



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



## CLINICAL RESEARCH

# General Anxiety in Dental Staff and Hemodynamic Changes over Endodontists' Workday during the Coronavirus Disease 2019 Pandemic: A Prospective Longitudinal Study

Juan Gonzalo Olivieri, DDS, PhD,\* Carlota de España, DDS,\* Marc Encinas, DDS,\* Xavier-Fructuós Ruiz, DDS,\* Queralt Miró, BSc,<sup>†</sup> Jordi Ortega-Martinez, DDS, PhD,<sup>‡</sup> and Fernando Durán-Sindreu, DDS, PhD\*

## SIGNIFICANCE

Dental staff presented higher levels of anxiety during the first workweeks and endodontists an increased cardiovascular response during the workday under the strict confinement during the pandemic.

## ABSTRACT

**Introduction:** The aim of this study was to assess general anxiety levels in endodontists and dental assistants related to different conditions during the pandemic and lockdown and to evaluate hemodynamic changes in endodontists' heart rate (HR), blood pressure, and blood oxygenation during their workday. **Methods:** Anxiety levels in endodontists and dental assistants were recorded weekly during the state of alarm declared because of the coronavirus disease 2019 pandemic. Hemodynamic parameters were monitored using a sphygmomanometer for HR and blood pressure and a pulse oximeter for oxygen saturation. Measurements were taken before and after each root canal treatment as well as on arrival at the clinic and at the end of the working day. Rest data, recorded every Saturday, served as a control. Data analysis was performed using chi-square, paired *t*, Mann-Whitney, and analysis of variance tests ( $P < .05$ ). **Results:** General anxiety decreased over the weeks, with significant differences between weeks 1 and 4 ( $P < .05$ ). Endodontists perceived higher anxiety levels of anxiety during anesthesia inoculation and dental assistants during the dental unit's disinfection and equipment material ( $P < .05$ ). There was a significant increase in the cardiovascular response in all endodontists in the clinic registrations compared with rest data ( $P < .05$ ). Values were higher in the strict confinement period and significant for HR when arriving at the clinic ( $P < .05$ ). **Conclusions:** Levels of general anxiety were higher during the first weeks. The chief perceived factors related to anxiety in endodontists and dental assistants were the risk of contagion and protection measures. Higher HR and blood pressure levels were registered during the workday, especially when arriving at the clinic. (*J Endod* 2021;47:196–203.)

## KEY WORDS

Anxiety; coronavirus disease 2019; endodontics; hemodynamics; oximetry; severe acute respiratory syndrome coronavirus 2

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first cases of COVID, which were reported in December 2019<sup>1</sup>, rapidly spread globally. Accordingly, on March 11, with more than 118,000 declared cases and 4,291 deaths in 114 countries, the World Health Organization declared COVID-19 a global pandemic<sup>2</sup>.

Spain's failure to contain the propagation of SARS-CoV-2 led its government to declare a state of alarm on March 14. During the first 2 months, strict confinement measures were adopted across Spain and extended in some regions, including Barcelona, until May 25. Subsequently, partial confinement was declared asymmetrically across Spain until the last prorogation of the state of alarm expired on June 21. Barcelona and Madrid were the most affected regions in Spain, with 1 of the highest ratios of cases and deaths per capita worldwide and where most prolonged periods of restriction measures were maintained. Given the apparent discrepancy in the reported data within the different indicators, it is

From the \*Department of Endodontics, <sup>†</sup>Department of Basic Sciences, Biostatistics Unit, and <sup>‡</sup>Department of Restorative Dentistry, Universitat Internacional de Catalunya, Barcelona, Spain

Address requests for reprints to Dr Juan Gonzalo Olivieri, Dentistry Faculty, Universitat Internacional de Catalunya, C/ Josep Trueta s/n, 08195 Sant Cugat del Vallès, Spain.  
E-mail address: [jgolivieri@uic.es](mailto:jgolivieri@uic.es)  
0099-2399/\$ - see front matter

Copyright © 2020 American Association of Endodontists.  
<https://doi.org/10.1016/j.joen.2020.10.023>

difficult to establish the approximate number of positive cases and deaths in Spain. However, according to the local regions reported data, the Spanish mortality monitoring system (MoMo), and the National Statistics Institute, the death rate can be estimated at around 40,000 deaths during this period<sup>3</sup>.

