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COVID-19 related anxiety among Canadian dentists

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DEDICATION

I would like to dedicate this work to my parents Dr. Praveen Mehrotra and Priti Mehrotra for their unparalleled support, love and blessings.

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LIST OF ABBREVIATIONS

C-19ASS: COVID-19 Anxiety Syndrome Scale
SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2
COVID-19: Coronavirus disease 2019
WHO: World Health Organization
AGP: Aerosol generating procedure
GAD: Generalized Anxiety Disorder
GAD-7: Generalized Anxiety Disorder 7 scale
C-19: COVID-19
EFA: Exploratory factor analysis
CFA: Confirmatory factor analysis
OHCP: Oral Healthcare Provider

ABSTRACT

Background: The COVID-19 pandemic has resulted in a high level of mental health problems for the population worldwide including healthcare workers. It highlighted the need to better understand levels and determinants of mental health problems among dental professionals. Several studies have assessed these mental health problems using generic and specific measures of anxiety. The COVID-19 Anxiety Syndrome Scale (C-19ASS) is a self-report measure developed to assess maladaptive forms of coping with COVID-19. Prior to our study, its validation has been limited.

Objectives: The specific objectives of this project were to: 1) validate the COVID-19 Anxiety Syndrome Scale (C-19ASS) questionnaire against the Generalised Anxiety Disorder-7 (GAD-7) tool in a population of dentists in Canada; 2) describe the anxiety levels among dentists in Canada during the COVID-19 pandemic and how they varied over time; 3) estimate the differences in the anxiety levels in dentists in Canada following vaccination against SARS-CoV2; 4) estimate the differences in the anxiety levels in dentists in Canada by age, sex and practice type; and 5) describe the economic impact of the COVID-19 pandemic and the anxiety due to this impact among dentists in Canada.

Methods: To address the aims of this study, data were used from a prospective cohort study conducted to estimate the incidence rate of COVID-19 among licensed dentists in Canada over a 12-month study period. To evaluate the validity of the C-19ASS, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed. Additionally, we used Cronbach's alpha to evaluate internal reliability and compared scores with the GAD-7 scale for

external validity. To address the remaining aims, mixed effects ordinal logistic regression models were used.

Results: Concerning the validity of the C-19ASS, the EFA revealed a 2-factor 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.

Regarding anxiety levels over time, the odds of being in a more severe category of anxiety were reduced by 26% (OR 0.74, 95% C.I. 0.72-0.76) with every 30-day increase in the follow-up time. The odds of being in a more severe category of anxiety increased by 20% (Odds Ratio =1.20, 95% C.I.= 1.12-1.27) with each 10,000 COVID-19 case increase in the dentists' work province during the 14 days prior to data collection. Age, sex and practice type were significantly associated with COVID-19 related anxiety in dentists. Reduced revenue collection, the ability to offer limited dental treatments, reduced number of patients and increased costs involved in practice were the major practice-related factors that led to increased anxiety in dentists. With every 11-year increase in age, the odds of the dentists having more severe economic burden increased by 4% (OR 1.04, 95% CI 1.02 –1.05). The odds for the dentists in Ontario having higher economic burden were increased by 97% (OR 1.97, 95% CI 0.96 – 4.0) as compared to the Atlantic provinces. Specialists had 42% reduced odds for severe economic burden compared to general dentists (OR 0.58, 95% CI 0.31- 1.09). The odds for dental practice-owners having more severe economic burden were increased by 59% (OR 1.59, 95% CI 0.99 – 2.57) compared to non-owners.

Conclusions: The C-19ASS is valid and reliable instrument to measure COVID-19 related anxiety in English and French among Canadian dentists. It is sensitive to change over time and with external anxiety stimuli. COVID-19 related anxiety among dentists was associated with age, sex and practice type. Age, sex, province, dental practice ownership and practice-related factors were associated with the anxiety due to the economic impact of the pandemic on dentists. The economic burden on dentists during the COVID-19 pandemic was associated with age, province, practice type and ownership of dental practice.

RÉSUMÉ

Contexte: La pandémie de COVID-19 a entraîné un niveau élevé de problèmes de santé mentale pour la population mondiale, y compris les professionnels de la santé. Elle a mis en lumière la nécessité de mieux comprendre les niveaux et les déterminants des problèmes de santé mentale chez les professionnels dentaires. Plusieurs études ont évalué ces problèmes de santé mentale en utilisant des mesures génériques et spécifiques de l'anxiété. L'échelle du syndrome d'anxiété lié à la COVID-19 (C-19ASS) est un outil d'auto-évaluation conçu pour mesurer les formes inadaptées de gestion de la COVID-19. Avant notre étude, sa validation restait limitée.

Objectifs: Les objectifs spécifiques de ce projet étaient de: 1)valider le questionnaire de l'échelle du syndrome d'anxiété lié à la COVID-19 (C-19ASS) en le comparant à l'outil de trouble d'anxiété généralisée-7 (GAD-7) dans une population de dentistes au Canada ; 2)décrire les niveaux d'anxiété parmi les dentistes au Canada pendant la pandémie de COVID-19 et leur évolution dans le temps ; 3)estimer les différences dans les niveaux d'anxiété des dentistes au Canada après la vaccination contre le SARS-CoV-2 ; 4)estimer les différences dans les niveaux d'anxiété des dentistes au Canada selon l'âge, le sexe et le type de pratique ; 5)décrire l'impact économique de la pandémie de COVID-19 et l'anxiété liée à cet impact parmi les dentistes au Canada.

Résultats: Concernant la validité de la C-19ASS, l'EFA a révélé une solution à 2 facteurs expliquant 47 % de la variance totale. La CFA a montré une bonne adéquation du modèle aux données en anglais et en français. L'alpha de Cronbach a indiqué des niveaux acceptables de

fiabilité. En outre, la C-19ASS a montré une excellente validité divergente par rapport à l'échelle GAD-7.

Concernant les niveaux d'anxiété au fil du temps, les chances d'appartenir à une catégorie plus sévère d'anxiété ont diminué de 26 % (OR 0,74, IC à 95 % 0,72-0,76) avec chaque augmentation de 30 jours dans le temps de suivi. Les chances d'appartenir à une catégorie plus sévère d'anxiété ont augmenté de 20 % (OR = 1,20, IC à 95 % = 1,12-1,27) pour chaque augmentation de 10 000 cas de COVID-19 dans la province de travail des dentistes pendant les 14 jours précédant la collecte des données. L'âge, le sexe et le type de pratique étaient significativement associés à l'anxiété liée à la COVID-19 chez les dentistes. La réduction des revenus, la capacité limitée à offrir des traitements dentaires, la diminution du nombre de patients et l'augmentation des coûts liés à la pratique étaient les principaux facteurs liés à la pratique ayant conduit à une augmentation de l'anxiété chez les dentistes. Avec chaque augmentation de 11 ans d'âge, les chances que les dentistes subissent un fardeau économique plus sévère augmentaient de 4 % (OR 1,04, IC à 95 % 1,02–1,05). Les chances que les dentistes de l'Ontario subissent un fardeau économique plus élevé augmentaient de 97 % (OR 1,97, IC à 95 % 0,96–4,0) par rapport aux provinces de l'Atlantique. Les spécialistes avaient 42 % de chances en moins de subir un fardeau économique sévère par rapport aux dentistes généralistes (OR 0,58, IC à 95 % 0,31-1,09). Les chances que les propriétaires de cabinets dentaires subissent un fardeau économique plus sévère augmentaient de 59 % (OR 1,59, IC à 95 % 0,99–2,57) par rapport aux non-propriétaires.

Conclusions: La C-19ASS est un instrument valide et fiable pour mesurer l'anxiété liée à la COVID-19 en anglais et en français parmi les dentistes canadiens. Elle est sensible aux changements au fil du temps et aux stimuli externes liés à l'anxiété. L'anxiété liée à la COVID-19

chez les dentistes était associée à l'âge, au sexe et au type de pratique. L'âge, le sexe, la province, la possession d'un cabinet dentaire et les facteurs liés à la pratique étaient associés à l'anxiété due à l'impact économique de la pandémie sur les dentistes. Le fardeau économique des dentistes pendant la pandémie de COVID-19 était associé à l'âge, à la province, au type de pratique et à la possession d'un cabinet dentaire.

PREFACE

This thesis follows a manuscript-based thesis model incorporating three manuscripts. The first manuscript has been published and the other manuscripts are submitted. This PhD project represents a significant contribution to the literature regarding COVID-19 related anxiety levels in Canadian dentists. The manuscripts were included in the body of the thesis after the study objectives. The manuscripts are comprised of a brief literature review, study methodology, main findings followed by a discussion section. There are eleven chapters. Following the introduction of the topic, chapter two provides a literature review, including significant information on anxiety and COVID-19 associated anxiety among various groups including the general population, healthcare workers and oral healthcare providers. Building upon this knowledge, the third and fourth chapters outline the study's rationale and objectives respectively. Chapters five to seven include the manuscripts, outlining the research methodology employed, data collection methods and analytical approaches. Chapter eight comprehensively discusses the findings, including future research directions. Finally, nine summarises the conclusion of this study. The thesis acknowledges the contributions of multiple authors. Their collaboration and insights have been invaluable is shaping the content and direction of this work.

CONTRIBUTION TO ORIGINAL KNOWLEDGE

The findings in manuscript I showed that the COVID-19 Anxiety Syndrome Scale (C-19ASS) is a valid and reliable instrument to measure COVID-19 related anxiety in English and French among Canadian dentists. In manuscript II, the results demonstrated the sensitivity to change over time of the C-19ASS among dentists in Canada over the course of 1 year during the COVID-19 pandemic. These results are important because responsiveness (sensitivity to change over time) is a necessary aspect of psychometric evaluation of outcome measures in mental health care. Overall, this validated measure, C-19ASS will contribute to the understanding of the mental health impact of the COVID-19 pandemic on dentists in Canada and enable the dental regulatory authorities and organizations to intervene to help dentists.

In manuscript II, we also found that COVID-19 related anxiety in dentists in Canada was associated with demographic and professional characteristics. This evidence about particularly vulnerable groups among dentists practising in Canada will aid in providing targeted psychological support to them and building a resilient dental workforce.

In Manuscript III we present findings that highlight information regarding anxiety caused to the dentists due to the economic impact of this public health challenge and the practice-related factors associated with the economic burden on them. This data is valuable for policy makers from various jurisdictions to provide timely, attuned and evidence-based guidelines for future pandemics and outbreaks and consequently avoid the restricted oral care phase, financial strains on dental clinics across Canada.

CONTRIBUTION OF AUTHORS

As a PhD candidate and first author on all the manuscripts included in this dissertation, I was responsible for developing the objectives, performing data analysis, writing the manuscripts and all the chapters included in this dissertation. The specific contribution of each co-author is described below. They provided feedback on their respective areas of expertise.

Rachita Seth, PhD Candidate, Faculty of Dental Medicine and Oral Health Sciences, McGill University: contributed to data analyses, interpretation of the data and drafted the manuscripts.

Dr. Paul Allison, Professor, Faculty of Dental Medicine and Oral Health Sciences, McGill University: main supervisor of this project, contributed to conception and design of the longitudinal cohort study, data analysis and interpretation of the data, drafting, critically revised the manuscripts and thesis.

Dr. Sreenath Madathil, Assistant Professor, Faculty of Dental Medicine and Oral Health Sciences, McGill University: co-supervisor of this project, contributed to the conception and design of the longitudinal cohort study, data analysis and interpretation of the data, drafting, critically revised the manuscripts and thesis.

Dr. Walter Siqueira, Professor, College of Dentistry, University of Saskatchewan: contributed to conception and design of the longitudinal cohort study, final version of the manuscripts.

Dr. Mary McNally, Professor, Faculty of Dentistry, Dalhousie University: contributed to conception and design of the longitudinal cohort study, final version of the manuscripts.

Dr. Carlos Quinonez, Vice-Dean, Director Dentistry at Schulich School of Medicine and Dentistry, Western University: contributed to conception and design of the longitudinal cohort study, final version of the manuscripts.

Dr. Michael Glogauer, Professor, Faculty of Dentistry, University of Toronto: contributed to conception and design of the longitudinal cohort study, final version of the manuscripts.

1. INTRODUCTION

COVID-19 caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2), was identified at the end of 2019 and had infected 100 million people worldwide by January 2021 [1]. This outbreak was declared a public health emergency of international concern by the World Health Organisation (WHO) on January 30, 2020 and characterized as a pandemic on March 11, 2020 [2]. It was of particular concern owing to the airborne transmission dynamics in asymptomatic and presymptomatic people [3, 4].

In addition to the high rates of infection across the world, the COVID-19 pandemic negatively influenced the mental health of the population 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 [5]. There were social restrictions, lockdowns, school and business closures, loss of livelihood, decreases in economic activity and shifting priorities of governments in their attempt to control COVID-19 outbreaks [6]. The Global Burden of Disease (GBD) data for 2020 indicates that the COVID-19 pandemic and associated lockdowns increased the prevalence of anxiety and depressive disorders among populations worldwide [6]. The two key factors behind these increases in anxiety and depressive disorders were the persistently rising community infection rates and lockdowns [6]. People from diverse backgrounds, including the general population and healthcare providers, including oral healthcare professionals grappled with the challenges of adapting to the “new normal” amidst an ongoing pandemic.

Researchers found a high risk of exposure for dentists to SARS-CoV-2 in dental settings [7, 8] due to their proximity with patients during treatment and the everyday use of aerosol-generating procedures (AGPs) in oral healthcare [9, 10]. The need to adopt advanced measures

for infection control in dental practice and the restrictions imposed on the scope of practice led to elevated levels of anxiety in dentists, worldwide. Multiple studies have reported the psychological impact of the COVID-19 pandemic on dentists in different parts of the world [11-13], however few studies were performed using a longitudinal design and there are few data available for dentists in Canada, highlighting the necessity for further research.

Currently, there is a lack of longitudinal studies focussing on the anxiety levels of this population over an extended period. As the epidemiological situation of infectious disease outbreaks evolved, more research is necessary to understand the changes in anxiety levels and the associated factors.

To improve mental health outcomes for dentists, it is crucial to understand their anxiety levels and identify associated factors. Anxiety among Canadians was arguably at an all-time high during the COVID-19 pandemic [14] and those in the high-risk group may have even higher anxiety levels.

This prospective cohort study aims to fill this knowledge gap by investigating the anxiety levels of dentists practising in Canada during the COVID-19 pandemic. The findings from this study will be instrumental in developing interventions and policies to support the psychological well-being of dentists practising in Canada and enhance mental wellness services and counselling for these populations.

2. LITERATURE REVIEW

2.1 COVID-19

An infectious viral disease emerged towards the end of 2019 in Hubei province, Wuhan city, China, called Coronavirus disease 2019 (COVID-19) [15, 16]. In mid-December 2019, the Wuhan health authorities detected few cases of an atypical pneumonia that was caused by a novel coronavirus [17]. Subsequent investigations discovered that the etiological agent was an RNA virus related to the same family of Coronavirus that caused the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 and the Middle East Respiratory Syndrome (MERS) outbreak in 2012 [18]. The International Committee on Taxonomy of Viruses named this RNA virus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2) [16]. COVID-19 can be transmitted asymptomatically via respiratory droplets, aerosols and splatter of oral fluid [19]. It causes symptoms like fever, dry cough, breathing difficulties, headache and pneumonia, which can progress to respiratory complications like alveolar damage, respiratory failure and even death [20]. COVID-19, which emerged as a novel disease, escalated exponentially within and beyond China and spread worldwide, causing disease and deaths among thousands of people in a short span of 3 months. Observing its high infectivity, rapid replication and transmission rate, the World Health Organisation (WHO) declared COVID-19 a worldwide distributed pandemic on March 11, 2020 [2].

As the COVID-19 pandemic rapidly escalated across the world, the governments around the world imposed a number of protective measures to contain the exponentially increasing spread [21]. Some measures were lockdowns to avoid social and work-related gatherings, social distancing mandates, quarantine of symptomatic and asymptomatic individuals with a history of contact with infected individuals and local and international travel restrictions to avoid infection

spread [21]. The effect on the health, wellbeing, business and other aspects of daily life were felt throughout societies and by individuals. There was increase in anxiety, depression and overall psychological distress [22].

The pandemic whipped up a mental health storm for healthcare workers as well. Studies reported anxiety and depression in dental healthcare workers which was associated with demographic and professional characteristics as well as perceived risk of COVID-19 [23]. Dental settings present a potentially high risk of COVID-19 infection as dental care workers work in closed environments and conduct aerosol-generating procedures [24]. Indeed, dentists' close interactions with patients and performance of aerosol-generating procedures created unique challenges during this pandemic.

2.2 ANXIETY

2.2.1 Anxiety Disorder

Anxiety represents an important physiological response that prepares a person to evade or confront a threat in the environment [25]. According to American Psychological Association (APA), anxiety as an emotion is characterized by feelings of tension, worried thoughts and physical manifestations such as increased blood pressure [26]. It is associated with impairment in daily life.

Individuals who experience anxiety have intrusive and recurring thoughts, often forcing them to avoid certain situations due to their innate fears. Although anxiety and fear are often used interchangeably, fear is a short-term response at the present time due to a valid and clear threat, while anxiety stems from a diffused threat which is far in the future, causing a long-term state of worry [26]. It is normal for people to occasionally worry about certain aspects of their life that

usually do not last for a long time, such as finances, wellness or family problems. However, anxiety remains persistent and can get worse over time [27]. Anxiety can also cause symptoms such as sweating, trembling, dizziness and rapid heartbeats [26] and can even hamper routine activities such as schoolwork, job performance and relationships [27]. Furthermore, 30% of adults all around the world experience anxiety during their lives, making it the most common mental health disorder [26].

Anxiety disorders are characterised by feelings of anxiety and fear, including phobias, generalized anxiety, panic and social anxiety disorder [28]. The duration of symptoms typically experienced by people with anxiety disorders characterized it as a chronic condition [29]. The long-term consequences of anxiety include chemical changes in the brain such as increased release of stress hormones resulting in increased frequency or intensity of other conditions such as dizziness, headache and depression [30]. Everyone can feel anxious sometimes, but people with anxiety disorders often experience fear and worry that is both intense and excessive [31]. These feelings are typically accompanied by physical tension and other behavioural and cognitive symptoms. They are difficult to control, cause significant distress and can last a long time if untreated. Anxiety disorders interfere with daily activities and can impair a person's family, social, school and working life [31]. They have been associated with impaired health-related quality of life (e.g., impaired physical and role functioning, more days in bed due to illness, more workdays lost, increased impairment at work and increased use of health services [32]. Moreover, anxiety disorders are chronic, relentless and can grow progressively worse if not treated [33]. An estimated 4% of the global population currently experience an anxiety disorder [34]. Healthcare workers are known to be at a risk for anxiety, depression and burn-out under usual working conditions [35, 36]. Anxiety disorders can manifest in various ways depending on

the timing of onset and its characteristic features. Depending on the type of anxiety, individuals will experience the symptoms differently. There are four main types of anxiety disorders that will be explored in the following section.

2.2.2 Types of Anxiety Disorders

There are several types of anxiety disorders, including generalized anxiety disorder, panic disorder, social anxiety disorder and various phobia-related disorders.

Generalized Anxiety disorder (GAD), one of the most common mental disorders, usually involves a persistent feeling of anxiety or dread, which can interfere with daily life [27]. It is not the same as occasionally worrying about things or experiencing anxiety due to stressful life events. People living with GAD experience anxiety for months. It develops slowly, often starting around 30 years of age, but can also occur in childhood. The disorder is more common in women than in men. The symptoms of GAD include feeling restless, being easily fatigued, having difficulty concentrating, being irritable, having headaches, muscle aches, stomach aches or unexplained pains, difficulty controlling feelings of worry, and sleep problems such as difficulty falling or staying asleep [37]. Risk for GAD can run in families [37]. Several parts of the brain and biological processes play a key role in fear and anxiety. Researchers have found that external causes such as experiencing a traumatic event or being in a stressful environment may increase the risk for developing GAD [37].

Panic disorder involves frequent and unexpected panic attacks [31]. Panic attacks are sudden periods of intense fear, discomfort or sense of losing control even when there is no clear danger or trigger. Everyone who experiences a panic attack will not develop a panic disorder.

People with panic disorder may have sudden and repeated attacks of overwhelming anxiety and fear, a feeling of being out of control, a fear of death or impending doom during a panic attack, an intense worry about when the next panic attack will happen and a fear or avoidance of places where panic attacks have occurred in the past. Panic attacks often include physical symptoms such as a pounding or racing heart, sweating, chills, trembling, difficulty breathing, weakness or dizziness, tingly or numb hands, chest pain, stomach pain and nausea. Researchers have found that several parts of the brain and certain biological processes may play a crucial part in fear and anxiety. Some researchers think panic attacks are like "false alarms" where our body's typical survival instincts are active either too often and too strongly [38].

