals is clearly a major issue, a number of instruments have been developed and validated (e.g., the Coronavirus Anxiety Scale (Lee, 2020), COVID-19 Anxiety Scale (Silva et al., 2022), Fear of COVID-19 Scale (Ahorsu et al., 2020), Perceived Coronavirus Threat Questionnaire (Cooper et al., 1987), Multidimensional Assessment of COVID-19 Related Fears (Schimmenti et al., 2020) and COVID Stress Scales (Taylor et al., 2020). The COVID-19 Anxiety Syndrome Scale (C-19ASS) was developed to reliably assess the presence of anxiety syndrome features associated with COVID-19 in general adult population in the United States (Nikčević & Spada, 2020). It tapped into maladaptive forms of coping (e.g., avoidance, threat monitoring and worry) and demonstrated acceptable levels of validity and reliability in that population. The C-19ASS has been broadly welcomed and used in Brazil, China, Greece, Indonesia, the Philippines, Iran, Italy, Saudi Arabia, Turkey, the United Kingdom and the United States (Akbari et al., 2023). It has demonstrated a significant association with COVID-19 anxiety, depressive symptoms, generalized anxiety, health anxiety, psychological distress and functional impairment in various countries (Akbari et al., 2023).

However, neither the C-19ASS nor any other similar instruments have been validated among dentists. Given the importance of understanding anxiety and stress among dentists, it is important to evaluate the validity of an instrument among practising dentists. Early in the pandemic, as we initiated a prospective cohort study of COVID-19 infection rates among dentists in Canada (Madathil et al., 2022), we chose to use the C-19ASS to specifically assess COVID-19 coping strategies in our sample. This was potentially a good measure to use in Canadian dentists, but we need to ensure that the C-19ASS is valid in this group, including using it in French and English languages. This study therefore aimed to evaluate the validity of the C-19ASS among

practising Canadian dentists in English and French languages. Specifically, the objectives of this study were to (1) evaluate the construct validity of C-19ASS in a population of dentists in Canada; (2) evaluate the cross-cultural validity of a French version of C-19ASS in French speaking dentists; (3) evaluate the divergent validity of the C-19ASS questionnaire against the Generalized Anxiety Disorder-7 (GAD-7) tool; and (4) evaluate the internal reliability of the C-19ASS.

2 | METHODS

To address these objectives, we used data from a prospective cohort study aiming to estimate COVID-19 incidence rates among licenced dentists in Canada during August 2020 to October 2021 (Madathil et al., 2022). In August 2020, 644 dentists from across Canada were recruited through email invitations sent to all registered members in the rosters of the collaborating organizations, which included provincial dental regulatory authorities, dental associations and dental schools covering provinces across Canada. Baseline data in this cohort were collected in August 2020. Self-report data on a range of variables were then collected from study participants every 4 weeks via an online questionnaire. The C-19ASS was added to the follow-up questionnaire in November 2020 and repeated monthly until the end of the study in October 2021. The GAD-7 (Spitzer et al., 2006) instrument was added to the online questionnaire in October 2021. The data from January and October 2021 were analysed to address this study's aims.

The study protocol was approved by the Institutional Review Board of McGill University, Montreal-IRB Review Number A06-M49-20A (20-06-018).

2.1 | Data collected

All data used in the analyses for this study were self-reported. At baseline, sociodemographic variables on participants' age, gender, sex, practice type, provincial location and language spoken were collected. C-19ASS data were first collected in our study in November 2020. The C-19ASS is a 9-item measure with two factors: perseveration (6 items) and avoidance (3 items) (refer to Table S1). The items are framed as statements regarding peoples' ways of dealing with the threat of COVID-19. Participants respond to a 5-point Likert-type scale to indicate how often they performed particular behaviours, from '0. Not at all' to '4. Nearly every day'. Participant dentists had to rate the extent to which each statement applied to them over the last 2 weeks. In the original validation study (Nikčević & Spada, 2020), items 2, 4, 6, 7, 8 and 9 loaded onto the perseveration factor, and items 1, 3 and 5 loaded onto the avoidance factor (Nikčević & Spada, 2020). Scores range from 0 to 24 for the perseveration factor and 0 to 12 for the avoidance factor with increased scores in both domains indicating increased anxiety. For our study, the instrument was translated into French by a professional translator. Several francophone members of the research team reviewed the translated instrument before its implementation.