During confinement in Spain, dental offices, classified as health centers, were not forced to close, and the final decision of whether or not to provide dental care to patients was left to the dentists. However, most national dental associations appealed to their members' responsibility and recommended to treat exclusively urgent and emergency cases, including "dental pain from pulpal inflammation and extensive dental caries or defective restorations causing pain"<sup>4</sup>. Experience and published data have shown that patients need dental services even in a pandemic<sup>5</sup>.

According to the US Occupational Information Network, the dental team, including the dentist and the dental assistant/s, are highly exposed to infectious diseases<sup>6</sup>. Dental procedures entail a potential risk of transmission of acute viral respiratory infections, mainly to aerosol production commonly contaminated with bacteria and viruses<sup>7</sup>. High-speed handpieces and ultrasounds can generate high levels of bioaerosols, increasing the risk of exposure to different diseases. Many types of aerosols can be hazardous to both patients and the dental team<sup>8</sup> because they have the potential to remain airborne and enter the respiratory system<sup>9</sup>. Thus, new protocols must be taken into account to avoid the viral spread of biological aerosols<sup>10</sup>. Hence, dental assistants must be adequately qualified and trained in decontamination and infection control. Creating a secure environment is vital to provide patients and dental staff with a safe working environment. In this context, the current high infection rate of COVID-19 and the insufficient availability of personal protective equipment (PPE), among others, have increased levels of anxiety and stress among health and dental personnel<sup>11</sup>, as also reported during the severe acute respiratory syndrome coronavirus outbreak in 2003<sup>12</sup>.

People facing an epidemic threat can suffer different levels of psychological distress that can be aggravated under lockdown conditions. The psychological impact of this distress has been reported in previous epidemics, including severe acute respiratory syndrome coronavirus in 2003 or influenza A virus subtype H1N1 in 2009<sup>12,13</sup>. During the initial outbreak in China, high levels of anxiety and psychological distress were observed in a general public survey<sup>14</sup>. However, the risk of

presenting anxiety, fear, or psychological distress is not limited to the general population. Health care professionals have reported various somatic and cognitive symptoms of anxiety<sup>15,16</sup> because they come into close contact with infected and possibly infected patients, leaving them exposed to a high risk of infection<sup>17,18</sup>. Levels of anxiety in dentists can affect their performance and decision making and are associated with burnout<sup>19</sup>. Dental professionals have been reported to experience higher levels of anxiety than those of the general population. This is related both to the number of work hours and the perception of job satisfaction<sup>20</sup>. However, data regarding dentist anxiety and psychological distress are scarce, and the authors of the present study have not found data on the anxiety experienced by dental assistants. In addition, no study has reported data on hemodynamic changes in endodontists during their workday.

Having data to interpret within the current context is essential to establish a framework in which to develop the conditions to handle them in the most appropriate conditions in similar situations in the future<sup>5</sup>. Thus, the present study aimed to evaluate the general levels of anxiety of the dental assistants and endodontists under conditions of a pandemic and confinement. In addition, we assessed hemodynamic changes in the endodontists' heart rate (HR), blood oxygenation (SpO<sub>2</sub>), and systolic (SBP) and diastolic (DBP) blood pressure, both before and after performing a root canal treatment (RCT) and before, after, and during the workday, in the context of a declared state of alarm in Barcelona, Spain. Moreover, this study also sought to compare data from the strict confinement and the partial confinement periods.

## MATERIALS AND METHODS

### Study Design

We used a prospective longitudinal cohort design to evaluate different variables before and after RCT procedures, both during the workday and during 2 specific periods of confinement (strict and partial confinement). The guidelines for observational studies of the Strengthening the Reporting of Observational Studies in Epidemiology were followed.

### Setting

The RCT procedures were performed in private dental offices, which are accredited by the competent authority to conduct clinical studies under the supervision of the University Ethics Committee (ENDECL201801E3). Variables were recorded over 2 periods during

the state of alarm, 1 in strict confinement (March 27–May 21) and 1 in partial confinement (May 26–June 18), in Barcelona, Spain.