Social Anxiety Disorder is an intense, persistent fear of being watched and judged by others. For people with social anxiety disorder, the fear of social situations may feel so intense that it seems beyond their control. For some people, this fear may prevent them from going to work, attending school or doing everyday things. People with social anxiety disorder may experience blushing, sweating or trembling, pounding or racing heart, stomachaches, rigid body posture or speaking with an overly soft voice, difficulty making eye contact or being around people they don't know and feelings of self-consciousness or fear that people will judge them negatively [31].

Phobia-related disorders involve an intense fear or aversion to specific objects or situations. People with phobias feel fear which is out of proportion to the actual danger caused by the situation or object. People with a phobia may have an irrational or excessive worry about encountering the feared object or situation, take active steps to avoid the feared object or situation, experience immediate intense anxiety upon encountering the feared object or situation and endure unavoidable objects and situations with intense anxiety [31].

Adverse mental health outcomes like anxiety are often used interchangeably with similar mental health experiences like stress symptoms. However, there are subtle differences between these terms, which should be used with caution as the approaches used to care for patients experiencing these are different. Therefore, it is essential to understand the differences between stress and anxiety.

2.2.3 Difference between stress and anxiety

Stress can be defined as a real or interpreted threat to the physiological or psychological integrity of an individual that results in a cascade of physiological and/or behavioural responses of the body to maintain homeostasis [39, 40]. Acute stress can alter numerous biological functions such as the hypothalamic-pituitary adrenal (HPA) axis [41], the immune system [42], the autonomic nervous system (ANS) and the enteric nervous system. There is a cascade of changes in the nervous, cardiovascular, endocrine and immune systems following the perception of an acute stressful event. Psychosocial stress contributes to adverse psychological effects such as anxiety disorders [43]. Chronic stress causes brain changes that may contribute to anxiety and depression. Changes in the HPA axis and immune system induced by chronic stress lead to damage in the prefrontal cortex, hippocampus and amygdala, critical brain regions associated with learning and memory, as well as anxiety and depression [44].

2.2.4 Global prevalence of anxiety before the pandemic

Anxiety disorders are the most prevalent mental disorder and were a leading cause of health loss worldwide in 2019, reaching approximately 301 million [45]. The American Psychological Association (APA) reports that about 30% of people globally experience anxiety

during their lifetime [26]. According to the Global Burden of Disease (GBD) study 2019, anxiety disorders are among the most prevalent mental health conditions globally, ranking in the top 25 leading causes of burden worldwide [6]. This burden was high across the entire lifespan, for both sexes and across many locations [46]. A systematic review focusing on the global, regional and national burden of mental disorders in 204 countries and territories by the GBD collaborators reported the global prevalence of mental disorders from 1990 to 2019 [46]. The global prevalence of mental disorders in 2019 was 970.1 million, an increase of 48.1 % since the year 1990, when it was 654.8 million cases. Furthermore, this study reported that age-standardized anxiety prevalence, which remained consistent among males and females between 1990 and 2019. In 2019, the burden of anxiety disorders was greater in females than males and 80.6% of the burden due to mental disorders occurred among individuals of working age (16-65 years).

According to another report, the prevalence of anxiety disorders, which include generalized anxiety disorder, panic disorder, posttraumatic stress disorder and obsessive-compulsive disorder, increased by 14.9% globally between 2005 and 2015 and was particularly high in the Americas [47]. They are the sixth largest cause of disability and as with depressive disorders, more women are affected than men [47].

Healthcare workers are known to be at a risk for anxiety, depression and burn-out even under usual working conditions [80].

2.3 ANXIETY EXPERIENCE DURING A PANDEMIC

2.3.1 Anxiety Experience due to past pandemics

Uncertainty, disruptions in daily routines and concerns for health and well-being during infectious disease outbreaks are likely associated with increases in generalized anxiety [48].

Several outbreaks of viral diseases including SARS, H1N1, H7N9, MERS, EBOLA have posed significant public health challenges since 2000. Such outbreaks place a serious strain on healthcare workers who can experience psychological distress due to the risk of infection and the demands of dealing with a public health emergency [49]. According to previous studies on SARS and Ebola epidemics, the onset of a sudden and immediately life-threatening illness could lead to extraordinary amount of pressure on healthcare workers (HCWs) [50]. The outbreak of an unusual and contagious pneumonia, severe acute respiratory syndrome (SARS) prompted fear in the community in countries including China, Hong Kong and Taiwan [51]. A cross-sectional study was conducted among healthcare workers in a tertiary hospital in Taiwan and 77.4% of participants reported anxiety as the most common symptom during the initial phase [51]. Interestingly, during the 'repair' phase or when the disease was controlled these healthcare workers felt more depressed and showed avoidance behaviours [51]. Increased workload, physical exhaustion, inadequate personal equipment, nosocomial transmission and the need to make ethically difficult decisions on the rationing of care may have dramatic effects on the physical and mental wellbeing of healthcare workers (HCWs).

During the H1N1 and SARS-1 pandemics, healthcare workers reported increased mental health distress [52, 53]. Sirois and Owens [54] reviewed data from previous pandemics and found that psychological distress was associated with being female, being a nurse and having contact with infected patients while increased social support, proper training and appropriate personal protective equipment (PPE) were protective factors.

Infectious disease outbreaks have undoubtedly caused poor mental health outcomes among the general population and healthcare workers including dentists, often leading them towards anxiety and depression. These impacts have the potential to last well after the pandemic

has been brought under control. In this context, poor mental health outcomes during this global COVID-19 pandemic are likely to be a significant issue. It is essential to understand how the COVID-19 pandemic has contributed to anxiety experiences among people from various backgrounds.

2.3.2 COVID-19 associated anxiety

COVID-19 anxiety can be described as an emotional state of nervousness among individuals caused by the COVID-19 pandemic and it fluctuated as the epidemic developed [55]. In China, COVID-19 anxiety had a great impact on people's mental health and quality of life [56]. In the U.S., mean levels of anxiety were found to be heightened and sustained during mid-March 2020 [57]. Furthermore, a study in Spain also reported an increased prevalence of COVID-19 anxiety in most of the respondents [58]. The concept of COVID-19 anxiety syndrome was first identified by professors in the UK, Ana V. Nikcevic (Kingston University) and Marcantonio Spada (London South Bank University) [59, 60]. It was characterized by avoidance (e.g. of public transport because of the fear of contracting COVID-19); checking (e.g. of symptoms of COVID-19); worrying (e.g. paying close attention to others displaying possible symptoms of COVID-19) and threat monitoring (keeping up with all the latest news about the COVID-19 pandemic).

During a stressful situation like an ongoing pandemic, people tend to experience social isolation due to reduced physical gathering and social activities, job loss, as well as lifestyle changes due to rapidly changing health and safety protocols. Although changes in behaviours, thoughts and feelings can be a normal response to stressful situations and might not always

indicate a mental health disorder, such symptoms can undermine an individual's well-being and quality of life and may create a need for mental health support [61].

A cross-sectional survey of Chinese residents conducted at the peak of the COVID-19 pandemic in February 2020 indicated that the prevalence of anxiety was 20.4% [62]. As the pandemic progressed with its high mortality and morbidity in a relatively short period, many people experienced poor mental health consequences like anxiety and depression. Another survey was conducted among the US general adult population in June 2020 to assess mental health during the COVID-19 pandemic and overall 40.9% of 5470 respondents reported at least one adverse mental or behavioural health condition [63]. Among these, 30.9% of the participants reported symptoms of anxiety disorder or depressive disorder, followed by 26.3% reporting trauma or stress-related disorder due to the pandemic and 13.3% reported having started or increased substance use to cope with stress or emotions related to the COVID-19 pandemic [63].

Measuring anxiety quantitatively is of critical importance in understanding the impact of the pandemic on mental health. To measure anxiety specifically related to the COVID-19 pandemic, we can use instruments specifically designed and validated for COVID-19. In this context, some published measures of COVID-19 related anxiety will be explained in the next section.

2.4 MEASURES OF COVID-19 RELATED ANXIETY

2.4.1 Measures of anxiety associated with COVID-19

The following key measures have been developed for documenting COVID-19 related anxiety, threat and stress. The Coronavirus Anxiety Scale (CAS) developed by Lee and colleagues is a brief mental health screener to identify probable cases of dysfunctional anxiety

associated with the COVID-19 crisis [64]. This 5-item scale which was based on 775 adults with anxiety over the coronavirus, demonstrated solid reliability and validity. Elevated CAS scores were found to be associated with coronavirus diagnosis, impairment, alcohol/drug coping, negative religious coping, extreme hopelessness, suicidal ideation as well as attitudes towards President Trump and Chinese products. The CAS discriminates well between persons with and without dysfunctional anxiety using an optimized cut-off score of >= 9 (90% sensitivity and 85% specificity). It is an efficient and valid tool for clinical research and practice [64].

The Perceived Coronavirus Threat Questionnaire (PCTQ) [65] is another measure which taps into threat-related thoughts and worries regarding COVID-19. This instrument 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”). It 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. This measure demonstrated good reliability and validity [65].

The 36-item COVID Stress Scales (CSS) were developed to measure the anxiety related responses of people in US and Canada to the COVID-19 pandemic [66]. They helped to better understand and assess COVID-19 distress. A stable 5 factor solution was identified corresponding to scales assessing COVID-19 related stress and anxiety symptoms: 1) danger and contamination fears; 2) fears about economic consequences; 3) xenophobia;
4) compulsive checking and reassurance seeking; and 5) traumatic stress symptoms about COVID-19. They were intercorrelated, loading on a single higher order factor, thereby providing

evidence of a COVID Stress Syndrome. Higher scores indicate greater levels of COVID-19 related distress. These scales performed well on various indices of reliability and validity [66].

Having described some assessment instruments designed to assess anxiety specifically related to COVID-19, some studies of anxiety during the COVID-19 pandemic used generic measures of anxiety. For example, the Generalised Anxiety Disorder (GAD-7) scale [67] was also extensively used in COVID-19 related research. Interestingly, it was used in several studies to measure anxiety in dentists due to the COVID-19 pandemic [12, 13, 68-70]. The GAD-7 is a 7-item anxiety scale with strong criterion, construct, factorial and procedural validity for identifying probable cases of Generalized Anxiety Disorders. It is also an excellent severity measure since increasing scores on the GAD-7 are strongly associated with multiple domains of functional impairment (all 6 Medical Outcomes Study Short-Form General Health Survey Scales and disability days). A score of 10 or greater on the GAD-7 represents a reasonable cut point for identifying cases of GAD. Cut points of 5, 10 and 15 might be interpreted as mild, moderate and severe levels of anxiety on the GAD-7. It may be particularly useful in assessing symptom severity and monitoring change across time [67].

The above described measures provide an invaluable resource for gaining a comprehensive understanding of the mental health impact of COVID-19. In the following section, the COVID-19 Anxiety Syndrome Scale (C-19ASS), a highly useful clinical tool that may help clinicians to recognize COVID-19-specific dysfunctional coping strategies will be discussed in detail.

2.4.2 COVID-19 ANXIETY SYNDROME SCALE

The COVID-19 Anxiety Syndrome Scale was developed by Nikcevic and Spada in 2020 to reliably identify the presence of anxiety syndrome features associated with COVID-19 among the general adult population in the U.S. [59]. This scale is a 9-item scale measuring 2 factors: avoidance and perseveration (Table 1). Out of the nine items, three items characterize avoidance behaviour with questions like "I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)", "I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19)", "I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19)". The rest six items are perseveration thinking behaviours, with questions like, "I have checked myself for symptoms of coronavirus (COVID-19)", "I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19)", "I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work", "I have checked my family members and loved ones for the signs of coronavirus (COVID-19)", "I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19)", "I have imagined what could happen to my family members if they contracted coronavirus (COVID-19)". Each item has a five-point Likert-type scale to indicate the level of agreement ("0. Not at all", "1. Rarely, less than a day or two", "2. Several days", "3. More than 7 days", "4. Nearly every day"). Higher scores on the scale indicate higher levels of COVID-19 anxiety. This scale has demonstrated acceptable levels of reliability and concurrent validity [59]. This scale was first developed for the U.S. general adult population and has been validated to be used in Canadian dentists in both English and French [71].

Table 1 COVID-19 Anxiety Syndrome Scale (C-19ASS)					
Please rate the extent to which each statement applies to you **over the last two weeks** Avoidance (0-12) Perseveration (0-24)	Not at all **(0)**	Rarely, less than a day or two **(1)**	Several days **(2)**	More than seven days **(3)**	Nearly every day **(4)**
1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)					
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					
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).					

2.5 COVID-19 ANXIETY EXPERIENCE

The COVID-19 pandemic has had diverse impacts on different populations. The COVID-19 Anxiety Syndrome Scale (C-19ASS) specifically focuses on the fears and concerns associated with the risk of contracting the virus. It encompasses worries about the health and well-being of family members and loved ones, the transmission of the infection and the potential consequences of being infected. However, it is essential to recognize that the pandemic has led to an increase in anxiety levels, which may not be directly linked to the fear of infection. Factors such as imposition of public health measures including government-imposed travel and social gathering restrictions, growing financial losses due to the loss of jobs and emotional distress caused by social isolation could also have significantly contributed to the overall anxiety experienced by the populations during the pandemic.

The subsequent sections will explore the anxiety experiences related to the pandemic in the general population, healthcare providers and dentists.

2.5.1 COVID-19 Anxiety among general population

The COVID-19 pandemic has led to mental health sequelae with associated risks and reduced quality of life in the general population [72]. The fear of COVID-19 infection along with social isolation, economic instability, uncertainty, unemployment and barriers to health services have exerted a negative influence on public mental health [73]. In March 2022, the WHO reiterated the substantial impact of the pandemic on mental health and well-being globally; stating that in the first year of the COVID-19 pandemic there was a 25% increase in anxiety and depression globally and that young people are at increased risk of suicide and self-harm injuries [74]. This massive spike was attributed to the unprecedented stress caused by the social isolation

resulting from constraints on people's ability to work, seek support from loved ones and engage in their communities [74]. Loneliness, fear of infection, suffering and death for oneself and for loved ones, grief and bereavement and financial worries have also been cited as stressors leading to anxiety and depression [74]. Moreover, access to mental health services has been a global problem prior to the pandemic and has been severely impeded during the pandemic. According to a WHO survey, the COVID-19 pandemic disrupted or halted critical mental health services in 93% of the countries while the demand for mental health is increasing [75].

Findings from a cross-sectional survey in China during the initial stage of the COVID-19 outbreak suggest that 53.8% of the respondents rated the psychological impact of the outbreak as moderate or severe [76]. Among this population, 28.8% reported moderate to severe anxiety, 8.1% reported moderate to severe stress levels and 75.2% were worried about their family members contracting the COVID-19 virus [76].

In Canada, 15% of adults (18 years and above) screened positive for generalized anxiety disorder and 19% for major depressive disorders from February to May 2021 according to the findings released by Statistics Canada and the Public Health Agency of Canada [61]. The Mental Health Research Canada (MHRC) reported that Canadians are experiencing considerable anxiety and depression during the pandemic, which is arguably at an all-time high [14]. In fact, the Canadian adults who were already diagnosed with anxiety before the onset of the COVID-19 pandemic, experienced a four-fold increase in anxiety levels, from 5% to 20% during the pandemic [14].

People were worried about the increasing number of diagnoses and deaths in Canada and the rest of the world. According to Statistics Canada, many Canadians were anxious about overloading the health care system, the health of family members, their own health and being socially

isolated [77]. In addition to the previously discussed causes of anxiety among the general population, anxiety and depression were associated with perceived unmet healthcare needs in Canadians during this pandemic [78]. In a cross-sectional study conducted between September to December 2020 in the Canadian Longitudinal Survey on Aging (CLSA), the presence of anxiety and depression were associated with higher odds of challenges in accessing health care, not visiting a hospital or doctor when needed, experiencing barriers to COVID-19 testing and among females in general [78]. These findings indicate that the COVID-19 pandemic has had substantial mental health impacts on populations in Canada. These effects can be attributed to the fear of contracting the virus as well as the more generalized anxiety stemming from external factors including government restrictions, financial hardships, uncertainty and disruptions in daily routines brought about by the pandemic.

While the general population encompasses people from various backgrounds and age groups without any distinctions, it is also imperative to understand the specific impacts on those who are the backbone of the entire healthcare system, the healthcare workers in various disciplines. The COVID-19 pandemic has challenged the capacity of hospitals and intensive care units (ICUs) worldwide. Organizational risk factors including increased work demands, the trauma of caring for patients who are critically ill with the risk of being infected represent important exacerbating factors for poor mental health among healthcare workers.

2.5.2 COVID-19 Anxiety Among Healthcare Workers

The COVID-19 pandemic had an unprecedented impact on healthcare workers, with anxiety being one of the most commonly reported mental condition. Frontline healthcare workers played a crucial role in caring for patients with COVID-19. Despite the lack of treatment

guidelines and feeling inadequately supported, they continued to perform their tasks, all while ensuring that they did not get infected themselves or transmit the disease to other sick patients.

Mental health is a "state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community" [79]. Multiple studies have reported that COVID-19 negatively affected the mental health of the healthcare workers. A cross-sectional study conducted early in 2020 in Singapore described healthcare workers as a vulnerable population experiencing high levels of anxiety and needing psychological interventions to support their well-being [80]. However, another study on longitudinal mental health data in Italian health care workers found an overall decrease in anxiety and depression symptoms 14 months after the first wave of the COVID-19 pandemic (March to April 2020) [81]. In Jordan, researchers reported that more than half (61%) of the healthcare workers experienced anxiety and 65% experienced depression during the pandemic [82]. There was significant worsening of anxiety and depression among healthcare workers [83, 84]. Moreover, frontline work [85-87] and increased workloads [86, 88] were significantly associated with the development of psychological problems among this group. Sampaio et al found that increased fear of infection and transmission of COVID-19 corresponded to increased anxiety symptoms among nurses working in healthcare settings in Portugal [89].

The COVID-19 pandemic posed unique challenges to healthcare professionals in Canada as well, which included adverse mental health impacts. Within this context, a cross-sectional study found concerning prevalence rates of anxiety (38%), depression (41%) and emotional exhaustion (60%) among nurses in one Canadian province [90]. Another cross-sectional survey assessed the self-reported prevalence of anxiety, stress, depression and obsessive-compulsive

symptoms in healthcare workers and other workers seeking support through Text4Hope, an evidence-based SMS text messaging service in Alberta [91]. The self-reported symptoms of stress, anxiety and depression were all statistically significantly higher in other workers than healthcare workers during the pandemic [91]. A mixed method study utilizing validated questionnaires and semi-structured qualitative interviews reported anxiety (67%), mild to severe depression (57%) and stress (54%) among Critical Care Registered nurses in Western Canada [92]. Literature has demonstrated heightened anxiety among Canadian nurses amid the COVID-19 pandemic. Additionally, an online national survey among medical oncologists revealed that 54% experienced anxiety and 52% experienced depression [93].

In summary, during this crisis, there were significant concerns regarding the mental health status of frontline healthcare workers [49]. They put the well-being of their patients above their own because of their sense of duty towards their patients and the broader public. In this context, it is also important to acknowledge that a particular subsection of healthcare providers, namely the oral healthcare providers, also face challenges during the infectious disease outbreaks, such as the COVID-19 pandemic. Their close interactions with the patients, performance of aerosol-generating procedures and the frequency with which practice guidelines were issued lead to severe psychological burden on dentists.

2.5.3 COVID-19 Anxiety among Oral Health Care Providers (OHCPs)

2.5.3.1 Infection rates in OHCPs

Due to the nature of their work, dentists have a high potential exposure to SARS-CoV-2, second only to medical practitioners working directly with COVID-19 patients and in other high-risk settings [94]. Oral health care settings carry a potentially high risk of causing cross-infection

between dentists and patients and among dental staff members due to close contact and use of aerosol generating procedures [19, 95, 96]. Common instruments used for oral health care (for example high-speed handpieces) can splash patient saliva or blood directly onto dental staff members and patients and aerosolize these fluids, potentially suspending them in the air for several hours [19, 95-97]. Consequently, as the COVID-19 pandemic emerged, routine dental practices in many countries were temporarily suspended during the initial period to contain the spread of the COVID-19 infection [96, 98, 99] and only emergency procedures were carried out during this period [100]. In Canada, during the initial weeks of the pandemic, dental regulatory authorities across Canada obliged dentists to close their offices to routine care and provide emergency care only [101-103].

In response to the perceived threat, dentists diligently implemented measures to curb the transmission of COVID-19 within their profession and the community. The highly infectious nature of COVID-19 required robust personal protection for dental staff members, new screening protocols for patients and sets of personal protective equipment [104-106]. Several studies were conducted worldwide to estimate the prevalence of COVID-19 infection among dentists. A longitudinal study designed by Araujo et al to track infection control practices and COVID-19 infection rates among U.S. dentists reported that the estimated prevalence by June 2020 was 0.9% [107]. The 6-month cumulative prevalence from this study remained low at 2.6% [108]. Similarly, the results from a cross-sectional study in Iran revealed a low incidence (0.8%) of COVID-19 infection among the surveyed dentists [109]. However, a cross-sectional study carried out between May and July 2022 among dentists in Italy reported that 10% of the vaccinated dentists contracted COVID-19 infection [110]. The low COVID-19 incidence rate of

5.10 per 100,000 person-days among dentists practicing in the community in Canada was reassuring to the dental and general community [111].