To assess divergent validity, we used the GAD-7 scale (Spitzer et al., 2006). This has also been extensively used in COVID-19-related research. It is one of the most frequently used, validated, self-reported questionnaires that is used to screen for, diagnose and assess the severity of GAD in clinical practice and research. It is a 7-item anxiety scale with strong criterion, construct, factorial and procedural validity for identifying probable cases of generalized anxiety disorders (Spitzer et al., 2006). The items are rated on a 4-point Likert scale from 0 (*not at all*) to 3 (*nearly every day*), with a total score ranging from 0–21. A score of 10 or greater on the GAD-7 represents a reasonable cut point for identifying cases of GAD requiring some form of therapy. Cut points of 5, 10 and 15 might be interpreted as mild, moderate and severe levels of anxiety on the GAD-7 (Spitzer et al., 2006).

2.2 | Data analyses

Descriptive analyses were conducted to describe the demographic characteristics of the study participants. The primary sample was divided into two subsets according to the language of response, English and French. There were 485 dentists in the English subset and 135 dentists in the French subset. The English subset was further divided randomly into two subsets. Exploratory factor analysis (EFA) was used to examine the factor structure of the C-19ASS, and factor loadings were compared with the original validation study (Nikčević & Spada, 2020). Maximum likelihood (ML) EFA with Promax rotation adopting kappa = 4 was conducted. Kaiser–Meyer–Olkin (KMO) test (Kaiser, 1970) and Bartlett's test of sphericity (Bartlett, 1937) were performed. The number of factors to be extracted was determined according to Kaiser's eigenvalue criterion (eigenvalues > 1) (Kaiser, 1970) and the scree-test criteria (Cattell, 1966).

We determined construct validity by performing confirmatory factor analysis (CFA) using a ML estimation on the English language subset. The latent variables were defined as perseveration and avoidance. Cross-cultural validity was evaluated by performing CFA on the French language dataset. Several fit indices were utilized to evaluate the fit of the model, such as the comparative fit index (CFI), Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA). Cronbach's alpha was calculated to check internal consistency of the C-19ASS in both languages. Analyses for convergent and divergent validity of the C-19ASS were also performed comparing scores with those of the GAD-7.

3 | RESULTS

At baseline in August 2020, we recruited 644 dentists. In January 2021, 620 of them completed C-19ASS evaluations, and in October 2021, 566 of them completed both the C-19ASS and GAD-7. The mean age of participants at baseline was 47.3 years (standard deviation 11.4 years). Other descriptive characteristics of the study participants are shown in Table 1. The following assumptions for EFA were met: A linear relationship between the variables was confirmed by

TABLE 1 Descriptive characteristics of the study participants ($N = 619$).

Characteristic Variable	Data
Age (Y)	
Mean (SD)	47.3 (11.4)
Median (min, max)	48 (24, 79)
Sex, No. (%)	
Female	352 (56.9)
Male	267 (43.1)
Age categories	
(Y), No. (%)	
20–30	43 (6.9)
31–40	155 (25)
41–50	166 (26.8)
51–60	175 (28.3)
61–70	68 (11)
71–80	12 (1.9)
Province of primary practice, No. (%)	
AB	27 (4.4)
BC	103 (16.6)
MB	26 (4.2)
NFL	2 (0.3)
NS	33 (5.3)
ON	231 (37.3)
PEI	11 (1.8)
Que	157 (25.4)
SK	28 (4.5)
YK	1 (0.2)
Response language, No. (%)	
English	485 (78.4)
French	134 (21.6)
Type of primary practice, No. (%)	
General dentist	562 (90.8)
Specialist	57 (9.2)

TABLE 2 Factor loadings from exploratory factor analysis of the COVID-19 Anxiety Syndrome Scale.

Items	Perseveration factor	Avoidance factor
1. I have avoided public using transport because of the fear of contracting coronavirus (COVID-19)	−0.14	**0.71**
2. I have checked myself for symptoms of coronavirus (COVID-19).	**0.61**	0.13
3. I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19).	−0.04	**0.72**
4. I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19).	−0.10	**0.37**
5. I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).	−0.03	**0.81**
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).	**0.45**	0.11
7. I have checked my family members and loved ones for the signs of coronavirus (COVID-19).	**1.06**	−0.17
8. I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).	**0.66**	0.13
9. I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).	**0.57**	0.13