### Participants

Two groups of participants were selected (endodontists and dental assistants):

1. Endodontists: 4 dentists with a master's degree in endodontics and a minimum of 4 years of experience who worked in private clinical practices and were accredited by the competent authority to perform clinical studies were included. Endodontists enrolled were 29–36 years old, practiced sports at least 2–3 times per week, had no history of previously known hypertension, and had a normal weight (body mass index = 18.5–24.9 kg/m<sup>2</sup>). Only root canal treatments that were initiated and completed in a single visit were included.
2. Dental assistants: 11 dental assistants who worked with 1 of the 4 previously mentioned endodontists were evaluated.

### Variables, Data Sources, and Measurement

The following variables of the endodontists were monitored and analyzed:

1. The level of anxiety using the Generalized Anxiety Disorder 7-item (GAD-7, 0–21) score every week, which was measured every weekend<sup>21</sup>
2. A specific self-administered questionnaire designed to perceive anxiety, stress, and safety in the pandemic and confinement context
3. SpO<sub>2</sub> using a pulse oximeter, HR, SBP, and DBP using a sphygmomanometer before and after each procedure and when arriving at the clinic and at the end of the working day
4. The total time of the procedures in minutes

The dental assistant evaluation was performed as follows:

1. The level of anxiety using the GAD-7 (0–21) score every week
2. A self-administered questionnaire on perceived anxiety, stress, and safety in the confinement context

### Procedure

#### Hemodynamic Changes

When arriving at the clinic, each endodontist recorded his or her HR, SBP, and DBP in a seated position using a sphygmomanometer placed around the right arm. This procedure was performed at the end of each workday

and 1 hour after arriving at home. In addition, for every pre- and post-RCT procedure, each dentist measured his or her HR, SBP, and DBP data using a sphygmomanometer and his or her SpO<sub>2</sub> by placing his or her left-hand forefinger in a pulse oximeter. All RCT procedures were performed in a standardized manner. Finally, each endodontist took 3 control measurements at rest every Saturday (the dentists' day off) in the morning, midday, and afternoon, and the mean served as a control.

### RCT Procedure

All endodontic treatments were performed under local anesthesia using articaine 40 mg/mL (4%) epinephrine 1/100,000 (Ultracain; Normon, Madrid, Spain). After rubber dam isolation, the access cavity was performed using a round diamond bur and an Endo-Z bur

(Dentsply Maillefer, Ballaigues, Switzerland). A #10 K-file (Dentsply Maillefer) was then used to achieve patency in all the canals, and the working length was determined using an electronic apex locator. A Reciproc 25 file (VDW, Munich, Germany) was used for root canal instrumentation, and apical enlargement was performed with ProFile .04 rotary files (Dentsply Maillefer, Ballaigues, Switzerland) powered by an endodontic motor with torque control (VDW Gold; VDW, Munich, Germany). The root canal system was continuously irrigated during all the procedures with a 4% sodium hypochlorite solution. Final irrigation with 10% citric acid and 4% sodium hypochlorite was performed. A tapered gutta-percha master cone (Autofit; Sybron Endo/Kerr, Orange, CA) was calibrated and coated with a resin sealer (AH Plus Jet, Dentsply Maillefer) for root canal obturation. Gutta

condensors (Dentsply Maillefer) were used for a thermomechanical compaction technique. Finally, a flowable composite and a temporary filling were placed for the coronal seal. Patients were given postoperative instructions and a prescription of analgesic (ibuprofen 600 mg) for 3 days only if necessary.

### Perceived Anxiety, Stress, and Safety in the Confinement Context

On Saturdays, all the endodontists and the dental assistants completed the GAD-7 items and the questionnaire to record their levels of stress, anxiety, and perceived safety in the pandemic context (Table 1).

### Bias

Several possible biases were identified, and offset measures were performed accordingly.