Despite being initially categorized as a high-risk profession during the early stages of the pandemic, dentists exhibited lower infection rates overall.

2.5.3.2 COVID-19 related anxiety in dentists

While studies have reported relatively lower COVID-19 infection rates in dentists, their perceived high risk of COVID-19 infection caused significant anxiety in their professional roles. This finding is consistent with previous studies during SARS and MERS-CoV-2 outbreaks [112, 113]. According to a cross-sectional study conducted among Iraqi dentists in July 2020, more than 80% of the respondents were anxious of contracting the COVID-19 infection. The self-reported anxiety levels were higher among younger dentists and females [98]. Another cross-sectional survey among 1302 dentists from China, India, Israel, Italy and the UK showed that the positive association between subjective overload and psychological distress differed among the countries, presumably due to social, cultural and environmental factors [114]. For example, dentists in Italy had higher anxiety than the other countries since the healthcare system in Italy was severely burdened with the COVID-19 disease [114]. Chen et al investigated the prevalence of mental health outcomes during the COVID-19 pandemic among emergency dental staff in China and 36.3% of the survey respondents reported anxiety [68]. Ahmed et al [98] confirmed symptoms of anxiety in 78% of the reporting dentists from 30 countries, highlighting the fear of infection and transmission to families.

While cross-sectional studies of anxiety levels among dentists highlight the outcome at a particular time-point, it is also essential to understand the change of anxiety experience among

them over time to understand the trends and associations with other environmental factors that could play a role in determining the anxiety levels. A qualitative longitudinal study was conducted by Beaton et al [115] to understand the COVID-19 associated psychological impacts on dental trainees, primary care dentists and dental staff in Scotland. Participants were asked about the COVID-19 associated impacts including emotional exhaustion, the impact of the pandemic on their work and training, adapting to new protocols and about their overall health and well-being weekly from June 2020 to December 2020. Trajectory analysis revealed that the participants worried about their future career and finances and experienced hardship in adapting to new working environments and safety protocols. They were also concerned about the impact of COVID-19 on their patients' dental treatments and overall well-being. An in-depth analysis of their responses revealed that the high uncertainties and worry related to their training and career collectively took an emotional toll on the participants [115]. Another longitudinal study was designed to assess the prevalence of anxiety and depression symptoms among dentists and dental hygienists in the United States from June 2020 through June 2021 and understand factors influencing their mental health during the COVID-19 pandemic [23]. Dentists and dental hygienists answered monthly questionnaires which included the validated Patient Health Questionnaire-4 (PHQ-4) [116] to screen for symptoms depression and Generalized Anxiety Disorder-2 [117] for anxiety symptoms. The results showed that anxiety symptom rates peaked in November 2020 (17% of dentists, 28% of dental hygienists) and declined to 12% for both professions in May 2021. Depression symptom rates were highest in December 2020 (17% of dental hygienists, 10% of dentists) and declined to 8% in May 2021. Overall, 17.7% of dental healthcare workers reported anxiety symptoms, 10.7% reported depression symptoms and 8.3% reported symptoms of both [23]. This study highlighted the crucial time-related changes in the

anxiety levels of dentists and dental hygienists but the response rate of this survey was only 6.7%. Moreover, the authors did not quantify the amount of anxiety experienced by the respondents.

Overall, it is evident that the COVID-19 pandemic has significantly impacted the anxiety levels of people from various backgrounds, including dentists. To better understand the anxiety experience due to a rapidly evolving infectious disease outbreak, we need to study a population over a time period. To our knowledge, very few studies have tried to capture the anxiety experience over time among dentists and there are no longitudinal studies quantifying the pandemic associated anxiety levels over multiple time points among Canadian dentists. The effects of the COVID-19 pandemic on the dentists' anxiety levels were highly significant and consistent with the reports observed during the past pandemics. By understanding the COVID-19 associated anxiety among this cohort, we will have evidence about the anxiety levels, which can be used to create support systems.

3. RATIONALE

The COVID-19 pandemic posed significant challenges and adversely impacted the lives of people worldwide since its onset in 2019. In contrast to previous global alerts and pandemics, COVID-19 has entailed a public health response that was unparalleled in Canadian history. This crisis presented a considerable challenge to all healthcare systems and workers [118] and highlighted the critical role of healthcare professionals, including oral healthcare personnel, in combatting infectious diseases. The dental profession experienced unprecedented disruption amid COVID-19 as well. Indeed, dentists' close interactions with patients and performance of aerosol-generating procedures created unique challenges during this pandemic. Despite the rapid vaccine rollout beginning in December 2020 and the progressive lifting of public health restrictions thereafter, authorities continued urging Canadian dentists to remain vigilant. More recent challenges included the emergence of novel SARS-CoV-2 variants and the ongoing evolution of public health policies. Dentists also highlighted longer-term fears for the economic viability of their dental practices [119].

Prepandemic literature has already reported high rates of suicidality, burnout, stress, anxiety and depression among dentists [120, 121]. With the addition of pandemic-related stressors, there has been a pressing need for further mental health research in the profession. The COVID-19 crisis had a profound impact on dental professionals and global dental practice [96, 122] and thus, there is burgeoning interest in the impact of the COVID-19 pandemic on psychological well-being of dentists. Accordingly, numerous studies conducted during the pandemic have identified high levels of self-reported mental health symptoms among dentists; however their cross-sectional designs prevented the assessment of temporal changes in mental health symptoms as the pandemic evolved. As the epidemiological situation of an infectious

disease outbreak or global pandemic like COVID-19 is constantly changing and evolving with time, more longitudinal studies are needed to understand the changes in anxiety levels and the factors associated with it.

The psychological well-being of dentists is a priority; however, as we read in the literature review, further research regarding the COVID-19 related mental health outcomes among Canadian dentists is warranted. We do not yet have a study focussing on the anxiety levels of dentists practising in Canada during this pandemic, over a prolonged period of time. Evidence based interventions to manage anxiety among this group of healthcare workers are needed to mitigate the mental health effects of infectious disease events such as COVID-19. It is essential for the concerned organisations to understand the unprecedented strain on the dentists in Canada and understand the trends in anxiety at different time points during this pandemic to reinstate their psychological well-being and positive functioning.

To the best of our knowledge, there is a lack of longitudinal studies in this context among dentists in Canada. The present prospective cohort study aims to bridge this knowledge gap by addressing the COVID-19 related anxiety among Canadian dentists. This study would be a crucial step in informing the policy makers to develop effective policy for mental health recovery of this group of healthcare professionals.

4. STUDY OBJECTIVES

The overall goal of this research is to estimate the anxiety levels among dentists in Canada during the COVID-19 pandemic.

The specific objectives of this project are:

1. To validate the COVID-19 Anxiety Syndrome Scale (C-19ASS) questionnaire against the Generalized Anxiety Disorder-7 (GAD-7) tool in a population of dentists in Canada.
2. To describe the mean anxiety levels among dentists in Canada during the COVID-19 pandemic and how they vary over time.
3. To estimate the differences in the anxiety levels in dentists in Canada following vaccination against SARS-CoV2.
4. To estimate the differences in the anxiety levels in dentists in Canada by age, sex and practice type.
5. To describe the economic impact of the COVID-19 pandemic and the anxiety due to this impact among dentists in Canada.

A preface to Manuscript I

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 U.S. and has been validated in several countries. Given the importance of understanding anxiety and stress among dentists, it is important to evaluate the validity of the C-19ASS among practising dentists. Early in the pandemic, as we initiated a prospective cohort study of COVID-19 infection rates among dentists in Canada 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 needed to ensure that the C-19ASS is valid in this group, including using it in French and English languages. Therefore, in the following manuscript, the validity of the C-19ASS was evaluated for dentists practising in Canada, in English and French languages.

5. MANUSCRIPT I

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

Running title: Assessment of validity and reliability of the COVID-19 Anxiety Syndrome Scale in a sample of dentists in Canada

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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 USA. 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), 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.

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.

Key words: COVID-19 Anxiety Syndrome Scale, anxiety, validity, dentists, reliability, Canada

Introduction

The COVID-19 outbreak was declared as a public health emergency of international concern by the World Health Organisation (WHO) on January 30, 2020 and characterised as a pandemic on March 11, 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 US 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 generalised 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 generalised 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 (AGP) (Estrich et al., 2020). A range of studies in various countries (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 etal., 2020; Duruk etal., 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; K. Y. Wu et al., 2021; P. E. Wu et al., 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).

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 US (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, 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.)

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 Generalised Anxiety Disorder-7 (GAD-7) tool; and 4) evaluate the internal reliability of the C-19ASS.

Methods

To address these objectives, we used data from a prospective cohort study aiming to estimate COVID-19 incidence rates among licensed 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 Generalised Anxiety Disorder-7 (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).

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 1 in Supplementary material) The items are framed as statements regarding peoples' ways of dealing with the threat of COVID-19. Participants respond to a five-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 two 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 Generalised Anxiety Disorder (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 generalised 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).

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 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 maximum likelihood (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), Root Mean Square Error of Approximation (RMSEA) 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.

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 examining the correlation matrix of the variables (all items were correlated at least 0.03 with at least one other item); the Kaiser-Meyer-Olkin (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 which 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.

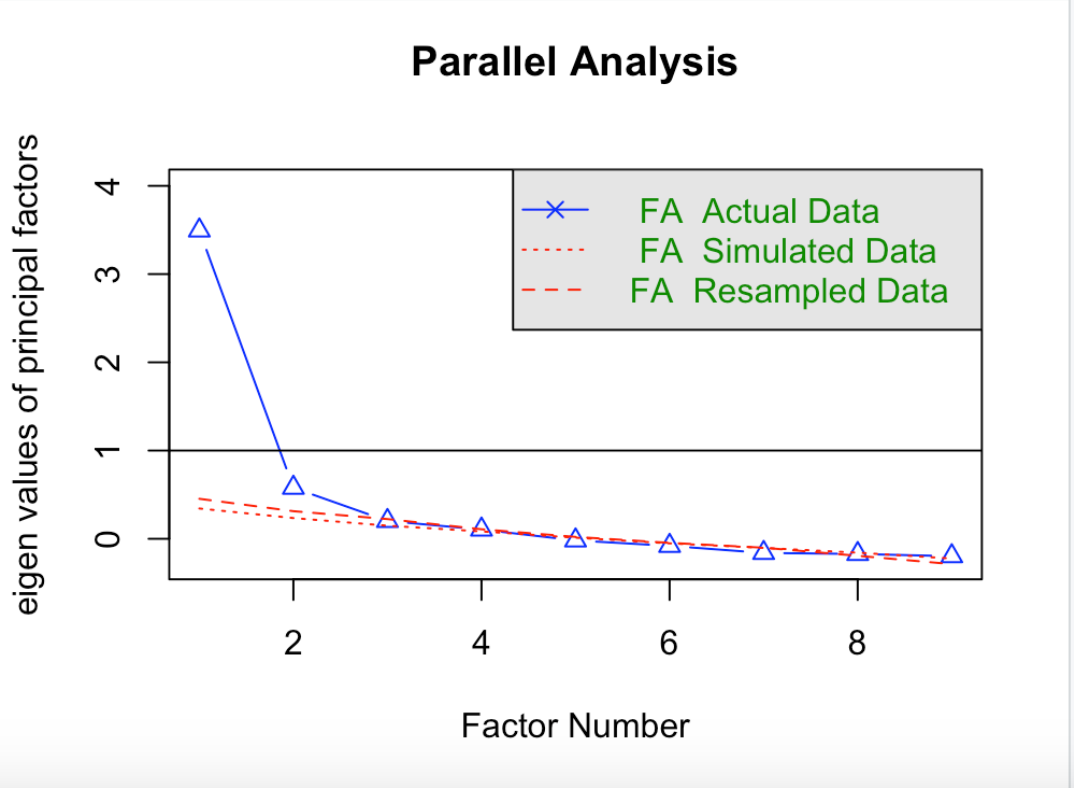
Table 1. Descriptive characteristics of the study participants (N=619)

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

Figure 1 Parallel Analysis Plot



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: χ^2= 67.49, degrees of freedom (df) = 26 and the resulting χ^2/df=2.6. The results of CFA on French subset: chi-square test χ^2= 32.68 and df= 26. The resulting χ^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 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

Note. χ^2 (chi-square test statistic); df (degree of freedom); CFI (Comparative Fit Index); TLI (Tucker Lewis Index); SRMR (Standardized Root Mean Square Residual); RMSEA (Root Mean Square Error of Approximation)

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 data, revealing that the total C-19ASS, as well as the avoidance and perseveration factor scores were 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 2 in Supplementary material)

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

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 exploratory factor analysis (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 utilising 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 to 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.

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.

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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Supplementary Material for Manuscript I

Table 1. COVID-19 Anxiety Syndrome Scale

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 seven days (3)	Nearly every day (4)
1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)					
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					
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).					

Table 2. Exploratory Factor loadings for divergent validity of C-19ASS from GAD-7

C-19ASS Items	Factor 1	Factor 2	Factor 3
1. I have avoided public using transport because of the fear of contracting coronavirus (COVID-19)	-0.04	0.02	0.60
2. I have checked myself for symptoms of coronavirus (COVID-19).	-0.01	0.83	-0.07
3. I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19).	0.00	-0.10	0.80
4. I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19).	-0.03	-0.15	0.72
5. I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).	-0.03	0.12	0.60
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).	-0.06	0.10	0.47
7. I have checked my family members and loved ones for the signs of coronavirus (COVID-19).	0.00	0.87	0.03
8. I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).	-0.01	0.72	0.18
9. I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).	0.09	0.34	0.45
GAD-7 Items			
1. Feeling nervous, anxious or on edge	0.88	0.01	-0.01
2. Not being able to stop or control worrying	0.90	0.00	-0.03
3. Worrying too much about different things	0.95	0.01	-0.08
4. Trouble relaxing	0.88	0.00	-0.02
5. Being so restless that it is hard to sit still	0.68	0.03	0.00

6. Being easily annoyed or irritable	0.71	-0.03	0.10
7. Feeling afraid as if something awful might happen	0.75	-0.04	0.17

Preface to Manuscript II

In the previous manuscript we evaluated the validity and reliability of the COVID-19 Anxiety Syndrome Scale (C-19ASS) in English and French among Canadian dentists and it can be used to evaluate COVID-19 related anxiety in this population. As a follow-up to this, further validation of this anxiety measure in Canadian dentists can be done by assessment of a longitudinal measurement aspect, responsiveness (sensitivity to change) which is an important psychometric property of a measure. Responsiveness is the ability of a measure to detect a real change in the true value of an underlying construct. To our knowledge, the responsiveness (sensitivity to change over time) of the C-19ASS among this population during the COVID-19 pandemic has not been reported by any studies. Therefore, the objectives of the present study in this manuscript were to estimate the sensitivity to change over time of the C-19ASS among a sample of Canadian dentists and identify factors associated with COVID-19 related anxiety in Canadian dentists over time. We tested the following hypotheses: 1) With increased time during the COVID-19 pandemic, the anxiety levels of the dentists decreased; 2) With increases and decreases in the COVID-19 disease prevalence in the province in which the dentists were working, their anxiety levels similarly increased and decreased.

6. MANUSCRIPT II

Sensitivity to change of the COVID-19 Anxiety Syndrome Scale among Canadian dentists

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Declarations

Human Ethics and Consent to participate declaration: This study protocol was approved by the Institutional Review Board of McGill University, Montreal– IRB Review Number A06-M49-20A (20-06-018). Participants provided informed consent by email and then completed the surveys.

Consent for publication: Not applicable

Availability of data and materials: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Competing interests: The authors declare that they have no competing interests to disclose.

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Author's contributions: R.S., P.A. and S.M. contributed to the conception, design of the work; analysis and interpretation of the data; drafted the manuscript. P.A., S.M. W.S., M.M., C.Q., M.G. contributed to the acquisition of the data. All authors reviewed the manuscript.

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Abstract

Introduction: There is a need to further validate the COVID-19 Anxiety Syndrome Scale (C-19ASS) by evaluating its sensitivity to change over time.

Aim: To estimate the sensitivity to change over time of the C-19ASS in a sample of Canadian dentists. To estimate the effect of age, sex, practice type and vaccination on the anxiety levels of dentists in Canada.

Methods: Longitudinal data were used from a prospective cohort study conducted to estimate the incidence of COVID-19 among dentists practising in Canada. Mixed effects ordinal logistic regression models were used to estimate the association between total C-19ASS scores and follow-up time in the study and COVID-19 case counts in the province of practice of the participants during the 14 days prior to completing the C-19ASS questionnaire. Mixed effects models were utilized to identify the factors associated with COVID-19 related anxiety.

Results: The odds of being in a more severe category of anxiety were reduced by 26% (OR 0.74, 95% C.I. 0.72-0.76) with every 30-day increase in the follow-up time. The odds of being in a more severe category of anxiety increased by 20% (Odds Ratio =1.20, 95% C.I.= 1.12-1.27) with each 10,000 COVID-19 case increase in the dentists' work province during the 14 days prior to data collection. Age, sex and practice type were significantly associated with COVID-19 related anxiety in dentists.

Conclusion: The C-19ASS is sensitive to change over time and with external anxiety stimuli. COVID-19 related anxiety among dentists was associated with age, sex and practice type.

Keywords: C-19ASS, dentists, responsiveness, anxiety, longitudinal, vaccination

INTRODUCTION

The COVID-19 pandemic led to increases in anxiety, depression and overall psychological distress. [1] There were adverse psychosocial impacts on various sociocultural groups in Canada. [2] There are reports of lasting anxiety following COVID-19 infection[3] and this experience evolved over time as the pandemic progressed. A recent review of longitudinal studies examining changes in mental health and lifestyle among college students during the COVID-19 pandemic revealed increases in anxiety, mood disorders, alcohol use, sedentary behaviour, internet use and a decrease in physical activity. [4] Healthcare workers also experienced significant levels of anxiety, especially those on the frontline and nurses because they were responsible for the care of patients with COVID-19 and more mentally overwhelmed by the lack of specific treatment guidelines or support. [5] A rapid review of the impact of COVID-19 on the mental health of healthcare workers identified underlying organic illness, female gender, concern about family, fear of infection, lack of personal protective equipment (PPE) and close contact with COVID-19 as risk factors associated with adverse mental health outcomes. [6]

There was considerable psychological impact of the pandemic on the mental health outcomes of dentists worldwide as well. [7] Prior to the COVID-19 pandemic, literature has reported high rates of suicidality, burnout, stress, anxiety and depression among dentists. [8,9] Dental settings present a potentially high risk of COVID-19 cross-infection as dental care workers work in closed environments and conduct aerosol-generating procedures.[5] Many dentists in Canada reported increased work-related stress as their tasks increased significantly during the pandemic. [10] The early months of the pandemic were complicated by personal protective equipment (PPE) shortages and heightened anxieties among patients and dental staff. [11] Despite

that COVID-19 vaccines were rapidly administered, starting in December 2020 and public health restrictions were progressively lifted thereafter, authorities continued urging dentists to remain vigilant. [12] Anxiety and depression in US dental healthcare workers during the pandemic were associated with demographic and professional characteristics as well as perceived risk of COVID-19. [13]

In China, the frontline dental staff were more likely to suffer from anxiety disorders than the general public. [14] Older age, sufficient personal protective measures and good relationships with colleagues and patients were factors associated with decreased anxiety among them during the pandemic. [14] Furthermore, vaccination against COVID-19 is an effective tool to control the spread of this infectious disease[15] and studies have shown that the anxiety levels of vaccinated healthcare providers were lower compared to the non-vaccinated healthcare providers. [15]
Elevated levels of stress, anxiety and depression could have long-term psychological implications on all healthcare workers, [16] therefore it is of paramount importance to identify the risk and protective factors associated with COVID-19 related and generalized anxiety in dentists for their long-term psychological well-being.

A number of instruments have been developed and validated for assessing fear, anxiety and stress related to COVID-19 (e.g., the Fear of COVID-19 Scale[17], Multidimensional Assessment of COVID-19 related fears[18], Coronavirus Anxiety Scale[19], COVID-19 Anxiety Scale[20], COVID Stress Scales[21], Perceived Coronavirus Threat Questionnaire[22]). A widely used instrument, the COVID-19 Anxiety Syndrome Scale[23] was initially developed to reliably assess the presence of COVID-19 anxiety syndrome features in a general US adult population. Later, it was validated in several countries including Iran, [24] Italy, [25] Indonesia, [26] Brazil, [27] Saudi Arabia[28]

, Canada[29] and Greece. [30] A previous study in Canada has evaluated the validity and reliability of the C-19ASS in English and French among Canadian dentists and it can be used to evaluate COVID-19 related anxiety in this population. [29]

As a follow-up to this, further validation of this anxiety measure in Canadian dentists can be done by assessment of a longitudinal measurement aspect, responsiveness (sensitivity to change) which is an important psychometric property of a measure. Responsiveness is the ability of a measure to detect a real change in the true value of an underlying construct. [31] Due to heightened interest in the impact of the COVID-19 pandemic on the psychological health of dentists, numerous cross-sectional studies have been conducted during this epidemiological crisis[32-36], however, they have not reported how COVID-19 related anxiety changed over time among dentists as the pandemic evolved. There is a pressing need for further longitudinal studies to improve our knowledge on this subject.