examining the correlation matrix of the variables (all items were correlated at least 0.03 with at least one other item); the KMO (KMO = 0.83) measure of sampling adequacy was 0.83 (KMO > 0.7; acceptable); and Bartlett's test of sphericity was significant (<0.001). The EFA revealed a two-factor solution in the dataset that was similar to the results of the original study (Nikčević & Spada, 2020). A Promax rotation was chosen since the factors assessing different aspects of a COVID-19 anxiety syndrome were assumed to be correlated. The eigenvalues of the factors were 3.37 and 1.14, which accounted for 47% of the variance, and the estimated correlation between the two factors was 0.69. Results of the EFA are displayed in Table 2. A parallel analysis confirmed the two-factor solution (Figure 1). These were the 'perseveration' (Factor 1) and 'avoidance' (Factor 2). A finding in this study was that item 4 about 'concern for not having adhered to social distancing guidelines' loaded onto the avoidance factor, while in the original study, it loaded onto the perseveration factor.

When we subjected the C-19ASS to CFA using the split English and French dataset, the measures of fit showed that the 2-factor model demonstrated a good fit for the data in English and French language datasets (Table 3). The chi-square test for English language dataset was not significant: $\chi^2 = 67.49$, degrees of freedom (df) = 26 and the resulting $\chi^2/df = 2.6$. The results of CFA on French subset: chi-square test $\chi^2 = 32.68$ and df = 26. The resulting $\chi^2/df = 1.26$.

The Cronbach's alpha for the English dataset was 0.72 (Perseveration) and 0.65 (Avoidance), and for the French dataset, it was 0.68 (Perseveration) and 0.59 (Avoidance).

Table 4 shows the means, standard deviations, ranges and intercorrelations for the study variables using data from the October 2021 follow-up. Pearson correlation analyses were conducted on these

FIGURE 1 Parallel analysis plot.

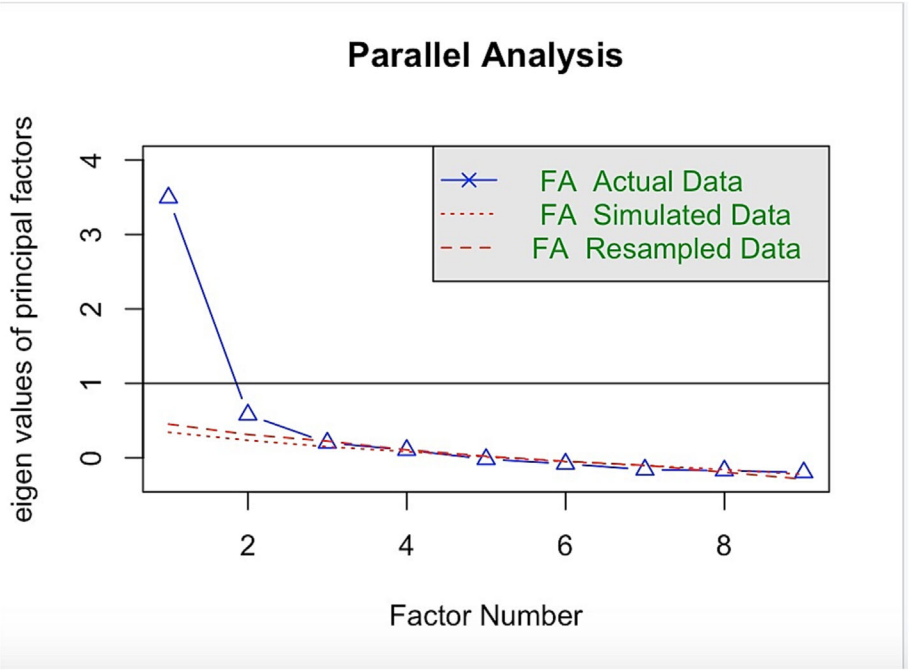

TABLE 3 Goodness of fit indices of the CFA model of the C-19ASS in English and French languages.

CFA index	χ^2 (df)	CFI	TLI	SRMR	RMSEA
Data in English $N = 243$	67.49 (26)	0.98	0.97	0.08	0.08
Data in French $N = 134$	32.68 (26)	0.9	0.9	0.08	0.04

Abbreviations: χ^2, chi-square test statistic; CFI, comparative fit index; df, degree of freedom; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis index.

TABLE 4 Descriptive statistics of the variables.