**TABLE 1** - Answer Frequency of the Different Items through the Different Time Periods (Strict [SC] and Partial Confinement [PC]) (Mean ± Standard Deviation)

Question	Endodontists		Dental assistants	
	SC	PC	SC	PC
1. Perceived patient increased level of anxiety	5.2 ± 2.7*	1.7 ± 1.7*	4.8 ± 2.5	4.2 ± 2.3
Week 1/5	7.2 ± 0.9 <sup>a</sup>	2.7 ± 1.7 <sup>bc</sup>	5.6 ± 2.8	6.0 ± 1.1
Week 2/6	7.0 ± 1.8 <sup>ab</sup>	2.0 ± 2.2 <sup>c</sup>	4.8 ± 1.7	5.4 ± 1.9
Week 3/7	3.7 ± 2.8 <sup>ab</sup>	1.3 ± 1.9 <sup>c</sup>	3.7 ± 2.8	4.4 ± 1.9
Week 4/8	2.7 ± 1.5 <sup>bc</sup>	1.0 ± 1.4 <sup>c</sup>	3.5 ± 2.3	2.0 ± 1.2
2. Perceived level of anxiety during the workday	3.7 ± 1.9*	2.1 ± 1.1*	4.2 ± 3.2	2.8 ± 1.9
Week 1/5	5.0 ± 2.4 <sup>a</sup>	2.7 ± 1.7 <sup>ab</sup>	5.7 ± 2.8	5.2 ± 2.5
Week 2/6	4.5 ± 1.0 <sup>ab</sup>	2.2 ± 0.5 <sup>ab</sup>	6.5 ± 2.5	3.7 ± 3.1
Week 3/7	3.2 ± 2.5 <sup>ab</sup>	2.0 ± 0.8 <sup>ab</sup>	3.7 ± 2.8	2.7 ± 2.8
Week 4/8	2.0 ± 2.0 <sup>ab</sup>	1.2 ± 0.5 <sup>b</sup>	5.1 ± 2.3	3.5 ± 2.8
3. Perceived cause that can further affect anxiety level				
Risk of contagion	4.9 ± 2.0*	2.9 ± 1.5*	5.5 ± 3.1	4.1 ± 2.9
Week 1/5	6.3 ± 1.7	4.0 ± 1.4	7.5 ± 1.3	4.8 ± 3.3
Week 2/6	5.5 ± 2.0	3.0 ± 1.1	6.7 ± 0.9	4.0 ± 2.6
Week 3/7	4.2 ± 2.0	2.2 ± 1.5	6.5 ± 1.7	3.6 ± 2.7
Week 4/8	3.5 ± 1.7	2.5 ± 1.9	4.8 ± 3.1	3.8 ± 3.1
4. Relieved to be able to leave home to go to work	7.3 ± 3.0	6.7 ± 3.6	6.0 ± 2.9	6.0 ± 3.1
5. Perceived sense of security during				
Travel to the clinic	8.1 ± 1.4 <sup>ab</sup>	7.8 ± 1.5 <sup>ab</sup>	7.4 ± 2.3 <sup>a</sup>	4.7 ± 3.1 <sup>a</sup>
In the dental clinic	6.6 ± 1.1 <sup>a</sup>	7.1 ± 1.6 <sup>a</sup>	6.7 ± 1.6 <sup>a</sup>	5.1 ± 2.3 <sup>a</sup>
Travel home	7.8 ± 1.2 <sup>ab</sup>	7.6 ± 1.5 <sup>ab</sup>	7.3 ± 2.2 <sup>a</sup>	5.8 ± 3.2 <sup>a</sup>
Arriving home	9.2 ± 0.4 <sup>b</sup>	8.6 ± 0.8 <sup>b</sup>	9.4 ± 0.8 <sup>b</sup>	9.0 ± 1.1 <sup>b</sup>
6. May the final treatment result be influenced by context	3.5 ± 2.2*	1.0 ± 1.3*	4.1 ± 3.4	3.5 ± 2.8
7. Level of perceived level of anxiety during work				
Patient management	1.6 ± 1.2 <sup>bc</sup>	2.4 ± 1.4 <sup>ab</sup>	4.0 ± 3.1	2.2 ± 2.3
Anesthesia inoculation/accompany the patient to the box	3.8 ± 3.0 <sup>a</sup>	3.1 ± 2.2 <sup>a</sup>	3.4 ± 3.6	2.5 ± 2.3
Rubber dam placement/assistance	1.3 ± 1.3 <sup>bc</sup>	1.8 ± 2.2 <sup>ab</sup>	2.8 ± 2.5	2.4 ± 2.1
RCT procedure/assistance	2.7 ± 1.8 <sup>ab</sup>	2.8 ± 1.7 <sup>ab</sup>	2.8 ± 2.5	2.4 ± 2.1
X-ray taking/disinfection material and box	0.8 ± 0.8 <sup>c</sup>	1.1 ± 0.7 <sup>b</sup>	5.0 ± 2.5 <sup>a</sup>	4.2 ± 2.4 <sup>a</sup>

RCT, root canal treatment.