Previously, studies have tested whether COVID-19 risk was positively correlated with mental health concerns among dental healthcare workers. [13] For this purpose, COVID-19 case rate per 100,000 people in each US state and territory from the Centers for Disease Control and Prevention (CDC) for the 7 days before each survey were obtained. [13] Data on the count of COVID-19 cases reported in Canada was extracted from https://health-infobase.canada.ca/covid-19/ to estimate the extent to which COVID-19 disease burden is associated with salivary cortisol levels in dentists during 1 year. [11]

To our knowledge, the responsiveness (sensitivity to change over time) of the C-19ASS among this population during the COVID-19 pandemic has not been reported by any studies. There is a need to further validate the C-19ASS among Canadian dentists by investigating its responsiveness (sensitivity to change over time) using longitudinal data. Further research regarding risk factors associated with COVID-19 related anxiety in dentists practising in Canada is warranted in order to build a resilient workforce. Adequate evidence is required about particularly vulnerable groups among dentists practising in Canada to provide targeted psychological support to them.

Therefore, the objectives of the present study were 1) to estimate the sensitivity to change over time of the C-19ASS among a sample of Canadian dentists; 2) to identify factors associated with COVID-19 related anxiety in Canadian dentists over time and 3) to estimate the differences in the anxiety levels in dentists in Canada following vaccination against SARS-CoV2. We tested the following hypotheses: 1) With increased time during the COVID-19 pandemic, the anxiety levels of the dentists decreased; 2) With increases and decreases in the COVID-19 disease prevalence in the province in which the dentists were working, their anxiety levels similarly increased and decreased.

METHODS

The study protocol was approved by the Institutional Review Board of McGill University, Montreal – IRB Review Number A06-M49-20A (20-06-018). To address the aims of this study, data were used from a prospective cohort study conducted with the aim of estimating the incidence rate of COVID-19 among licensed dentists in Canada over a 12-month study

period. [37] A convenient non-probability sampling strategy was used to maximize participation and retention.

In August 2020, 644 dentists were recruited through email invitations sent to all registered members in the rosters of the collaborating organisations, which included dental regulatory authorities, dental associations and dental schools covering provinces and territories across Canada.

After providing informed consent, participants were invited to complete an online baseline survey where detailed information including sociodemographic information, type, province of practice and number of years of practice were collected. Every 4 weeks after baseline, participants completed an online questionnaire through a LimeSurvey [22] platform until October 2021. For every follow-up data collection point starting from November 2020, participants completed the C-19ASS (see Appendix A): a 9-item instrument that assesses the presence of perseverate thinking (6 items) and avoidance (3 items) jointly defined as COVID-19 anxiety syndrome. To aid interpretation, we categorized the continuous total C-19ASS scores into mild (0-12), moderate (13-24) and severe (25-36) levels of anxiety. The participants who completed the follow-ups from November 2020 (N=632) till October 2021 were analyzed in the present study. Those who provided questionnaire responses (N=632) were analyzed in the present study. To account for the change in the pandemic situation in Canada, we identified the total count of COVID-19 cases reported in the province of primary practice of the participant during the 14-day period prior to the date of follow-up survey completion, from https://health-infobase.canada.ca/covid-19/. We used mixed-effect ordered logistic regression models with random intercept to estimate the association between COVID-19 case counts, follow-up time and the C-19ASS scores. The mixed effect model allowed us to consider the correlation due to

repeated measures within a participant by including a random intercept. These association estimates aid in describing how strongly the C-19ASS scores of the participants change in relation to chronological time (November 2020 to October 2021) and with the change of the epidemiological situation of COVID-19 pandemic in their province.

Mixed effects ordinal logistic regression models were utilized to identify factors associated with COVID-19 related anxiety and to estimate the differences in the anxiety levels in dentists in Canada following vaccination against SARS-CoV2.

RESULTS

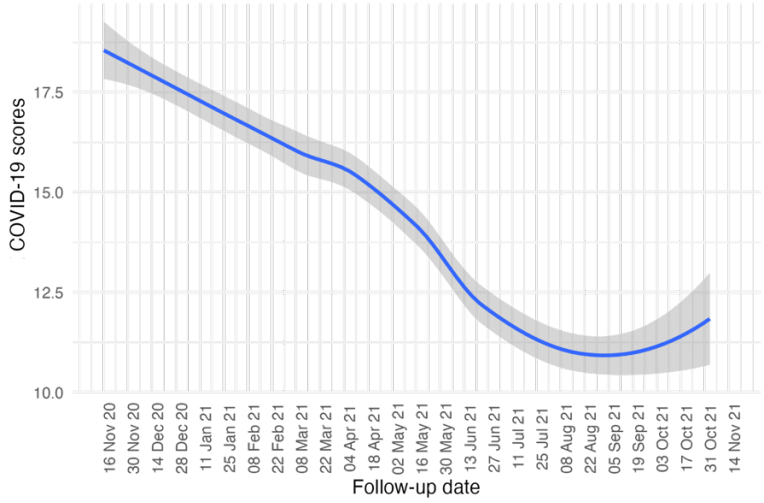
Demographic and dental practice characteristics of the study cohort are presented in Table 1. The mean age of the dentists was 47.3 years (standard deviation 11.4 years). There was a higher proportion of female participants (56.8%) in our sample.

The average trajectory of the total C-19ASS scores showed a progressive decrease from November 2020 to October 2021 (Figure 1). Ordinal mixed-effects regression analysis revealed that the mean C-19ASS scores of the dentists decreased over time. The output for the cumulative link mixed multivariate model fitted to the data is shown in Table 2. The odds of being in a more severe category of anxiety for the dentists reduced by 26% with every 30-day increase in follow-up time during the study (O.R.= 0.74, 95% C.I. 0.72-0.76). However, the odds of being in a more severe category of anxiety increased by 20% (O.R.= 1.20, 95% C.I.= 1.12-1.27) with every increase of 10,000 in the total count of COVID-19 cases in the province of primary practice of the dentists during the last 14 days from the date on which they completed the C-19ASS questionnaire.

Ordinal mixed-effects regression analysis to identify factors associated with COVID-19 related anxiety in Canadian dentists showed that with every increase of 11 years in the age of the dentists, the odds of the dentists being in a more severe category of anxiety reduced by 15% (OR 0.85, 95% CI 0.84 –0.85) (Table 3). The odds for male dentists being in a more severe category of anxiety were reduced by 11% (OR 0.89, 95% CI 0.89 – 0.90). Controlling for age, sex, follow-up time, province of primary practice and ethnicity of the dentists, the odds for specialists being in a more severe category of anxiety were increased by 48% (OR 1.48, 95% CI 0.61-3.59).

At the time of the baseline survey (August 2020), COVID-19 vaccines were not yet available to dentists in Canada. In the fourth follow-up period (January 2021 to February 2021) only 1.5% of respondents indicated that they had received at least one dose of the COVID-19 vaccine (Table 4). The proportion of participants who received at least one dose of the COVID-19 vaccine increased sharply between follow-up 4 and 6. At follow-up 6 in March 2021, 41.8% of respondents indicated that they had received one dose of the COVID-19 vaccine. At the last follow-up in October 2021, 97.7% of participants self-reported that they had received at least one dose of a COVID-19 vaccine. Compared with unvaccinated dentists, those vaccinated against SARS CoV2, had no reduction in odds of being in a more severe category of anxiety (OR 0.98, 95% CI 0.77 – 1.24) (Table 5).

Figure 1. Average trajectory of the total C-19ASS scores



Note: Gray band represents the standard deviations of the mean C-19ASS scores

Table 1. Demographic and Dental Practice Characteristics of the Study Cohort (N= 632)

Characteristic	n %
Sex	
Female	359 (56.8%)
Male	273 (43.2%)
Age (Years)	
20-30	43 (6.8%)
31-40	158 (25.0%)
41-50	172 (27.2%)
51-60	177 (28.0%)
61-70	69 (10.9%)
71-80	13 (2.1%)
Dental License Type	
Generalist	575 (91.0%)
Specialist	57 (9.0%)
Location of primary dental practice	
Alberta	27 (4.3%)
British Columbia	107 (16.9%)
Manitoba	26 (4.1%)
Newfoundland and Labrador	2 (0.3%)
Nova Scotia	33 (5.2%)
Ontario	236 (37.3%)
Prince Edward Island	11 (1.7%)
Quebec	160 (25.3%)
Saskatchewan	29 (4.6%)
Yukon	1 (0.2%)

Table 2. Association between the state of the COVID-19 pandemic, chronological time and C-19ASS scores

	Odds Ratios	95% C.I.
Variable name		
Follow-up time (each 30-day increase)	0.74	0.72-0.76
COVID-19 case burden (for each 10,000 case increase)	1.20	1.12 - 1.27

C.I. confidence interval; follow-up time is each 30-day increase in the follow-up time of the study; COVID-19 case burden refers to each 10,000 increase in the number of COVID-19 cases in the province of primary practice of the dentists in the last 14 days prior to completing the C-19ASS questionnaire

Table 3. Association between age, sex, practice type and C-19ASS scores

	Odds Ratios	95% C.I.
Variable name		
Age (each 11-year increase)	0.85	0.84-0.85
Sex Males Reference category- Females	0.89	0.89-0.90
Practice type Specialist Reference category-generalist	1.48	0.61-3.59

Note: Odds Ratios for more severe anxiety. Model adjusted for follow-up time, province of primary practice and ethnicity of the dentists

Table 4. Participant COVID-19 vaccination status by follow-up visit

	Follow-up 4 (Jan 2021) n (%)	Follow-up 5 (Feb 2021) n (%)	Follow-up 6 (March 2021) n (%)	Follow-up 7 (April 2021) n (%)	Follow-up 8 (May 2021) n (%)	Follow-up 9 (June 2021) n (%)	Follow-up 10 (July 2021) n (%)	Follow-up 11 (Oct 2021) n (%)
Not vaccinated	611 (98.5)	574 (94.6)	348 (58.2)	95 (16.6)	21 (3.8)	13 (2.4)	18 (3.2)	13 (2.3)
Vaccinated	9 (1.5)	33 (5.4)	250 (41.8)	479 (83.4)	531 (96.2)	526 (97.6)	538 (96.8)	553 (97.7)

Table 5. Association between vaccination against SARS-CoV2 and C-19ASS score

	Odds Ratios	95% C.I.
Vaccinated dentists	0.98	0.77 – 1.24

Model adjusted for follow-up time, age, sex, practice type, province of primary practice and ethnicity of the dentists.

DISCUSSION

We have previously investigated and reported the internal, convergent and cross-cultural validity of the C-19ASS, demonstrating the instrument works well with Canadian dentists. [29] Given the longitudinal nature of our work we wanted to also investigate the instrument's responsiveness to change during the COVID-19 pandemic. This study has built on our previous work by demonstrating the instrument's sensitivity to change, which is necessary for instruments to be used in longitudinal studies, particularly given the cross-sectional nature of previous psychometric validation studies. [23-25,30] The objectives of our study were 1) to estimate the sensitivity to change over time of the C-19ASS among a sample of Canadian dentists; 2) to identify factors associated with COVID-19 related anxiety in Canadian dentists over time and 3) to estimate the differences in the anxiety levels in dentists in Canada following vaccination against SARS-CoV2.

Assessment of responsiveness requires a longitudinal study design. [38] Methods to evaluate responsiveness usually involve an anchor-based method to explore the relationship between change over time in scores of the measure and change over time in an anchor. Responsiveness reflects the extent to which changes in a measure over a specified time frame relate to corresponding changes in a reference measure of health status. [39] It is commonly reported through minimally important difference (MID) estimate, whereby a change score on a measure should equal or exceed its MID estimate to be considered important. [40]A limitation in our study was that we did not have longitudinal data from a 'gold-standard' measure of anxiety. Having acknowledged this potential limitation in our study, we chose the approach of testing the changes in C-19ASS scores over time against two hypotheses: i) that anxiety ratings would

decrease with time as dentists became used to the pandemic; and ii) that their ratings would increase and decrease as local provincial COVID-19 case numbers also increased and decreased. Our analyses supported these hypotheses and so we conclude that the C-19ASS can be used to detect change over time in COVID-19 related anxiety ratings among French and English-speaking Canadian dentists. A similar approach was utilised in a study using data from the same prospective study which aimed to estimate the extent to which COVID-19 disease burden is associated with salivary cortisol levels of a cohort of Canadian dentists. [11] Data on the count of COVID-19 cases reported in Canada was extracted from https://health-infobase.canada.ca/covid-19/ and the results indicated a modest positive association between the dentists' salivary cortisol levels and the count of COVID-19 cases in Canada. [11] It also strongly suggested a link between COVID-19 related anxiety as measured with the C-19ASS and salivary cortisol levels in Canadian dentists during the COVID-19 pandemic. A similar method was utilized in a study to test whether COVID-19 risk was positively correlated with mental health concerns among US dental healthcare workers (DHCWs). [13] The results in that study showed that DHCWs living in states and during periods with high levels of COVID-19 community transmission had significantly higher odds of anxiety and depression symptoms than those living with lower transmission. [13]

We identified the following pivotal factors associated with COVID-19 related anxiety in Canadian dentists over time. Our findings show that dentists in older age groups had reduced levels of anxiety during the COVID-19 pandemic. These are consistent with previous reports about DHCWs in the US[13]and surveys that showed an increased prevalence of mental health symptoms among young adults. [41] A recent systematic review of dentists' psychological well-

being during the COVID-19 pandemic identified age as a risk factor for adverse mental health outcomes in this group. [7] Gasparro et al postulated that younger, less experienced dentists were more likely to develop psychological symptoms of anxiety and depression. [42] Zhao et al concluded that with increase in age, the frontline dental staff were less likely to suffer from anxiety disorders. [14]

As has been commonly found, [4,41] female dentists reported higher levels of anxiety than male dentists. A cross-sectional study on dental professionals in India reported that female dental professionals had more anxiety and depression. [43] This might be due to the fact that females are more vulnerable to mood and anxiety disorders. [44] Rates of depression and some anxiety disorders are higher in adult women. [44]

The specialists in our study had higher levels of anxiety as compared to the general dentists. This differs from a study investigating the prevalence of COVID-19 related anxiety among Iranian dentists in which there were no significant differences in the anxiety of general dentists and specialists. [45] There were no differences in mental health concerns between these groups of DHCWs in the US as well. [13]

In our study, we found that vaccination against COVID-19 did not have an effect on the anxiety levels in dentists. Uptake of COVID-19 vaccination contributes to low infection rates among oral-healthcare professionals but since they are a high-risk group for exposure to the SARS-CoV2-virus, [46-48] vaccinated dentists still experienced some level of anxiety. Contrary to our findings, vaccination against COVID-19 had positive effects on the anxiety levels of Turkish dental professionals. [49] The DHCWs in US who were unvaccinated experienced significantly

higher rates of anxiety and depression symptoms than those who were vaccinated. [13] These findings imply that if dentists have the resources to safely practice dentistry, including vaccination then psychological distress may be reduced.

Previous research regarding potential factors associated with the anxiety of frontline dental staff during the COVID-19 pandemic showed that personal protective measures could ease the anxiety of frontline dental staff, having less conflicts and good communication with colleagues and patients could help them. [14]

The results of our study must be interpreted with caution since it has some limitations. This study may have enabled self-selection bias because email invitations were sent to the majority of dentists practising in Canada during the pandemic but similar to other studies conducted during the COVID-19 pandemic, our response rate was low. The 632 dentists in our study represented just 3.1% of those invited to participate. Furthermore, to our knowledge there are no other prospective cohort studies that gathered self-reported measurements of anxiety among our population of interest during the COVID-19 pandemic. Notwithstanding the limitations of the present study, the results are important because responsiveness is a necessary aspect of psychometric evaluation of outcome measures in mental health care. [50] Some further recommendations for future research about C-19ASS among dentists include the following: a longitudinal study design including a global measure of anxiety can be utilised to evaluate the longitudinal construct validity of the C-19ASS in a sample of Canadian dentists. These would strengthen our findings about sensitivity to change over time of this COVID-19 anxiety measure in this population.

Conclusion

In summary, our project demonstrates the sensitivity to change over time of the C-19ASS among dentists in Canada over the course of 1 year during the COVID-19 pandemic. COVID-19 related anxiety in dentists in Canada was associated with demographic and professional characteristics.

This is an important step in supporting the validity of this measure and will enable documentation of changes in COVID-19 related anxiety ratings among dentists in Canada in relation to the COVID-19 pandemic.

Appendix A

COVID-19 Anxiety Syndrome Scale

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 seven days (3)	Nearly every day (4)
1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)					
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					
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).					

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Preface to Manuscript III

The findings of the previous manuscripts showed that the COVID-19 Anxiety Syndrome Scale (C-19ASS) is valid and reliable in English and French among Canadian dentists and so can be used to evaluate COVID-19 related anxiety in this population.

The COVID-19 pandemic led to a major public health crisis for countries, also causing unprecedented disruption for the dental profession worldwide. The limited provision of dental services and widespread closure of dental practices caused concerns among dental professionals. Studies have evaluated the pandemic's effect on dental patient volumes and on the broader healthcare sector but information regarding anxiety caused to the dentists practising in Canada due to the economic impact of the COVID-19 pandemic is still lacking in the literature. Therefore, in Manuscript III we have described the anxiety due to the economic impact of the pandemic on dentists in Canada and investigated the factors associated with anxiety and economic burden in this sample.

7. MANUSCRIPT III

Anxiety due to the economic impact of the COVID-19 pandemic on Canadian dentists

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Declarations

Ethics Approval and Consent to participate: This study protocol was approved by the Institutional Review Board of McGill University, Montreal– IRB Review Number A06-M49-20A (20-06-018). Participants provided informed consent by email and then completed the surveys.

Consent for publication: Not applicable

Availability of data and materials: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Competing interests: The authors declare that they have no competing interests to disclose.

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Author's contributions: RS, PA and SM: Conceptualization and design, data collection, data analysis, writing and editing. All authors read and approved the final manuscript.

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Will be submitted to: BMC Psychology journal

Abstract

Background

The COVID-19 pandemic led to a major public health crisis for countries, also causing unprecedented disruption for the dental profession worldwide. The limited provision of dental services and widespread closure of dental practices caused concerns among dental professionals.

Aim

The present study aimed to describe the anxiety due to the economic impact of the pandemic on dentists in Canada and investigate the factors associated with anxiety and economic burden in this sample.

Methods

Cross-sectional data from the October 2021 monthly follow-up in a prospective longitudinal cohort study conducted to estimate the incidence of COVID-19 among dentists practising in Canada, were used. Mixed effects ordinal logistic regression models were utilized to identify the factors associated with the anxiety levels and economic burden in dentists.

Results

Reduced revenue collection, the ability to offer limited dental treatments, reduced number of patients and increased costs involved in practice were the major practice-related factors that led to increased anxiety in dentists during the COVID-19 pandemic. Vaccination against COVID-19, guidance from the provincial dental regulatory authority and financial support schemes emerged as the top factors that helped them to manage their anxiety. Age, sex, province, ownership of dental practice and major practice-related factors were significantly associated with anxiety levels of the dentists. With every 11-year increase in age, the odds of the dentists having more severe economic burden increased by 4% (OR 1.04, 95% CI 1.02 –1.05). The odds for the

dentists in Ontario having higher economic burden compared to those in the Atlantic provinces were increased (OR 1.97, 95% CI 0.96 – 4.0). Specialists had 42% reduced odds for severe economic burden compared to general dentists (OR 0.58, 95% CI 0.31- 1.09). The odds for dental practice-owners having more severe economic burden were increased by 59% (OR 1.59, 95% CI 0.99 – 2.57) compared to non-owners of dental practices.

Conclusion

Age, sex, province, dental practice ownership and practice-related factors were associated with the anxiety levels of dentists. The economic burden on dentists during the COVID-19 pandemic was associated with age, province, practice type and ownership of dental practice.

Keywords: COVID-19, Canada, economic burden, anxiety, dentists

Background

The COVID-19 pandemic affected populations globally [1], imposing a particularly severe burden on the dental community. The risk of being infected and transmitting the infection to households contributed to psychological distress in oral healthcare workers (OHCWs) [2].

Due to the nature of their work, dentists had a high potential exposure to SARS-CoV-2, second only to medical practitioners working directly with COVID-19 patients and in other high-risk settings [3]. A strong potential for transmission of the etiologic agent, the SARS-CoV-2 virus existed in dental settings during the delivery of aerosol generating procedures (AGP) [4]. Handpieces and ultrasonic instruments used during dental procedures unavoidably generate aerosols containing blood and saliva droplets, which could result in the airborne spreading of COVID-19 [5].