Variable	Mean	SD	Range	Inter-quartile range (IQR)
C-19ASS	11.4	8.9	0–36	13
C-19ASS-P	7.9	6.3	0–24	9
C-19ASS-A	3.5	3.5	0–12	6
GAD-7	6.3	6.9	0–21	6

TABLE 5 Correlations between the variables.

	Factor 1	Factor 2	Factor 3
Factor 1	1.00		
Factor 2	0.36	1.00	
Factor 3	0.51	0.65	1.00

data, revealing that the total C-19ASS, as well as the avoidance and perseveration factor scores, was positively correlated with the total GAD-7 score (see Table 5). To assess divergent validity, an EFA with Promax rotation was performed. It comprised the C-19ASS and GAD-7 items. The results showed a 3-factor solution: the perseveration and avoidance items of C-19ASS loaded on two separate factors, while the GAD-7 items tightly loaded onto a third factor (refer Table S2).

4 | DISCUSSION

The goal of the analyses reported in this paper was to test the validity of the C-19ASS in English and French languages among a sample of dentists practising in Canada. The results demonstrate the instrument is indeed valid and reliable in both languages among Canadian dentists and so can be used to evaluate COVID-19 related anxiety in this population.

The results of EFA and CFA confirmed a 2-factor structure of the English and French language versions of the C-19ASS in our sample. This was also confirmed by a parallel analysis (Harshman & Lundy, 1994; Henson & Roberts, 2006). Our modelling showed a good fit for the data with two factors, and the Cronbach's alpha indicated acceptable levels of reliability in both languages. The results of our analyses were similar to those of the original study (Nikčević & Spada, 2020), although there were minor differences. In our analyses, item 4, concerning adherence to social distancing guidelines, loaded onto the avoidance factor, whereas in the original study (Nikčević & Spada, 2020), it loaded onto the perseveration factor. We have identified two other studies evaluating validity of the C-19ASS in general community samples of Iranians (Hoseinzadeh et al., 2022) and Italians (Mansueto et al., 2022), both of which found a two-factor structure similar to the original study. The Persian C-19ASS showed excellent divergent validity from generalized anxiety, indicating that it is concerned explicitly with COVID-19, supported by correlation analyses

and EFA (Akbari et al., 2022). Alhakami et al. conducted a study aimed to validate the Arabic version of the C-19ASS and to explore the association between C-19ASS ratings and psychological symptoms in a Saudi Arabian population (Alhakami et al., 2023). The EFA showed that item 4 loaded onto the Avoidance factor (Alhakami et al., 2023). The C-19ASS has demonstrated a consistent factor structure, measurement invariance across gender and validity and reliability across different languages and cultures (Akbari et al., 2023). It could serve as an anxiety measure in future potential viral pandemics, perhaps by utilizing a relevant pandemic associated keyword instead of 'coronavirus' (Akbari et al., 2023).

When we evaluated the correlations of the C-19ASS scores with the total GAD-7 scores, the correlations ranged between 0.36 and 0.65, which supports the convergent validity of the C-19ASS with the GAD-7. In terms of divergent validity, the EFA revealed that the C-19ASS is not identical with the GAD-7, with the C-19ASS evaluating specifically COVID-19-related anxiety, which is separate from GAD.

5 | LIMITATIONS AND MITIGATION STRATEGY

Like all studies, ours has its limitations. Principal among ours was that for the cross-cultural validation, the reverse translation of the C-19ASS from French back to English was not performed by a professional translator. This was due to the time constraints during the data collection and to adapt to the rapidly changing information need during the pandemic. Nevertheless, the items in the scale ask about general behaviours of the participants, which has a lower potential to be misinterpreted due to suboptimal translation. Furthermore, several francophone members of the research team reviewed and piloted the French version of the instrument before its implementation in our study and found the face validity and translation to be good. Nevertheless, our evaluations of the cross-cultural validity of the French version of the C-19ASS demonstrated a valid instrument.

6 | KNOWLEDGE TRANSLATION

The availability of this validated measure in English and French will contribute to understanding of the mental health impact of the COVID-19 pandemic on dentists in Canada and elsewhere, enabling dental associations, regulatory authorities and other organizations to intervene to improve the mental health of dentists. The impact of this work will be very strong as it will help inform dentists and dental professional leaders of the relevant issues.

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CONFLICT OF INTEREST STATEMENT

None of the authors have declared a conflict of interest.

ETHICS STATEMENT

This study protocol was approved by the Institutional Review Board of McGill University, Montreal-IRB Review Number A06-M49-20A (20-06-018).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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