Values with different superscript letters within each column have statistically significant differences. Significance was set at  $P < .05$ .

\*Indicates statistically significant differences.

Measuring hemodynamic changes during and after the procedure during the workday can increase anxiety in dental professionals. Thus, 1 endodontist served as a control and only recorded measures before, when finishing the workday, and at home but not during each procedure. GAD-7 is used to measure an individual's previous 2 weeks of anxiety. Because confinement measures in a pandemic context can affect levels of anxiety week by week, each week's data were recorded.

### Sample Size

Because there are no previous data on hemodynamic changes in endodontists, the DBP reported for general dentists during work time was used<sup>22</sup>. Accepting alpha and beta risks of 0.05 and 0.2, respectively, for a 2-sided test and assuming the standard deviation of 7.7 mm Hg, 44 measurements were considered necessary for each period (strict confinement and partial confinement) to recognize a difference of 4.6 mm Hg. Because the data were registered at the same visit, no dropouts were predicted for this study.

### Statistical and Data Analysis

Because of mobility restrictions, each endodontist entered their data online in a shared Excel spreadsheet (Microsoft Corporation, Redmond, WA). The central tendency and dispersion values were calculated. Differences between groups regarding anxiety and completed questionnaires were analyzed using *t* and chi-square tests. Paired data were assessed using the paired *t* test. Time comparisons of hemodynamic changes were evaluated using Mann-Whitney and analysis of variance tests. Statistical analyses were performed using R software (Free Software Foundation, Boston, MA), and significance was set at  $P < .05$ .

## RESULTS

Data collection from the 4 endodontists and the 11 dental assistants, all of whom worked in private clinics accredited to perform clinical studies, were included for analysis. Table 2 shows the GAD-7 scores for the perceived

level of anxiety. The levels of general anxiety decreased over the weeks, with significant differences between weeks 1 and 4 ( $P = .001$ ). No differences were found between endodontists and dental assistants ( $P > .05$ ) or within the endodontist group or the dental assistant group ( $P > .05$ ). Higher scores were observed in items 3 and 5 (concern and restlessness).

Table 1 summarizes the responses to perceived sensations related to the pandemic and confinement. All of the endodontists selected the risk of contagion as the most probable influence on their level of anxiety ( $P < .05$ ) followed by PPE measures, confinement, the patient, and the use of a high-speed dental handpiece. The dental assistants rated PPE measures and the risk of contagion as the chief related causes of anxiety in the 2 periods ( $P < .05$ ). Endodontists associated anesthesia inoculation with a higher level of anxiety than anything else in the treatment procedure ( $P < .05$ ). However, the dental assistants perceived a greater increase in anxiety during the disinfection of the dental unit and the dental equipment ( $P < .05$ ).

### Endodontists' Hemodynamic Changes during RCT Procedures

Table 3 shows the mean (HR, SBP, and DBP) and median (SpO<sub>2</sub>) preoperative and postoperative data of the 96 RCT procedures (45 in strict confinement and 51 in partial confinement). In addition, a comparison with measurements at rest is included below each value description of data. The differences between the pre- and postoperative data in the 2 time periods evaluated showed no statistical difference ( $P > .05$ ).

### Endodontists' Hemodynamic Changes during the Workday

Table 4 shows the mean and standard deviation of HR and blood pressure in the different periods evaluated and the comparison with data at rest. Compared with at-rest data, a significant increase in HR, SBP, and DBP was observed in the measurements taken in the dental office by the endodontists ( $P < .05$ ). Table 4 shows the differences

between each time point. No differences were found between HR, SBP, and DBP in each endodontist's at-rest values and in measurements taken 1 hour after arriving home in both periods ( $P > .05$ ). HR and blood pressure values were higher during the strict confinement period and significant only for HR when arriving at the clinic ( $P < .05$ ).