Many countries adopted a range of policies and measures to contain the spread of COVID-19, including restrictions and lockdowns. The COVID-19 pandemic, its associated policies and the steps taken to contain its spread have affected dentists and the dental practice economy as well [6-11]. On March 16, 2020, the American Dental Association (ADA) called on dentists to postpone elective dental procedures for three weeks to mitigate the spread of COVID-19 and to reserve treatment for emergencies only [12]. The subsequent closure and reduced services of private dental practices throughout the United States led to decreased availability of oral health care [13]. The National Health Service in the United Kingdom took a similar action on March 25, 2020 [14]. The frequency with which the guidelines were issued, the need to adopt advanced measures for infection control in dental practice and the restrictions imposed on the scope of practice posed unprecedented challenges for oral health care.

Dentists had to work under stressful conditions due to the nature of their work. They faced a new reality, with more new guidance for patient screening, new sets of personal protective equipment (PPE), modifying diagnostic and treatment protocols, restricting practice to urgent oral health care and doing teleconsultations [14-16]. Lack of personal protective equipment, economic effects of COVID-19 on the dental profession due to the reduction in the number of patients, reduction of working hours, decreased number of elective dental treatments aggravated the stresses of dental professionals, a population already at a heightened risk for psychological distress [17].

There were serious monetary implications for dental practices worldwide [18]. General dental practices suffered financial losses as they could provide only emergency dental care. A survey conducted by the Irish Dental Association (IDA) in March 2020 reported that one-fifth of the participant dentists closed their practices [19]. The Irish government supported businesses including dental practices by allocating a COVID-19 Business loan. The British Dental Association (BDA) also indicated that dental practices in the UK would face crippling losses due to suspension of routine dental care [20]. The dental practices which came under the umbrella of NHS in the UK received some funds to reimburse losses due to the COVID-19 outbreak [20]. According to a study investigating the economic impact among Iraqi dentists working during the outbreak, about 75% of the practitioners reported that their income had decreased by about 50% [21]. Another study aimed to evaluate the impact of the pandemic on dental practice in Iran showed that the income decreased for 97% of the participant dentists since the start of the pandemic [8].

The COVID-19 pandemic impacted how dentistry was practised in academic dental institutions [22, 23]. Elective and routine dental procedures were cancelled until further notice in

order to prioritize essential urgent care and prevent community transmission of COVID-19 [24]. Dental students in North America were worried about the possible economy in recession and its impact on the job market, financial burden associated with student debt and occupational hazards of performing dentistry in the world post-COVID [24].

Additionally, the global public health crisis caused by COVID-19 pandemic posed significant challenges for the dental professionals in Canada. With the spread of COVID-19 across Canada in early to mid-March 2020, dental regulatory authorities, including the Provincial Dental Board of Nova Scotia (PDBNS) ordered temporary cessation of dental care except for emergency care in identified clinics [25]. This mandate in Nova Scotia and other similar ones elsewhere caused massive disruption of dental services, although many jurisdictions provided dentists with guidance [25]. On March 15, 2020, the Royal College of Dental Surgeons of Ontario (RCDSO) strongly recommended that all non-essential and elective dental services should be suspended immediately and emergency dental treatment should continue [26]. Other provincial dental regulatory authorities in Canada made similar recommendations. The dentists could apply for support under the Economic Response Plan set up by the Canadian Government in March 2020 and save their practices from immediate closure due to financial losses [27]. Recently, a study examining the economic output, job levels and total hours worked in the Canadian dental industry was published by Statistics Canada [28]. Findings from the study showed that between 2019 and 2020, the total economic output in the dental industry reduced from $18.1 billion to $15.5 billion (-14.6%) while the number of dental office jobs fell by 15.4% nationwide. In 2020, the total hours worked for all jobs in the dental industry declined by 15.7 % since 2019, due to the impact of the COVID-19 pandemic [28].

Studies have evaluated the pandemic's effect on dental patient volumes and on the broader healthcare sector [29] but information regarding anxiety caused to the dentists practising in Canada due to the economic impact of the COVID-19 pandemic is still lacking in the literature. Therefore, the objectives of the present study were 1) to describe the anxiety due to the economic impact of the pandemic on dentists in Canada and 2) to identify factors associated with anxiety and economic burden in this sample over time.

Methods

The study protocol was approved by the Institutional Review Board of McGill University, Montreal – IRB Review Number A06-M49-20A (20-06-018). To address the aims of this study, data were used from a prospective cohort study conducted with the aim of estimating the incidence rate of COVID-19 among licensed dentists in Canada over a 12-month study period [30].

A convenient non-probability sampling strategy was used to maximize participation and retention. In August 2020, 644 dentists were recruited through email invitations sent to all registered members in the rosters of the collaborating organisations, which included dental regulatory authorities, dental associations and dental schools covering provinces and territories across Canada.

After providing informed consent, participants were invited to complete an online baseline survey where detailed information including sociodemographic information, type of practice, province of practice and number of years of practice were collected. Every 4 weeks after baseline, participants completed an online questionnaire through a LimeSurvey platform until October 2021. In October 2021, participants completed a questionnaire, retrospectively, on

the economic impact of COVID-19 (refer to Additional file 1). A statement at the beginning of the questionnaire introduced the purpose and stated the four time-periods of the pandemic. Since the situation was changing dynamically during the pandemic, we divided the pandemic times into four periods: 1) Strict lockdown period- March to April 2020, 2) Return to work period – May to July 2020, 3) Chronic period – August to December 2020 and 4) Vaccination period – January 2021 to present. The participants referred to these time periods while answering questions.

Descriptive analyses were conducted to describe the demographic characteristics of the study participants. The survey included questions about practice-related factors that led to increased anxiety for dentists during the COVID-19 pandemic and factors that helped them to manage their anxiety. The dentists responded to the question [Compared to before the pandemic, what was the effect of the above economic aspects of your practice on your levels of anxiety during the following time periods of the pandemic?]; on a five-point Likert-type scale ("5. Very much decreased", "4. Somewhat decreased", "3. No change", "2. Somewhat increased", "1. Very much increased"). The dentists were divided into the following four groups according to the practice-related factors leading to increased anxiety, chosen by them; A- Dentists who chose reduced revenue collection ; B- Dentists who chose reduced revenue collection, increased costs involved in practice; C- Dentists who chose reduced revenue, increased costs involved in practice and reduced number of patients; D- Dentists who chose reduced revenue collection, increased costs involved in practice, reduced number of patients and ability to offer limited dental treatments.

To address aim 1 we calculated the mean anxiety levels of the dentists during the different time-periods of the COVID-19 pandemic. To address aim 2 of this study, we performed linear mixed effects modelling to investigate the association between the anxiety levels of the dentists and the

groups of dentists according to the practice-related factors leading to increased anxiety among them, time periods during the pandemic. We utilized mixed effect ordered logistic regression models with random intercept to identify factors associated with anxiety levels of the dentists.

The economic impact questionnaire also comprised questions about the change in practice income, practice costs and net revenue generation for dentists during the four time periods of the COVID-19 pandemic. The participants responded to the above series of questions using a 5-point scale from '5. Very much decreased to 1. Very much increased'. An economic burden score variable was calculated by adding the scores of these questions concerned with the economic aspects of dental practice. To aid interpretation, we categorized the continuous economic burden score variable into mild (3-9) and severe (10-15) levels of economic burden. To address aim 2, mixed effect ordered logistic regression models with random intercept were utilized to identify factors associated with economic burden on dentists practising in Canada during the above-mentioned time-periods of the COVID-19 pandemic.

The data obtained from the survey was analyzed using R statistical software.

Results

Demographic and dental practice characteristics of the study cohort are presented in Table 1.

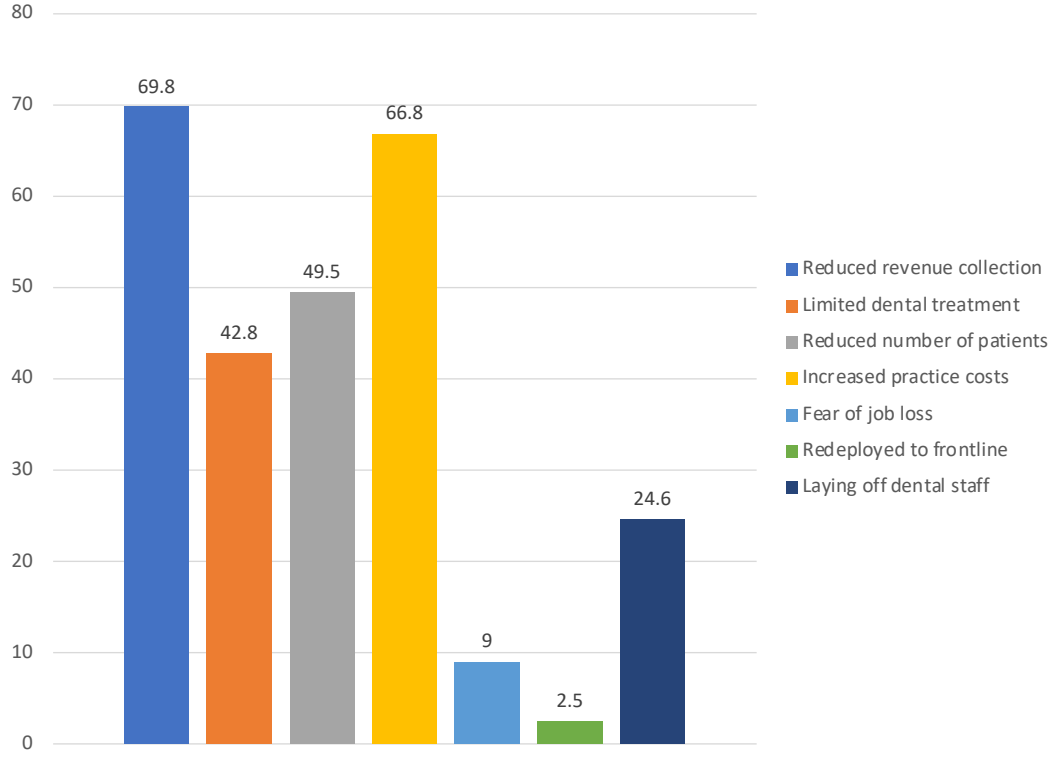
In response to the question about practice-related factors that led to increased anxiety for the dentists during the COVID-19 pandemic, reduced revenue collection (69.8%), increased costs involved in practice (66.8%), reduced number of patients (49.5%) and the ability to offer limited dental treatments (42.6%) emerged as the top factors (Figure 1). Furthermore, the main factors that helped the dentists to manage their anxiety during the pandemic were: having a received COVID-19 vaccination for themselves, their families and dental office staff (87.5%);

following guidance from the provincial dental regulatory authority (64.8%); and financial support schemes from the government (57.2%) (Figure 2).

Table 1: Demographic and dental practice characteristics of the study cohort (N= 566)

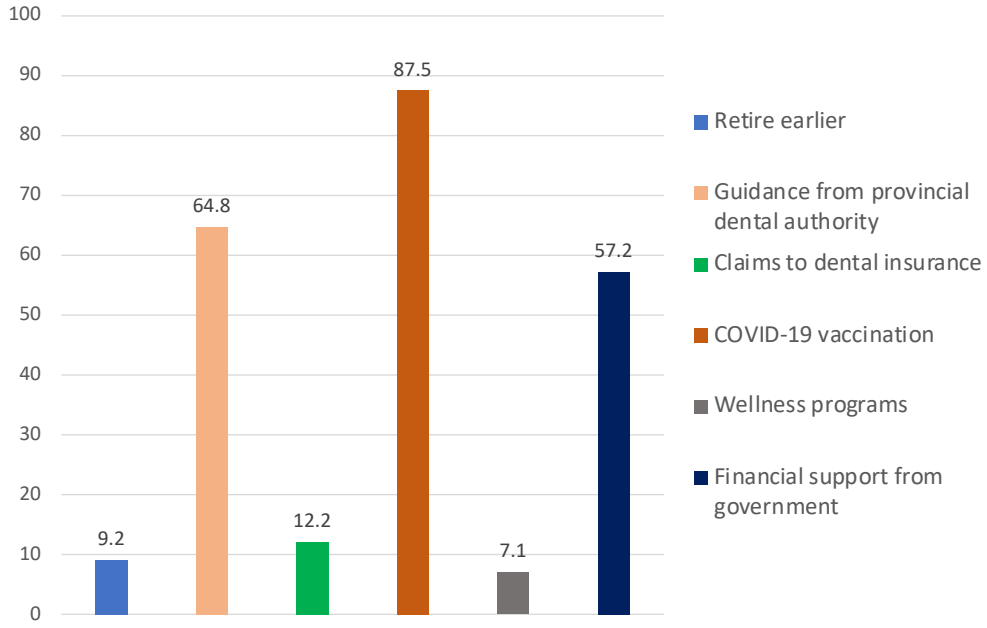
Characteristic	n %
Sex	
Female	327 (57.8%)
Male	239 (42.2%)
Age (Years)	
20-30	38 (6.7%)
31-40	137 (24.2%)
41-50	160 (28.3%)
51-60	161 (28.4%)
61-70	59 (10.4%)
71-80	11 (1.9%)
Dental License Type	
Generalist	513 (90.6%)
Specialist	53 (9.4%)
Location of primary dental practice	
Alberta	23 (4.1%)
British Columbia	96 (16.6%)
Manitoba	24 (4.2%)
Newfoundland and Labrador	2 (0.4%)
Nova Scotia	32 (5.7%)
Ontario	211 (37.3%)
Prince Edward Island	10 (1.8%)
Quebec	144 (25.4%)
Saskatchewan	25 (4.4%)
Yukon	1 (0.2%)

Figure 1: Practice-related factors that led to increased anxiety among dentists.



Note: Percentages of practice-related factors are presented. Total number of respondents 566

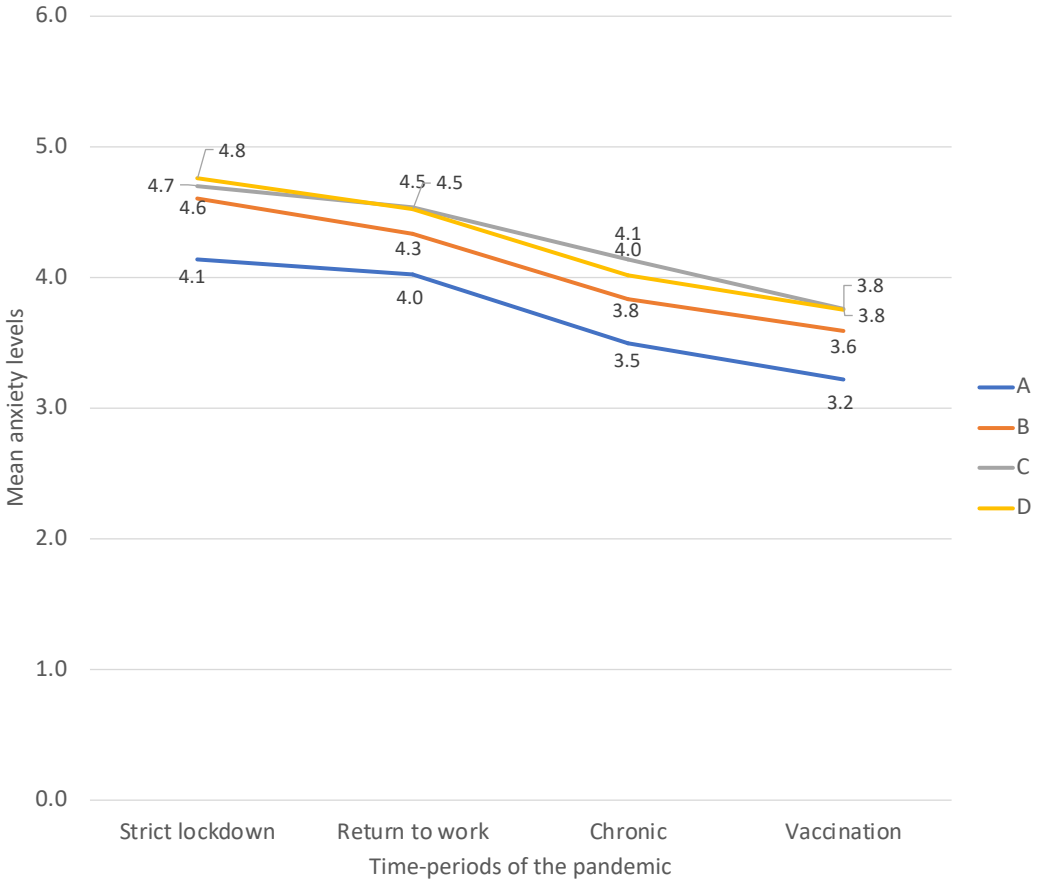
Figure 2: Factors that helped the dentists to manage anxiety during the COVID-19 pandemic



Note: Percentages of factors are presented. Total number of respondents 566

The mean anxiety levels of the dentists practising in Canada decreased over the four time-periods of the COVID-19 pandemic. The mean anxiety levels of four different groups of dentists according to the practice related factors leading to increased anxiety, chosen by them are shown in Figure 3. Dentists who chose one factor (reduced revenue collection) had lower anxiety during the four time-periods of the pandemic compared to dentists who chose two, three and four factors. The output of the linear mixed effects model shows the association between the dentists'anxiety levels, groups according to practice-related factors leading to increased anxiety and time-periods during the pandemic (Table 2 and 3). Groups B, C and D had significantly higher anxiety than Group A. The negative estimate for time period indicates that anxiety levels decreased over time and this effect was significant ($p < 0.0001$).

Figure 3: Mean anxiety levels of 4 different groups of dentists according to the practice related factors leading to increased anxiety, chosen by them.



A- Dentists who chose reduced revenue collection; B- Dentists who chose reduced revenue collection, increased costs involved in practice; C- Dentists who chose reduced revenue, increased costs involved in practice and reduced number of patients; D- Dentists who chose reduced revenue collection, increased costs involved in practice, reduced number of patients and ability to offer limited dental treatments as the practice-related factors leading to increased anxiety. The X-axis represents the 4 time-periods during the COVID-19 pandemic.

Table 2: Association between different groups of dentists according to the practice related factors leading to increased anxiety, chosen by them, time-periods during the COVID-19 pandemic and the anxiety levels of the dentists.

Fixed effects	Estimate	Std. Error	P-values
Intercept	4.5	0.09	< 0.0001
Group B	0.44	0.13	0.0006
Group C	0.55	0.14	0.0001
Group D	0.61	0.13	0
Time periods	-0.33	0.028	< 0.0001

Note: Time-periods was a continuous variable (days)

Table 3: Type III Analysis of Variance Table with Satterthwaite's Method

Main effects	P values
Groups of dentists	< 0.0001
Time periods	< 0.0001
Groups of dentists: Time periods	0.09

To address aim 2 (i.e. to identify factors associated with anxiety in dentists), ordinal mixed-effects regression analysis was performed and the results are presented in Table 4. With every increase of 11 years in age, the dentists had 12% increased odds of having increased anxiety (OR 1.12, 95% CI 1.11- 1.12). Male dentists had 53% reduced odds of reporting increased anxiety over time periods as compared to female dentists. Compared to those in the Atlantic provinces, dentists in British Columbia (OR 1.78, 95% CI 1.77-1.78), Ontario (OR 1.72, 95% CI 1.12-2.64) and the Prairie provinces (OR 2.36, 95% CI 1.24-4.50) had greater odds to

report increased anxiety, while dentists in Quebec had reduced odds (OR 0.58, 95% CI 0.37 – 0.93) for increased anxiety. The odds for practice-owners reporting increased anxiety were nearly three times (OR 2.98, 95% CI 1.78- 5.0) those of dental practice non-owners. Additionally, dentists who did not choose the top three factors leading to increased anxiety for them during the COVID-19 pandemic had 86% reduced odds (OR 0.14, 95% CI 0.10- 0.20) of reporting increased anxiety compared to those study participants who chose the top three factors (presented in Figure 1).

The mean scores of the economic burden variable decreased over time during the COVID-19 pandemic (Figure 5). The mean scores of the economic burden variable for different categories of dentists are presented in Table 5. To address aim 2 (i.e. to identify factors associated with economic burden in dentists) ordinal mixed-effects regression analysis was performed and the results are presented in Table 6. Age of the dentists was significantly associated with their self-rated economic burden. With every increase of 11 years in age, the odds of them reporting more severe economic burden increased by 4% (OR 1.04, 95% CI 1.02 – 1.05) (Table 6). Also, the odds for the dentists in Ontario having higher anxiety compared to Atlantic provinces were increased by 97% (OR 1.97, 95% CI 0.96 – 4.0). Finally, the odds for practice-owners reporting more severe economic burden were increased by 59% (OR 1.59, 95% CI 0.99 – 2.57) as compared to dental practice non-owners.

Table 4: Association between age, sex, province, dental practice-ownership, practice-related factors leading to increased anxiety and anxiety of dentists

Variable name	Odds Ratios	95% C.I.
Age (Every 11-year increase)	1.12	1.11-1.12
Sex Male Reference category Female	0.47	0.32-0.68
Province British Columbia Ontario Prairie Quebec Reference category Atlantic provinces	1.78 1.72 2.36 0.58	1.77-1.78 1.12 - 2.64 1.24 - 4.50 0.37 - 0.93
Practice-ownership Dental practice owner Reference category Non-owner	2.98	1.78 – 5.0
Dentists who did not choose the top 3 practice-related factors that lead to increased anxiety Reference category Dentists who chose the top 3 practice-related factors that lead to increased anxiety	0.14	0.10 - 0.20

Table 5: Mean economic burden score in different categories of dentists

	Mean score during strict lockdown period (March to April 2020)	Mean score during return to work period (May to July 2020)	Mean score during chronic period (August to December 2020)	Mean score during vaccination period (January 2021 to present)
Sex				
Female	12.4 (1.6)	12.6 (1.8)	11.1(1.9)	10.4 (1.9)
Male	12.3 (1.6)	12.2 (1.9)	10.9 (2.1)	10.5 (2.1)
Age-groups (years)				
24-38	12.5 (1.6)	12 (2.0)	10.5 (2.0)	9.9 (1.9)
39-48	12.5 (1.5)	12.7 (1.8)	11 (2.1)	10.3 (2.0)
49-56	12.3 (1.7)	12.5 (2.0)	11.4 (2.0)	10.6 (2.1)
57-79	12.2 (1.6)	12.4 (1.8)	11.4 (1.8)	10.9 (1.8)
Practice type				
General dentists	12.4 (1.6)	12.4 (1.9)	11.1 (2.0)	10.5 (2.0)
Specialists	12.3 (1.6)	12.1 (2.0)	10.6 (2.0)	10.1 (2.0)
Practice-ownership				
Owner	12.2 (1.6)	12.8 (1.8)	11.5 (1.9)	10.6 (2.0)
Non-owner	12.4 (1.6)	12.3 (1.9)	10.9 (2.0)	10.4 (2.0)

Note: Standard Deviations of mean scores are written in brackets

Figure 5: Mean economic burden scores during the four time-periods of the COVID-19 pandemic

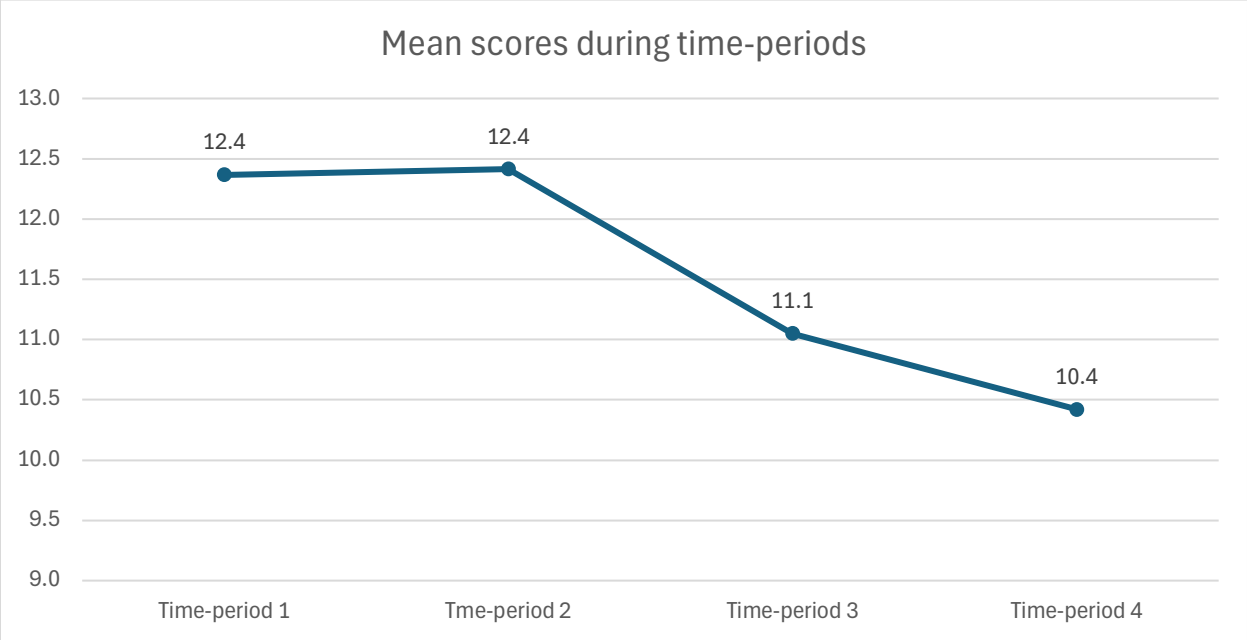


Table 6: Association between age, province, practice-ownership and economic burden scores

Variable name	Odds Ratios	95% C.I.
Age (For each 11-year increase	1.04	1.02 - 1.05
Ontario Reference category Atlantic provinces	1.97	0.96 - 4.00
Practice-owner Reference category Non-owner	1.59	0.99 - 2.57

C.I. confidence interval. Model adjusted for sex of the dentists.

Discussion

The dental profession has faced arduous circumstances amid COVID-19. Unsurprisingly, reports throughout the pandemic have evaluated its multifaceted impact on dental practices [31-33]. The objectives of the present study were 1) to describe the anxiety due to the economic impact of the pandemic on dentists in Canada and 2) to identify factors associated with anxiety and economic burden in this sample over time.

In addressing aim 1, our finding was that the mean anxiety levels of the dentists practising in Canada decreased over the four time-periods of the COVID-19 pandemic. We also identified the following factors associated with anxiety due to the economic aspects of dental practice among dentists practising in Canada during the COVID-19 pandemic. Older dentists had increased anxiety. This is in concordance with a previous study in Texas in which more than one-half of the respondents found working to be difficult during the pandemic, especially in the oldest groups [31].

As commonly reported in the literature [6, 34], female dentists in our study reported higher levels of anxiety than male dentists.

Dentists in British Columbia, Ontario and Prairie provinces had higher anxiety levels than their colleagues in the Atlantic provinces. Similar to our findings, there were significant differences in dental workload reduction during the COVID-19 pandemic between different regions in Germany as well [35].

The dental practice owners in our sample had higher anxiety levels than the non-owners. Possible explanation for this could be mandatory reduction of dental care to emergency treatment, while at the same time the costs of maintaining dental practice, such as staff salaries, rent remained constant or increased. Additionally, the costs of personal protective equipment,

disinfectants increased exponentially due to higher demand and thus the economic pressure on dentists increased.

Our findings revealed that reduced revenue collection, increased costs involved in practice, reduced number of patients and ability to offer limited dental treatments were the major factors that led to increased anxiety among Canadian dentists. Dentists in our study who had reduced revenue collection, increased costs involved in dental practice and reduced number of patients had higher anxiety levels as compared to those who did not choose these practice-related factors leading to increased anxiety. These results are in concordance with those from a study in the United States where most of the dentists reported increased costs of providing dental treatment (operating expenses) as one of their top three concerns regarding operating in a changed business environment owing to the pandemic [36]. Most dentists are small business owners who operate independently or with a few partner dentists. The prolonged closure of dental practices caused financial strain similar to what many other small businesses experienced during the COVID-19 pandemic. Previous studies have shown that small businesses, notably medical and dental practices experienced dramatic economic and workflow disruptions [37, 38]. Collections for most dentists in the US were down more than 95% during the shutdown from March to May 2020 [39]. According to a study based on representative US survey data, 46.7% of adult patients delayed their dental treatment owing to the COVID-19 pandemic [40].

In our study, the main factors that helped dentists to manage their anxiety during the crisis were; 1) received COVID-19 vaccination for themselves, their families and dental office staff, 2) followed guidance from the provincial dental regulatory authority and 3) financial support schemes from the government. The timing of this questionnaire may explain the finding about COVID-19 vaccination. By October 2021, vaccine rollout had gained traction in Canada

and most of the dentists had been vaccinated. Understandably, the respondents were optimistic about their financial future at the time of distribution of this survey. Similarly, vaccination against COVID-19 led to decrease of fear and anxiety levels of Turkish dental professionals [41]. According to a longitudinal web-based survey, vaccinated dental healthcare workers in the US reported lower levels of anxiety and depression symptoms than those who were not yet vaccinated [42]. Our findings were in concordance with a previous study in which majority of the Nova Scotia dentists stated that the provincial dental board provided sufficient information and guidance on approaches during the pandemic [25].

In addressing aim 2, our findings indicated that the score of the economic burden variable decreased over time during the different time periods of the pandemic. Moreover, as the pandemic progressed, infection control protocols proved effective at preventing transmission in dental settings and the COVID-19 infection rate among practising dentists in Canada was notably low [30]. This was in line with the results of the study in the US that explored the practising dentists' financial confidence, workflow changes and future perspectives in early 2021 [36]. They suggested that despite the shutdown and ensuing workflow changes, many dentists were rebounding financially [36]. The results from this survey conducted February through April 2021 showed that despite added costs, dentists' outlook on their financial futures was optimistic; most expected their personal finances and practice performance to remain the same or grow in the near future [36]. In the long term, most expected additional fiscal improvements postpandemic and did not believe that their personal or practice finances would be affected negatively [36]. Relatedly, a recent report by Statistics Canada shows that with the continuing easing of public health measure restrictions in 2021, the total economic output in the dental industry rose by 22.7% from the previous year to $19.2 billion, surpassing pre-pandemic levels

[28]. Dental office jobs also experienced a full recovery in 2021, with the total number of jobs increasing 24.1% over 2020. In 2021, the total number of hours worked in the dental industry reached 188.3 million hours, representing a 28.3% increase from 2020 as well as the highest single-year increase since 2010 [28].

Our data indicated that dentists in Ontario experienced higher economic burden compared to their colleagues in the Atlantic provinces. This could be due to the heterogeneity across jurisdictions in lifting restrictions. In Canada, health services including oral health care fall under provincial and territorial jurisdictions, resulting in 13 regulatory bodies developing mitigation strategies [43]. Daily COVID-19 incidence rates were markedly different across Canada [44], which influenced the timeline of closure phases, partial and complete reopenings of dental clinics and recommendations included in the infection prevention and control guidelines (IPCGs) [43]. There were evident differences in reopening strategies and face-covering recommendations for dentists and dental hygienists across Canada [43]. Statistics Canada reported that the impact of the COVID-19 pandemic on dental office jobs varied significantly across Canadian provinces and territories, reflecting the diverse responses and challenges faced by each jurisdiction, as well as the duration of restrictions on healthcare providers, which varied from jurisdiction to jurisdiction [28]. In 2020, all provinces and territories saw a decrease in job levels compared to 2019. Notably, Nunavut (-22.6%), Ontario (-18.6%) and the Northwest Territories (-17.6%) experienced the largest declines in dental office jobs [28].

Increased costs and pent-up demand for PPE may be a possible explanation for dental practice owners experiencing higher economic burden as compared to non-owners in our study. There was widespread shutdown of dental practices and owners faced challenges in retaining the dental office staff. Most dental practices rely on team members from all categories of oral

healthcare workers to function effectively. M. McNally and colleagues reported that 73.5% of dentists and 89% of dental hygienists strongly believed returning to work would increase their risk of infection [45]. Data from previous studies suggest that dental hygienists and dental assistants employed in practices might be uncomfortable with the limited availability of PPE, the patient screening process and measures to ensure patient safety [46]. They were more concerned than dentists about contracting the disease [46]. These could be potential reasons for practice-owners in Canada facing economic hardships during the COVID-19 pandemic.

The results of our study should be interpreted with caution as there are some limitations. It is important to recognize that although our sample included dentists from multiple provinces across Canada, it is a convenience sample of participants who voluntarily responded to an invitation to participate. Therefore, this study may have enabled self-selection bias because email invitations were sent to the majority of dentists practising in Canada during the pandemic but similar to other studies conducted during the COVID-19 pandemic, our response rate was low. The present study is based on retrospective data, which might have led to recall bias to an extent. However, these findings are valuable because dentists play an integral role in societal health and they will aid in developing approaches to ensure continued access to oral health care for populations in Canada. They are important for understanding the economic recovery of oral health care in Canada post pandemic.

Conclusion

Our results provide a clear insight into the anxiety and the dentists' professional and financial perspectives in the shadow of the COVID-19 pandemic. Age, sex, province, dental practice ownership and practice-related factors were associated with the anxiety levels of

dentists. The economic burden on dentists during the COVID-19 pandemic was associated with age, province, practice type and ownership of dental practice.

This data can help the dental regulatory authorities with long-term planning for dental clinics and provide recommendations for dentists and dental practices that need to treat patients in rapidly evolving settings such as public health emergencies.

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Additional file 1 for manuscript III

Economic impact of COVID-19

Context:
The following set of questions are concerning the economic impact that the COVID-19 pandemic might have had on your practice and the anxiety you might have had due to any such economic impact during this period. Understanding that the situation may have been changing dynamically, we have divided the pandemic times into four periods as follows:

- Strict lockdown period (March to April 2020)
- Return to work period (May to July 2020)
- Chronic period (August to December 2020)
- Vaccination period (January 2021 to present)

Please refer to the above time periods in the pandemic while answering questions 3 to 6

48. Which of the following options regarding type of dentist applies to you? *

(Please choose all that apply)

- General dentist
- Specialist
- Practice-owner
- Associate dentist
- Employed with corporate dental practice
- Working in a hospital or dental school
- Other_____

49. Which practice-related factors have led to increased anxiety for you during the COVID-19 pandemic? *

(Please choose all that apply)

- Reduced revenue collection
- Ability to offer limited dental treatments
- Reduced number of patients
- Increased costs involved in practice
- Fear of losing your job
- Being redeployed to frontline healthcare services
- Laying off dental office staff
- Other_____

50. Compared to before the pandemic, what was the change in your practice income during the following time periods of the COVID-19 pandemic?*

'Your practice income' refers to the income generated through services provided in your dental practice(s).

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

51. Compared to before the pandemic, what was the change in your practice costs during the following time periods of the COVID-19 pandemic? *

Practice costs refers to the expenses involved in running the practice. These include the salaries paid to dental office staff.

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

52. Compared to before the pandemic, what was the change in your practice net revenue generation during the following time periods of the COVID-19 pandemic? *

Net revenue is defined as "for you" only. It is income left over after practice expenses and business taxes and includes salary, commission, bonus and/or dividends and any payments made to a retirement plan on the dentist's behalf.

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

53. Compared to before the pandemic, what was the effect of the above economic aspects of your practice on <u>your levels of anxiety</u> during the following time periods of the COVID-19 pandemic? *

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

54. Which factors have helped you to manage your anxiety during the COVID-19 pandemic? *

(Please choose all that apply)

- Decided to retire earlier than previously planned
- Followed guidance from the provincial dental regulatory authority
- Submitted claims to dental insurance companies
- Received COVID-19 vaccination for yourself, family and dental office staff
- Enrolled in wellness initiative programs
- Financial support schemes from the government
- Other_____

55. What are the policy changes from dental regulatory authorities you would like to see in order to assist you to manage your anxiety during the COVID-19 pandemic?

Please write your answer here:

8. DISCUSSION

8.1 Summary of Results

The overall aim of this study was to estimate the anxiety levels among dentists in Canada during the COVID-19 pandemic. The goal of the analyses reported in Manuscript I 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 Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) performed in this manuscript 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 [123]. 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 [59], 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 [59] it loaded onto the perseveration factor. We have identified two other studies evaluating validity of the C-19ASS in general community samples of Iranians [124] and Italians [125] both of which found a two-factor structure similar to the original study. Similar to our findings, the Greek C-19ASS demonstrated a two-factor structure consistent with the original scale's perseveration and avoidance subscales [126]. 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 exploratory factor analysis [127]. 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 [128]. The EFA showed that item 4 loaded onto the Avoidance factor [128]. The C-19ASS has demonstrated a consistent factor structure, measurement invariance across gender, and validity and reliability across different languages and cultures [129]. It could serve as an anxiety measure in future potential viral pandemics, perhaps by utilising a relevant pandemic associated keyword instead of 'coronavirus' [129]. When we evaluated the correlations of the C-19ASS scores with the total GAD-7 scores, the correlations ranged between 0.36 to 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 Generalised Anxiety Disorder (GAD).

The work in Manuscript II built on our previous work by demonstrating the instrument's sensitivity to change, which is necessary for instruments to be used in longitudinal studies, particularly given the cross-sectional nature of previous psychometric validation studies [59, 125-127]. The objectives of this study were 1) to estimate the sensitivity to change over time of the C-19ASS among a sample of Canadian dentists; 2) to identify factors associated with COVID-19 related anxiety in Canadian dentists over time and 3) to estimate the differences in the anxiety levels in dentists in Canada following vaccination against SARS-CoV2.

We concluded that the C-19ASS can be used to detect change over time in COVID-19 related anxiety ratings among French and English-speaking Canadian dentists. A similar approach was utilized in a study using data from the same prospective study which aimed to estimate the extent to which COVID-19 disease burden is associated with salivary cortisol levels of a cohort of Canadian dentists. Data on the count of COVID-19 cases reported in Canada was

extracted from https://health-infobase.canada.ca/covid-19/ and the results indicated a modest positive association between the dentists' salivary cortisol levels and the count of COVID-19 cases in Canada [130]. It also strongly suggested a link between COVID-19 related anxiety as measured with the C-19ASS and salivary cortisol levels in Canadian dentists during the COVID-19 pandemic. We identified the following pivotal factors associated with COVID-19 related anxiety in Canadian dentists over time. Our findings showed that dentists in older age groups had reduced levels of anxiety during the COVID-19 pandemic. These are consistent with previous reports about DHCWs in the US [23] and surveys that showed an increased prevalence of mental health symptoms among young adults [131]. As has been commonly found [131, 132], female dentists reported higher levels of anxiety than male dentists. The specialists in our study had higher levels of anxiety as compared to the general dentists. We found that vaccination against COVID-19 did not have an effect on the anxiety levels in dentists.

In manuscript III, the overall goal of our study was to describe the anxiety due to the economic impact of the pandemic on dentists practising in Canada and identify factors associated with their economic burden over time. Our findings revealed that reduced revenue collection, increased costs involved in practice, reduced number of patients and ability to offer limited dental treatments were the major factors that led to increased anxiety among Canadian dentists. They are in concordance with those from a study in the United States where most of the dentists reported increased costs of providing dental treatment (operating expenses) as one of their top three concerns regarding operating in a changed business environment owing to the pandemic [133].

In our study, the main factors that helped dentists to manage their anxiety during the crisis were: 1) COVID-19 vaccinations for themselves, their families and dental office staff; 2)

guidance from the provincial dental regulatory authority; and 3) financial support schemes from the government. The timing of this questionnaire may explain the finding about COVID-19 vaccination. By October 2021, vaccine rollout had gained traction in Canada and most of the dentists had been vaccinated. Understandably, the respondents were more optimistic about their financial future at the time of distribution of this survey, compared to the beginning of the pandemic. Similarly, vaccinated dental healthcare workers in the US reported lower levels of anxiety and depression symptoms than those who were not yet vaccinated [23]. Another interesting finding was that the mean anxiety levels of the dentists practicing in Canada decreased over the four time-periods of the COVID-19 pandemic. We also identified that older and female dentists reported greater anxiety. These findings were commonly reported in the literature [76, 99].

In addressing aim 2 of this study (i.e. to identify factors associated with economic burden over time on dentists), our findings indicated that the level of economic burden decreased over time during the different time periods of the pandemic. This was in line with the results of the study in the US that explored the practising dentists' financial confidence, workflow changes and future perspectives in early 2021 [133]. They suggested that despite the shutdown and ensuing workflow changes, many dentists were rebounding financially and most expected their practice performance to grow in the near future [133]. A study by Statistics Canada also reported that with the easing of restrictions in 2021, total economic output in the dental industry rose 22.7 % from the previous year to $19.0 billion, surpassing pre-pandemic levels. Dental office jobs increased by 24.1% over the same period, bringing the total number of jobs in the industry above pre-pandemic levels [134].

Our data indicated that dentists in Ontario experienced higher economic burden compared to their colleagues in the Atlantic provinces. Increased costs and pent-up demand for PPE may be a possible explanation for dental practice owners experiencing higher economic burden as compared to non-owners in our study.

8.2 Strengths of our research

During an infectious disease outbreak, such as the COVID-19 pandemic, epidemiological considerations change rapidly, such as the emergence of different virus strains, variations in infection rates and government policies and interventions to combat these challenges. In such a situation, understanding mental health outcomes in populations requires study designs that capture the time-related effects of the pandemic on populations. This study utilized a prospective longitudinal study design, which makes it possible to observe the participants' anxiety over a one-year period, making it a significant strength of this research.

A validated and reliable COVID-19 anxiety syndrome scale was used to record the anxiety experience of participants. This scale is specifically designed to capture COVID-19 associated anxiety, with questions focussing on avoidance behaviour and perseverate thinking. This scale was validated as in this study for the Canadian dentists in the community, in both English and French, making it an appropriate scale to measure COVID-19 related anxiety among this cohort.

Finally, to analyze the rich longitudinal data, a linear mixed effects model with random intercept was used. This is a robust statistical methodology that is particularly used when there is a hierarchical structure of the data. It includes random effects which account for participant level randomness. This approach handles missing data without deleting a participant because they are

missing data at one follow-up data collection point. If a participant does not respond for just one follow-up, only the missed follow-up data will be left out and their data from other follow-ups will be used for the analyses. In a longitudinal study, where participants might miss a few follow-ups, this plays an important role in improving the statistical power of the analyses.

Furthermore, to our knowledge, there are no other longitudinal prospective cohort studies on COVID-19 related anxiety among Canadian dentists.

8.3 Limitations of our research

The results of our study should be interpreted with caution as there are some limitations. Firstly, it is important to recognize that although our sample included dentists from multiple provinces across Canada, it is a convenience sample of participants who voluntarily responded to an invitation to participate. Therefore, this study may have enabled self-selection bias because email invitations were sent to the majority of dentists practising in Canada during the pandemic but similar to other studies conducted during the COVID-19 pandemic, our response rate was low. Furthermore, to our knowledge there are no other prospective cohort studies that gathered self-reported measurements of anxiety among our population of interest during the COVID-19 pandemic.

Methods to evaluate responsiveness usually involve an anchor-based method to explore the relationship between change over time in scores of the measure and change over time in an anchor. Responsiveness reflects the extent to which changes in a measure over a specified time frame relate to corresponding changes in a reference measure of health status [135]. A limitation in our study was that we did not have longitudinal data from a 'gold-standard' measure of anxiety. Having acknowledged this potential limitation in our study, we chose the approach of

testing the changes in C-19ASS scores over time against two hypotheses: i) that anxiety ratings would decrease with time as dentists became used to the pandemic; and ii) that their ratings would increase and decrease as local provincial COVID-19 case numbers also increased and decreased. Notwithstanding the limitations of the present study, the results are important because responsiveness is a necessary aspect of psychometric evaluation of outcome measures in mental health care [136].

The study aimed to describe the anxiety due to the economic impact of the COVID-19 pandemic on dentists in Canada is based on retrospective data, which might have led to recall bias to an extent. However, to our knowledge there are no other prospective cohort studies that described the economic impact among our population of interest during the COVID-19 pandemic. These findings are valuable because dentists play an integral role in societal health and they will aid in developing approaches to ensure continued access to oral health care for populations in Canada. They are important for understanding the economic recovery of oral health care in Canada post-pandemic.

Another limitation common to all longitudinal cohort studies is loss to follow-up and missing data. This may lead to selection and information bias. To address this, we could quantify the bias due to missing values using a sensitivity analysis following multiple imputation procedure. To assess the missing value pattern and inform the imputation model we could compare the socio-demographic information and average anxiety scores, till the last available visit, between participants who were lost to follow-up and those who completed the study. In this study, some participants were lost to follow-up every month. At the last follow-up, 12.1% (78 out of 644 participants) were lost to follow-up compared with the baseline. According to our

findings, the average trajectory of the total C-19ASS scores of the participant dentists showed a progressive decrease from November 2020 to October 2021.

Lastly, 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.

8.4 Practical Implications of the study

The implications of this study are significant and offer valuable insights for various stakeholders involved in dental practice. The validated measure, C-19ASS will contribute to understanding of the mental health impact of the COVID-19 pandemic on dentists in Canada and enable the dental regulatory authorities and organizations to intervene to help dentists. Findings from our study can help dental organizations with long-term planning for dental clinics and provide recommendations for dentists and dental practices that need to treat patients in rapidly evolving settings such as public health emergencies. It is valuable for policy makers from various jurisdictions to provide timely, attuned and evidence-based guidelines for future pandemics and outbreaks and consequently avoid the restricted oral care phase, financial strains on dental clinics

across Canada. Lastly, this project would serve to make the dental workforce more resilient and better equipped to adapt to practice modifications during similar future outbreaks.

8.5 Future Research Directions

This study has set the groundwork for further research among Canadian dentists during future pandemics and during more "normal" times. Several potential directions can be considered for that. Different analyses could be undertaken to examine whether certain groups of individuals who exhibit higher and lower baseline infectious disease associated anxiety levels maintain those relatively high and low levels throughout the period of the study. If this is the case, then it would be important to identify factors associated with consistently high and consistently low levels of anxiety in those dentists.

Another important area of research in this field is to determine what size of difference in C-19ASS scores is 'clinically' important or meaningful, enabling more robust conclusions regarding differences observed between groups and among groups of dentists over time. Also, this helps us to understand better which members of the profession may benefit from a range of interventions.

Studies have indicated that extensive exposure to media coverage and information about the pandemic can contribute to heightened anxiety related to the fear of contracting the infection. Continuous news updates and discussions on social media surrounding COVID-19 have the potential to increase worry and anxiety among dental healthcare workers [12]. Additionally, it is important to consider pre-existing risk factors for COVID-19 anxiety, such as individuals with pre-existing health anxiety who may be particularly susceptible to heightened fear and anxiety

regarding the virus. Screening these individuals could be a valuable approach to address their specific needs and provide appropriate support [137].

Qualitative research can provide greater insight and understanding into people's lived experiences and perceptions than can be achieved by quantitative studies [138]. By incorporating qualitative research in a mixed methods study, future studies can enhance our understanding of anxiety among dentists and contribute to developing effective interventions and support mechanisms.

9. CONCLUSION

The C-19ASS is valid and reliable instrument to measure COVID-19 related anxiety in English and French among Canadian dentists. Additionally, our project demonstrated the sensitivity to change over time of the C-19ASS among dentists in Canada over the course of 1 year during the COVID-19 pandemic. COVID-19 related anxiety in dentists in Canada was associated with demographic and professional characteristics.

Age, sex, province of primary practice, dental practice ownership and practice-related factors were associated with the anxiety levels of dentists. The economic burden on dentists during the COVID-19 pandemic was associated with age, province, practice type and ownership of dental practice.

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12. APPENDIX I

12.1 IRB Approval letter

McGill

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June 5, 2020

Dr. Sreenath Madathil
Dentistry
Faculty of Dentistry
2001 McGill College
Montreal, Quebec H3A 1G1

RE: IRB Review Number: A06-M49-20A (20-06-018)

COVID-19 incidence rates among Canadian dentists as they return to work: a cohort study

Dear Dr. Madathil,

Thank you for submitting the above-referenced study for an ethics review.

As this study involves no more than minimal risk, and in accordance with Articles 2.9 and 6.12 of the 2nd Edition of the Canadian Tri-Council Policy Statement of Ethical Conduct for Research Involving Humans (TCPS 2 2018) and U.S. Title 45 CFR 46, Section 110 (b), paragraph (1), we are pleased to inform you that approval for the study, French questionnaire, French recruitment email and English and French consent forms (IRB dated May 2020) was provided by an expedited/delegated review on 05-Jun-2020, valid until **04-Jun-2021**. The study proposal will be presented for corroborative approval at the next meeting of the Committee.

Prior to initiating the study, please add the following contact information on the French and English consent forms: **For any questions regarding your rights as a research participant, please contact the Faculty of Medicine Ethics Officer at ilde.lepore@mcgill.ca . Si vous avez des questions concernant vos droits en tant que participant à cette recherche, veuillez contacter l'Agente en éthique de la Faculté de Médecine ilde.lepore@mcgill.ca .**

The Faculty of Medicine Institutional Review Board (IRB) is a registered University IRB working under the published guidelines of the Tri-Council Policy Statement 2, in compliance with the Plan d'action ministériel en éthique de la recherche et en intégrité scientifique (MSSS, 1998), and the Food and Drugs Act (17 June 2001); and acts in accordance with the U.S. Code of Federal Regulations that govern research on human subjects (**FWA 00004545**). The IRB working procedures are consistent with internationally accepted principles of good clinical practice.

The Principal Investigator is required to immediately notify the Institutional Review Board Office, via amendment or progress report, of:

- Any significant changes to the research project and the reason for that change, including an indication of ethical implications (if any);
- Serious Adverse Effects experienced by participants and the action taken to address those effects;
- Any other unforeseen events or unanticipated developments that merit notification;
- The inability of the Principal Investigator to continue in her/his role, or any other change in research personnel involved in the project;
- A delay of more than 12 months in the commencement of the research project, and;
- Termination or closure of the research project.

The Principal Investigator is required to submit an annual progress report (continuing review application) on the anniversary of the date of the initial approval (or see the date of expiration).

The Faculty of Medicine IRB may conduct an audit of the research project at any time.

If the research project involves multiple study sites, the Principal Investigator is required to report all IRB approvals and approved study documents to the appropriate Research Ethics Office (REO) or delegated authority for the participating study sites. Appropriate authorization from each study site must be obtained before the study recruitment and/or testing can begin at that site. Research funds linked to this research project may be withheld and/or the study data may be revoked if the Principal Investigator fails to comply with this requirement. A copy of the study site authorization should be submitted the IRB Office.

It is the Principal Investigator's responsibility to ensure that all researchers associated with this project are aware of the conditions of approval and which documents have been approved.

The McGill IRB wishes you and your colleagues every success in your research.

Sincerely,

Roberta M. Palmour

Roberta Palmour, PhD
Chair
Institutional Review Board

cc: Dr. S. Baillet, Associate Dean, Research
A06-M49-20A (20-06-018)

12.2 Study Questionnaire

COVID-19 incidence rates among Canadian dentists and dental hygienists: a cohort study (Updated: 28/10/2020)

Baseline and Follow-up Questionnaires

Sections 5, 6, 7, 8 and 10 will be repeated for all follow-up visits.

Questions with an asterisk (*) are mandatory.
Questions with a hash (#) will only be asked to participants who consent to provide saliva sample.

Contents

Section 1. Contact information

The contact information you provide, on this page, will be kept confidential and will only be used for the purpose of communicating matters pertinent to this study.

1. **Please enter your contact information ***

Please write your answer(s) here:

First name: _____

Second name / Surname: _____

Phone: _____

Please **do not** use country code or leave spaces for your phone number.
Example: **5141238888**

2. **Please provide a mailing address to which we can send the sampling kit for saliva collection:*#**

Please write your answer(s) here:

Unit _____
Street number _____
Street name _____
Address line 2 _____
City _____
Postal Code (e.g.,A1A2B2) _____
Province _____

Please enter "None" into the fields that does not apply to you.
Please do not leave spaces before, between or after your postal code.

Section 2. Demographics & Comorbidity

3. How old are you: *

Your answer must be between 18 and 99
Only an integer value may be entered in this field.

Please write your answer here: _____years

4. Sex: *

Choose one of the following answers
Please choose **only one** of the following:

- Female
- Male

5. Gender

Check all that apply
Please choose **all** that apply:

- Agender
- Genderqueer
- Gender fluid
- Man
- Non-binary
- Questioning or unsure
- Transgender
- Trans man
- Trans woman
- Woman
- Prefer not to disclose
- Other: _____

6. Please indicate below which group best describes you: *

Choose one of the following answers
Please choose **only one** of the following:

- White (Caucasian)
- South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.)
- Chinese
- Black
- Filipino
- Latin American
- Arab
- Southeast Asian (e.g., Vietnamese, Cambodian, Laotian, Thai, etc.)

- West Asian (e.g., Iranian, Afghan, etc.)
- Korean
- Japanese
- Aboriginal
- Other

7. Smoker

Please choose **only one** of the following:

- Yes
- No

8. Have you ever had following disease(s)/condition(s)? *

Please choose the appropriate response for each item: (Yes/No/Unknown):

	Yes	No	Unknown
Obesity			
Cancer			
Diabetes			
HIV/other immune deficiency			
Asthma (requiring medication)			
Chronic lung disease (non-asthma)			
Chronic liver disease			
Chronic haematological disorder			
Chronic kidney disease			
Chronic neurological impairment/disease			
Organ or bone marrow replacement			
Heart condition			

9. Any other comorbidity:

Please write your answer here: _____

10. Are you currently pregnant? *

Please choose **only one** of the following:

- Yes
- No
- Unknown

11. Specify trimester:

Only answer this question if the following conditions are met:
Answer was 'Yes' at question 10 (Are you currently pregnant?)

Please choose **only one** of the following:

- First trimester
- Second trimester
- Third trimester

12. What is the estimated delivery date?

Only answer this question if the following conditions are met:
Answer was ' Yes' at question 10 (Are you currently pregnant?)

Answer must be greater or equal to today

Please enter a date: ☐

Section 3: Professional Information

13. Please indicate the province where your primary practice, as a dentist or a dental hygienist, is located:

(office at which you work the most during a week) *

Please choose **only one** of the following:

- Alberta
- British Columbia
- Manitoba
- New Brunswick
- Newfoundland and Labrador
- Nova Scotia
- Ontario
- Prince Edward Island
- Quebec
- Saskatchewan
- Northwest Territories
- Nunavut
- Yukon

14. Please indicate the postal code of your primary practice as a dentist or a dental hygienist (office at which you work the most during a week): *

Please enter a valid postal code (E.g.,A1F3Y7)

Please write your answer here:

15. In your primary practice as a dentist or a dental hygienist, are you largely serving a:

Choose one of the following answers

Please choose **only one** of the following:

- Metropolitan community
- Urban community
- Suburban community
- Rural community
- Remote community

16. How many offices do you work in each week?

Please choose **only one** of the following:

- One per week
- Two per week

- Three per week
- More than three per week

17. Are you a dentist or a dental hygienist? *

Please choose **only one** of the following:

- Dentist – General practitioner
- Dentist – Speciality practitioner
- Dental Hygienist
- I have retired from clinical practice since:_____(Date)

18. Please specify your speciality *

Only answer this question if the following conditions are met:

Answer was 'Dentist-Specialist practitioner' at question 17

Please choose **all** that apply:

- Dental Public Health
- Endodontics
- Oral and Maxillofacial surgery
- Pediatric Dentistry
- Oral Medicine and Pathology
- Periodontics
- Oral and Maxillofacial Radiology
- Prosthodontics
- Orthodontics and Dentofacial Orthopedics
- Other: _____

19. Please specify your practice type as a dental hygienist.

- Clinical Dental Hygienist *(Working alongside a dentist in private or public sectors)*
- Independent Dental Hygienist *(Working independently or along with other dental hygienists, but not with a dentist, in private or public sectors)*
- Other:_____

20. Is the clinic where you provided care most of the time over the past 2 weeks: *

Please choose **only one** of the following:

- Open [no walls between dental chairs]
- Semi-open [some areas are open to each other while others have walls or other barriers separating them]
- Closed concept [all areas are separated by walls]
- Other

Section 4: Potential for exposure

21. Have you travelled outside Canada, or have you returned to Canada, in the past 28 days? *

Please choose **only one** of the following:

- Yes
- No

22. In past 28 days, have you travelled within or outside your province or region of residence?

- Yes
- No

23. If yes, please specify the following:

- Travelled only with in the region of my current residence
- Travelled outside the region, but within the province of my current residence
- Travelled outside the province of my current residence

24. Have you shared a living space with someone (family or other), in past 28 days? *

Please choose **only one** of the following:

- Yes
- No

25. Did any of your co-habitants attended primary or secondary school in-person, in the past 28 days?

- Yes
- No

26. Did any of your co-habitants attend a day care in-person during the past 28 days?

- Yes
- No

27. Has anyone whom you are living with had a positive test for COVID-19, in the past 28 days? *

Please choose **only one** of the following:

- Yes
- No
- Unknown

28. Has anyone whom you are living with had any symptoms that made you suspect they have COVID-19, in the past 28 days? *

Please choose **only one** of the following:

- Yes
- No
- Unknown

29. In past 28 days, have you attended a health care facility (other than the clinics you provide care) for yourself or a companion?

- Yes
- No

30. In past 28 days, have you attended any private gatherings with persons outside your household?

- Yes
- No

31. In past 28 days, have you attended any public gatherings/events with 50 or more people?

- Yes
- No

32. Have you ever worked at a facility which cares for COVID-19 patients? *

Please choose **only one** of the following:

- Yes
- No

33. Have you ever provided any form of dental care for patients with COVID-19?*

Choose one of the following answers

Please choose **only one** of the following:

- Yes
- No
- Unknown

Section 5: COVID-19 Tests and symptoms

34. Have you been tested for COVID-19, other than this project since the last follow-up survey?

- Yes
- No

35. Please specify the type of test:

- Nasopharyngeal swab sample and PCR based test
- Nasopharyngeal swab sample and antigen test
- Saliva sample (Other than the test performed in this project) and PCR based Test
- Saliva sample (Other than the test performed in this project) and antigent Test
- Serum sample (Blood) and antibody testing
- Other:_____

36. Date of testing:_____

37. Were you tested positive for SARS-COV2 or COVID-19 in this test?

- Yes
- No
- Inconclusive
- Still waiting for the results

38. Did you ever test positive for COVID-19? *

Please choose **only one** of the following:

- Yes
- No

39. If yes, date of testing: *

Answer must be less or equal to 'today'

Please enter a date: ☐

40. Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19, in last 28 days? *

Please choose **only one** of the following:

- Yes
- No

41. Date of first symptom onset:

Only answer this question if the following conditions are met:

Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)
Answer must be less or equal to 'today'

Please enter a date: ☐

42. Fever (≥38 °C) or history of fever *
Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

43. Date of onset of fever:
Only answer this question if the following conditions are met:
Answer was ' Yes' at question 42 (Fever (≥38 °C) or history of fever)
Answer must be less or equal to 'today'

Please enter a date: ☐

44. Sore throat *
Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

45. Date of onset of sore throat:
Only answer this question if the following conditions are met:
Answer was ' Yes' at question 44 (Sore throat)

Answer must be less or equal to 'today'

Please enter a date: ☐

46. Cough *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

47. Date of onset of cough:
Only answer this question if the following conditions are met:

Answer was ' Yes' at question 46 (Cough)
Answer must be less or equal to 'today'

Please enter a date: ☐

48. Runny nose *
Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)
Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

49. Date of onset of runny nose:
Only answer this question if the following conditions are met:
Answer was ' Yes' at question 48 (Runny nose)
Answer must be less or equal to 'today'

Please enter a date: ☐

50. Shortness of breath *
Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

51. Date of onset of shortness of breath:
Only answer this question if the following conditions are met:
Answer was ' Yes' at question 50 (Shortness of breath)
Answer must be less or equal to 'today'

Please enter a date: ☐

52. Other symptoms *
Please choose the appropriate response for each item:

	Yes	No	Unknown
Chills			
Vomiting			
Nausea			
Diarrhoea			
Headache			
Rash			
Conjunctivitis			
Muscle aches			
Joint aches			
Nosebleed			
Fatigue			
General malaise			
Loss of appetite			
Loss of smell /altered sense of smell			
Loss of taste / altered sense of taste			

53. Any other symptoms *
Choose one of the following answers
Please choose **only one** of the following:

- Yes (Please specify below)
- No
- Unknown

Make a comment on your choice here:

54. Have you stopped working/practicing (even temporarily), in the past 28 days? *

Please choose **only one** of the following:

- Yes
- No

55. Please specify your last date of working/practicing: *

Answer must be less or equal to 'today'

Please enter a date:

Section 6: Activities

These questions are about your clinical activities in the 2 weeks prior to your last working day, or of 2 weeks prior to your COVID-19 positive test; depending on the answer to questions in the previous section.

56. During this period, did you spend most of your time at home? *

Please choose **only one** of the following:

- Yes
- No

57. During this period, how many times did you leave your home?

Choose one of the following answers

Please choose **only one** of the following:

- Never
- Once
- Twice
- 3 to 5 times
- 6 to 10 times
- More than 10 times

58. Please choose the outdoor activities you engaged in during this period:

(Choose all that applies)

- Shopping (Including shopping for groceries)
- Physical activity in groups (e.g., Gym, sports, dancing)
- Wellness or lifestyle services (e.g., Spa, Hair or Nail Saloons)
- Accompanying family members to events or appointments
- Visiting family or friends in residence or long-term care facilities
- Other:_____

59. During this period did you provide any form of in-person dental care (including consultations)? *

Please choose **only one** of the following:

- Yes
- No

Section 7: In-person dental care episodes

This section refers to the in-person care you provided during the 2 weeks prior to your last working day, or of 2 weeks prior to your COVID-19 positive test; depending on the answer to questions in the previous section.

60. During this period how many patients did you provide some form of in-person dental care per day on average? *

Your answer must be at least 1
Only an integer value may be entered in this field.

Please write your answer here: _____
Please enter an average number.

61. During this period how many patients per day required an aerosol-generating procedure? *

Only an integer value may be entered in this field.

Please write your answer here: _____
Please enter an average number. If none, enter "0".

62. During this period did you provide any in-person dental care for COVID-19 positive patients? *

Please choose **only one** of the following:

- Yes
- No

63. If yes, for how many COVID-19 positive patients? *

Your answer must be at least 1
Only an integer value may be entered in this field.

Please write your answer here: _____

64. During this period did any of the patients you cared for, have any symptoms that made you suspect they are infected with COVID-19? *

Please choose **only one** of the following:

- Yes
- No

65. If yes, how many patients? *

Your answer must be at least 1

Only an integer value may be entered in this field.

Please write your answer here: _____

66. Please specify the types of in-person dental care you provided during this period

Check all that apply

Please choose **all** that apply:

- Advice and education only
- Tooth extraction
- Radiographs
- Examination and evaluation
- Scaling with hand instruments
- Scaling with ultrasonic scaler
- Abscess drainage
- Mineralized tissue removal with handpiece
- Adjustment of prosthesis or orthodontic appliance
- Pulp removal
- Provision of a prescription for a painkiller
- Provision of a prescription for an antibiotic
- Provision of a prescription for another medication
- Other: _____

67. Please specify the types of facial protection you used while providing in-person dental care, during this period *

Please choose the appropriate response for each item:

	For all procedures	For AGPs only	For non AGPs only	For none
Routine surgical mask				
N-95 [or higher] mask				
Eye glasses or goggles				
Facial visor				
Other form of hood or complete head coverage				

68. Did you use any other form of facial covering during the provision of in-person care during this period?*

Choose one of the following answers

Please choose **only one** of the following:

- No
- Yes (Please specify below)
- Make a comment on your choice here:_____

69. From the list below, please choose the Infection Prevention and Control (IPC) procedures and amenities in-place at the clinic you provided care during this period* (Choose all that applies)

- Separate entrance and exit doorways
- Screening or interviewing patients before appointment for COVID-19 related symptoms
- Screening or interviewing staff members for COVID-19 related symptoms
- Checking the temperature of the patients using a thermometer before the appointment
- Checking the temperature of the staff members at least once a day using a thermometer
- Insisting or encouraging patients to wear masks or face covering
    - At all times
    - Only in the waiting area
    - Only in areas close to where dental care is provided
- Disinfecting of surfaces frequently touched by patients (e.g., doorknobs, switches)
    - After every patient
    - More than once per day but not after every patient
    - Once a day only
    - Never
- Preprocedural mouthwash rinse
- Installation of special air filtering or purification unit
- Use of extra oral aerosol suction device during procedures
- Installation of physical barriers in areas of frequent staff-patient interaction (e.g., plexiglass frames)
- Plan in place for contact tracing in case of an outbreak at your clinic
- Other:_____

Section 8: Co-workers

The questions on this page are referring to the period of 2 weeks prior to your last working day, or of 2 weeks prior to your COVID-19 positive test; depending on the answer to questions in the COVID-19 test and symptoms section.

70. During this period how many members of staff (including dentists, receptionists, dental hygienists, dental assistants and others) **were working with you in the same clinic where you worked most of the time? ***

Your answer must be at least 0
Only an integer value may be entered in this field.

Please write your answer here: _____
Please enter "0" if none.

71. During this period did any of your co-workers, at the office you provided care, have a positive test for COVID-19? *

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

72. Please choose the description(s) that best fit the position of the staff member(s) who had a positive test for COVID-19: *

Please choose **all** that apply:

- Dentist
- Dental hygienist
- Dental assistant
- Receptionist
- Other:

73. During this period did any of your co-workers, at the office you provided care, have any symptom which made you suspect that they have COVID-19? *

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

74. Please choose the description(s) that best fit the position of the staff member(s) who had symptoms similar to COVID-19: *

Check all that apply

Please choose **all** that apply:

- Dentist
- Dental hygienist
- Dental assistant
- Receptionist
- Other: _____

Section 9: COVID-19 Anxiety

75. 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)
• I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)					
• I have checked myself for symptoms of coronavirus (COVID-19)					
• I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19)					
• I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19)					
• I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).					
• I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work.					
• I have checked my family members and loved one for the signs of coronavirus (COVID-19).					
• I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).					
• I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).					
• I am afraid of getting COVID-19 from a patient or a co-worker					
• I am anxious when providing treatment to patients with flu like symptoms					
• I fear that the PPE I am using may not be sufficient to protect me against COVID-19					

Section 10: Comments

76. Please provide any observations you have concerning the dental care provision during the COVID-19 pandemic:

Please write your answer here:

Thank you for your participation!

You may close your browser now.

COVID-19 incidence rates among Canadian dentists: a cohort study

Follow-up Questionnaires (Updated 31/8/2021)

Sections 7 to 9 are added to the standard follow-up questionnaire (section 1 to 6).

Questions with an asterisk (*) are mandatory.
Questions with a hash (#) will only be asked to participants who consent to provide saliva sample.

Contents

Section 1: COVID-19 Vaccine

The following questions are about vaccination against COVID-19

1. Have you been vaccinated against COVID-19?

(*Answer 'Yes' if you have received at least one dose of the COVID-19 vaccine.*
Note: Certain types of vaccines require more than one dose to protect against COVID-19. You would have been informed at the time of vaccination if you needed a second dose.)

- Yes
- No

2. How many doses of the COVID-19 vaccine have you received so far?

Choose one of the following answers

- One dose
- Two doses
- More than two doses

3. When did you receive your first dose of the COVID-19 vaccine? _____

4. When did you receive your second dose of the COVID-19 vaccine?_____

5. Which vaccine did you receive? *(Choose one of the following answers)*

Was it:

- Pfizer and BioNTech mRNA vaccine
- Moderna mRNA vaccine
- AstraZeneca Oxford vaccine
- Don't know
- Other:

Section 2: COVID-19 Tests and symptoms

6. **Have you been tested for COVID-19, other than this project since the last follow-up survey?**
   - Yes
   - No

7. **Please specify the type of test:**
   - Nasopharyngeal swab sample and PCR based test
   - Nasopharyngeal swab sample and antigen test
   - Saliva sample (Other than the test performed in this project) and PCR based Test
   - Saliva sample (Other than the test performed in this project) and antigent Test
   - Serum sample (Blood) and antibody testing
   - Other:_____

8. **Date of testing:**_____

9. **Were you tested positive for SARS-COV2 or COVID-19 in this test?**
   - Yes
   - No
   - Inconclusive
   - Still waiting for the results

10. **If yes, date of testing:** *

Answer must be less or equal to 'today'

Please enter a date: ☐

11. **Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19, in last 28 days?** *

Please choose **only one** of the following:

- Yes
- No

12. **Date of first symptom onset:**

Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)
Answer must be less or equal to 'today'

Please enter a date: ☐

13. Fever (≥38 °C) or history of fever *

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

14. Date of onset of fever:

Only answer this question if the following conditions are met:
Answer was ' Yes' at question 42 (Fever (≥38 °C) or history of fever)
Answer must be less or equal to 'today'

Please enter a date: ☐

15. Sore throat *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

16. Date of onset of sore throat:

Only answer this question if the following conditions are met:
Answer was ' Yes' at question 44 (Sore throat)

Answer must be less or equal to 'today'

Please enter a date: ☐

17. Cough *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers

Please choose **only one** of the following:

- Yes
- No
- Unknown

18. Date of onset of cough:

Only answer this question if the following conditions are met:

Answer was ' Yes' at question 46 (Cough)

Answer must be less or equal to 'today'

Please enter a date: ☐

19. Runny nose *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers

Please choose **only one** of the following:

- Yes
- No
- Unknown

20. Date of onset of runny nose:

Only answer this question if the following conditions are met:

Answer was ' Yes' at question 48 (Runny nose)

Answer must be less or equal to 'today'

Please enter a date: ☐

21. Shortness of breath *

Only answer this question if the following conditions are met:
Answer was 'Yes' at question 40 (Have you experienced any respiratory symptoms (e.g., sore throat, cough, running nose, shortness of breath) of COVID-19?)

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

22. Date of onset of shortness of breath:

Only answer this question if the following conditions are met:
Answer was ' Yes' at question 50 (Shortness of breath)
Answer must be less or equal to 'today'

Please enter a date: ☐

23. Other symptoms *

Please choose the appropriate response for each item:

	Yes	No	Unknown
Chills			
Vomiting			
Nausea			
Diarrhoea			
Headache			
Rash			
Conjunctivitis			
Muscle aches			
Joint aches			
Nosebleed			
Fatigue			
General malaise			
Loss of appetite			
Loss of smell /altered sense of smell			
Loss of taste / altered sense of taste			

24. Any other symptoms *

Choose one of the following answers

Please choose **only one** of the following:

- Yes (Please specify below)
- No
- Unknown

Make a comment on your choice here:

25. Have you stopped working/practicing (even temporarily), in the past 28 days? *

Please choose **only one** of the following:

- Yes
- No

26. Please specify your last date of working/practicing: *

Answer must be less or equal to 'today'

Please enter a date:

Section 3: Activities

These questions are about your clinical activities in the 2 weeks prior to your last working day, or of 2 weeks prior to your COVID-19 positive test; depending on the answer to questions in the previous section.

27. During this period, did you spend most of your time at home? *

Please choose **only one** of the following:

- Yes
- No

28. During this period, how many times did you leave your home?

Choose one of the following answers

Please choose **only one** of the following:

- Never
- Once
- Twice
- 3 to 5 times
- 6 to 10 times
- More than 10 times

29. Please choose the outdoor activities you engaged in during this period:

(Choose all that applies)

- Shopping (Including shopping for groceries)
- Physical activity in groups (e.g., Gym, sports, dancing)
- Wellness or lifestyle services (e.g., Spa, Hair or Nail Saloons)
- Accompanying family members to events or appointments
- Visiting family or friends in residence or long-term care facilities
- Other:_____

30. During this period did you provide any form of in-person dental care (including consultations)? *

Please choose **only one** of the following:

- Yes
- No

Section 4: In-person dental care episodes

This section refers to the in-person care you provided during the 2 weeks prior to your last working day, or of 2 weeks prior to your COVID-19 positive test; depending on the answer to questions in the previous section.

31. During this period how many patients did you provide some form of in-person dental care per day on average? *

Your answer must be at least 1
Only an integer value may be entered in this field.

Please write your answer here: _____
Please enter an average number.

32. During this period how many patients per day required an aerosol-generating procedure? *

Only an integer value may be entered in this field.

Please write your answer here: _____
Please enter an average number. If none, enter "0".

33. During this period did you provide any in-person dental care for COVID-19 positive patients? *

Please choose **only one** of the following:

- Yes
- No

34. If yes, for how many COVID-19 positive patients? *

Your answer must be at least 1
Only an integer value may be entered in this field.

Please write your answer here: _____

35. During this period did any of the patients you cared for, have any symptoms that made you suspect they are infected with COVID-19? *

Please choose **only one** of the following:

- Yes
- No

36. If yes, how many patients? *

Your answer must be at least 1

Only an integer value may be entered in this field.

Please write your answer here: _____

37. Please specify the types of in-person dental care you provided during this period

Check all that apply

Please choose **all** that apply:

- Advice and education only
- Tooth extraction
- Radiographs
- Examination and evaluation
- Scaling with hand instruments
- Scaling with ultrasonic scaler
- Abscess drainage
- Mineralized tissue removal with handpiece
- Adjustment of prosthesis or orthodontic appliance
- Pulp removal
- Provision of a prescription for a painkiller
- Provision of a prescription for an antibiotic
- Provision of a prescription for another medication
- Other: _____

38. Please specify the types of facial protection you used while providing in-person dental care, during this period *

Please choose the appropriate response for each item:

	For all procedures	For AGPs only	For non AGPs only	For none
Routine surgical mask				
N-95 [or higher] mask				
Eye glasses or goggles				
Facial visor				
Other form of hood or complete head coverage				

39. **Did you use any other form of facial covering during the provision of in-person care during this period?***

Choose one of the following answers
Please choose **only one** of the following:

- No
- Yes (Please specify below)
- Make a comment on your choice here:_____

40. **From the list below, please choose the Infection Prevention and Control (IPC) procedures and amenities in-place at the clinic you provided care during this period*** (Choose all that applies)

    - Separate entrance and exit doorways
    - Screening or interviewing patients before appointment for COVID-19 related symptoms
    - Screening or interviewing staff members for COVID-19 related symptoms
    - Checking the temperature of the patients using a thermometer before the appointment
    - Checking the temperature of the staff members at least once a day using a thermometer
    - Insisting or encouraging patients to wear masks or face covering
        - At all times
        - Only in the waiting area
        - Only in areas close to where dental care is provided
    - Disinfecting of surfaces frequently touched by patients (e.g., doorknobs, switches)
        - After every patient
        - More than once per day but not after every patient
        - Once a day only
        - Never
    - Preprocedural mouthwash rinse
    - Installation of special air filtering or purification unit
    - Use of extra oral aerosol suction device during procedures
    - Installation of physical barriers in areas of frequent staff-patient interaction (e.g., plexiglass frames)
    - Plan in place for contact tracing in case of an outbreak at your clinic

Other:_____

Section 5: Co-workers

The questions on this page are referring to the period of 2 weeks prior to your last working day, or of 2 weeks prior to your COVID-19 positive test; depending on the answer to questions in the COVID-19 test and symptoms section.

41. **During this period how many members of staff** (including dentists, receptionists, dental hygienists, dental assistants and others) **were working with you in the same clinic where you worked most of the time?** *

Your answer must be at least 0
Only an integer value may be entered in this field.

Please write your answer here: _____
Please enter "0" if none.

42. **During this period did any of your co-workers, at the office you provided care, have a positive test for COVID-19?** *

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

43. **Please choose the description(s) that best fit the position of the staff member(s) who had a positive test for COVID-19:** *

Please choose **all** that apply:

- Dentist
- Dental hygienist
- Dental assistant
- Receptionist
- Other:

44. **During this period did any of your co-workers, at the office you provided care, have any symptom which made you suspect that they have COVID-19?** *

Choose one of the following answers
Please choose **only one** of the following:

- Yes
- No
- Unknown

45. Please choose the description(s) that best fit the position of the staff member(s) who had symptoms similar to COVID-19: *

Check all that apply

Please choose **all** that apply:

- Dentist
- Dental hygienist
- Dental assistant
- Receptionist
- Other: _____

Section 6: COVID-19 Anxiety

46. 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)
• I have avoided using public transport because of the fear of contracting coronavirus (COVID-19)					
• I have checked myself for symptoms of coronavirus (COVID-19)					
• I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19)					
• I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19)					
• I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).					
• I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work.					
• I have checked my family members and loved one for the signs of coronavirus (COVID-19).					
• I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).					
• I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).					
• I am afraid of getting COVID-19 from a patient or a co-worker					
• I am anxious when providing treatment to patients with flu like symptoms					
• I fear that the PPE I am using may not be sufficient to protect me against COVID-19					

47. Over the last 2 weeks, how often have you been bothered by the following problems?*

	Not at all (0)	Several days (1)	More than half the days (2)	Nearly every day (3)
• Feeling nervous, anxious or on edge				
• Not being able to stop or control worrying				
• Worrying too much about different things				
• Trouble relaxing				
• Being so restless that it is hard to sit still				
• Becoming easily annoyed or irritable				
• Feeling afraid as if something awful might happen				

Section 7: Economic impact of COVID-19

Context:
The following set of questions are concerning the economic impact that the COVID-19 pandemic might have had on your practice and the anxiety you might have had due to any such economic impact during this period. Understanding that the situation may have been changing dynamically, we have divided the pandemic times into four periods as follows:

- Strict lockdown period (March to April 2020)
- Return to work period (May to July 2020)
- Chronic period (August to December 2020)
- Vaccination period (January 2021 to present)

Please refer to the above time periods in the pandemic while answering questions 3 to 6

48. Which of the following options regarding type of dentist applies to you? *

(Please choose all that apply)

- General dentist
- Specialist
- Practice-owner
- Associate dentist
- Employed with corporate dental practice
- Working in a hospital or dental school
- Other_____

49. Which practice-related factors have led to increased anxiety for you during the COVID-19 pandemic? *

(Please choose all that apply)

- Reduced revenue collection
- Ability to offer limited dental treatments
- Reduced number of patients
- Increased costs involved in practice
- Fear of losing your job
- Being redeployed to frontline healthcare services
- Laying off dental office staff
- Other_____

50. Compared to before the pandemic, what was the change in your practice income during the following time periods of the COVID-19 pandemic?*

'Your practice income' refers to the income generated through services provided in your dental practice(s).

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

51. Compared to before the pandemic, what was the change in your practice costs during the following time periods of the COVID-19 pandemic? *

Practice costs refers to the expenses involved in running the practice. These include the salaries paid to dental office staff.

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

52. Compared to before the pandemic, what was the change in your practice net revenue generation during the following time periods of the COVID-19 pandemic? *

Net revenue is defined as "for you" only. It is income left over after practice expenses and business taxes and includes salary, commission, bonus and/or dividends and any payments made to a retirement plan on the dentist's behalf.

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

53. Compared to before the pandemic, what was the effect of the above economic aspects of your practice on your levels of anxiety during the following time periods of the COVID-19 pandemic? *

	Very much decreased	Somewhat decreased	No change	Somewhat increased	Very much increased
Strict lockdown period *(Mar to Apr 2020)*					
Return to work period *(May to Jul 2020)*					
Chronic period (Aug to Dec 2020)					
Vaccination period (Jan 2021 to present)					

54. Which factors have helped you to manage your anxiety during the COVID-19 pandemic? *

(Please choose all that apply)

- Decided to retire earlier than previously planned
- Followed guidance from the provincial dental regulatory authority
- Submitted claims to dental insurance companies
- Received COVID-19 vaccination for yourself, family and dental office staff
- Enrolled in wellness initiative programs
- Financial support schemes from the government
- Other_____

55. What are the policy changes from dental regulatory authorities you would like to see in order to assist you to manage your anxiety during the COVID-19 pandemic?

Please write your answer here:

Section 8: Overall impact of COVID-19

56. Some provinces are moving towards mandating proof of vaccination for obtaining certain services (e.g., gyms, bars, festivals). What is your perspective on such a policy for dental visits and/or for your staff?

57.How were your regulatory body's COVID-19 guidelines communicated to you? What are your thoughts on these communications?

58. What is your perspective on your regulatory body's COVID-19 guidelines?

59. What was your experience navigating information (e.g., guidelines, scientific reports and journals) that were available to you in providing dental care during different stages of the pandemic?

60. How are you managing patients with known or suspected COVID-19?

61. As researchers, we are interested in learning as much as we can about the COVID-19 experience for Canadian Dentists. Given your experiences, can you describe questions that warrant further exploration?

62. Please provide any observations you have concerning the dental care provision during the COVID-19 pandemic:

Section 9: Participant satisfaction

We would like to evaluate how you feel about this research study, for future research purposes.

63. Please select one answer that best represents how you feel about the online survey part of this research study*

	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
a. This research study met my expectations					
b. I was comfortable with the research procedure.					
c. I was comfortable working with the research team.					
d. The informed consent form was easy to understand					
e. Based on my experience with this research study, I would participate in a similar study in the future.					

64. How disruptive was participating in this research study on your daily routine?*

- Completely disruptive
- Very disruptive
- Moderately disruptive
- Not very disruptive
- Not at all disruptive

65. Please select one answer that best represents how you feel about the

	Strongly agree (5)	**Agree (4)**	**Neutral (3)**	**Disagree (2)**	**Strongly Disagree (1)**
a. It was easy to follow the instructions of the saliva sample collection					
b. I feel confident that I followed the sample collection procedure as instructed.					
c. I felt comfortable collecting my own saliva sample.					
d. The package delivery and shipping procedures were well-instructed					
e. Using the prepaid self-addressed envelopes and FedEx was easy					
f. I would be comfortable participating in another study using the same saliva sample collection and shipping procedure					
g. The courier strategy of saliva samples will be essential to facilitate the diagnosis and prognosis of oral and systemic diseases					
h. The saliva collection procedure was not time consuming					
i. I was concerned about shipping my saliva samples via FedEx					

66. If you chose 5 or 4 for the question 63.i. above, please choose the reasons for your concern (select all that apply) #*

- Disease transmission
- Inappropriate handling and use
- Sample loss
- Other: _____

Appendix -II

Copyright approval for Manuscript I

Wednesday, December 11, 2024 at 14:16:25 Eastern Standard Time

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Subject: Re: Request for copyright approval
Date: Tuesday, December 10, 2024 at 1:48:13 AM Eastern Standard Time
From: Clinical Psychology and Psychotherapy Editorial Office
To: Rachita Seth
CC: Paul Allison, Dr.
Attachments: image001.png

Dear Dr. Seth,

Thank you for reaching out. You are welcome to include your manuscript in your PhD thesis. For more information, please visit the attached link and carefully:

https://authorservices.wiley.com/author-resources/Journal-Authors/licensing/self-archiving.html

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Should you need any further assistance, please feel free to ask.

Best Regards,
Deepti

Deepti Pathak (She/Her)
Editorial Assistant
Clinical Psychology & Psychotherapy
CPPedoffice@wiley.com

From: Rachita Seth <rachita.seth@mail.mcgill.ca>
Sent: Tuesday, December 3, 2024 12:03 AM
To: Clinical Psychology and Psychotherapy Editorial Office <CPPedoffice@wiley.com>
Cc: Paul Allison, Dr. <paul.allison@McGill.Ca>
Subject: Request for copyright approval

This is an external email.

Hello,
Our manuscript titled **Validity and Reliability of the COVID-19 Anxiety Syndrome Scale in Canadian dentists** was published in your esteemed journal on June 20, 2023. I need to insert it in my PhD thesis document and kindly request your permission to do the same.