## DISCUSSION

In comparison with the general population, dentists have high levels of anxiety. In a nonpandemic context, anxiety is mainly related to the number of hours worked and job satisfaction<sup>19,20</sup>. Dentists and auxiliary personnel are at a higher risk of exposure to Sars-Cov-2 because of the closed environment of the clinic and the dental procedure itself<sup>6,17,18</sup>. The increased risk of exposure can raise the levels of anxiety and fear. The burden is not limited solely to self-concern but also to spreading the virus to family members, including immune-compromised, newborn, and elderly relatives<sup>15</sup>.

Generalized anxiety disorder is identified by disproportionate, irrational, and uncontrollable concern toward an action or situation that may interfere with daily life. A pandemic event results in different manifestations of psychological distress, fear, and anxiety<sup>14</sup>. The GAD-7 is a 7-item scoring system designed to self-report anxiety validated for the general population and in primary care. It has a specificity of 82% and a sensitivity of 89%<sup>16</sup> and has been used to evaluate health workers during the present pandemic, resulting in a polled prevalence of anxiety of 23.2%<sup>23</sup>.

Anxiety is closely associated with the severity of the pandemic and the number of daily reported cases and deaths<sup>14</sup>. The present study during the 2 first workweeks revealed mean mild levels of anxiety in all endodontists, similar to levels reported in dentists in Italy<sup>24</sup>, 1 of the other European Union countries most affected by COVID-19. The study by Consolo et al<sup>24</sup> showed that anxiety in dentists was mainly related to the

**TABLE 2 - Perceived Level of Anxiety Scores (Generalized Anxiety Disorder 7-item Score) of Endodontists and Dental Assistants according to the Different Week Periods (Median [Quartile 1, Quartile 3])**

Group	Period	Week 1/5	Week 2/6	Week 3/7	Week 4/8	Total	P value
Endodontists	Strict confinement	7.7 [7, 8.5] <sup>a</sup>	6.0 [5, 8] <sup>ab</sup>	4.5 [4, 5.5] <sup>ab</sup>	2.5 [2, 4] <sup>b</sup>	5.5 [4, 7] <sup>*</sup>	<.001
	Partial confinement	2.5 [1.5, 4] <sup>c</sup>	2.0 [1.5, 3] <sup>c</sup>	1.5 [0.5, 3] <sup>c</sup>	1.0 [1, 2] <sup>c</sup>	2.0 [1, 3] <sup>*</sup>	
Dental assistants	Strict confinement	8 [6.5, 11] <sup>a</sup>	6 [5.5, 7.5] <sup>ab</sup>	6 [4, 9] <sup>b</sup>	4 [3, 6] <sup>b</sup>	6 [5.5, 8] <sup>*</sup>	<.001
	Partial confinement	6 [5, 6] <sup>a</sup>	5 [2, 5] <sup>ab</sup>	4 [1, 4] <sup>b</sup>	2 [1, 4] <sup>b</sup>	4 [2, 5] <sup>*</sup>	

Values with different superscript letters within each column have statistically significant differences. Significance was set at  $P < .05$ .

\*Indicates statistically significant differences.

**TABLE 3** - Heart Rate (HR), Systolic (SBP) and Diastolic (DBP) Blood Pressure (Mean ± Standard Deviation), and Oxygen Saturation (SpO<sub>2</sub>) (Median and Quartile Range [Quartile 1–Quartile 3]) of Endodontists in the Different Time Points Heart Rate (HR) and Systolic (SBP) and Diastolic (DBP) Blood Pressure of Dentists Pre- and Posttreatment in the Two Evaluated Periods

Time period Variable	SC		PC		P value SC–PC
	Pretreatment	Posttreatment	Pretreatment	Posttreatment	
HR	75.8 (8.2)	75.9 (8.5)	72.2 (6.3)	72.4 (8.1)	.990
≠ HR rest	+9.6	+8.8	+7.2	+7.4	
SpO <sub>2</sub>	98 [97, 99]	98 [97, 99]	99 [98, 99]	99 [98, 99]	.923
≠ SpO <sub>2</sub> rest	–1	–1	0	0	
SBP	118.5 (11.4)	119.3 (11.2)	116.7 (9.8)	117.1 (10.4)	.829
≠ SBP rest	+6.2	+7.0	+3.5	+3.6	
DBP	77.6 (5.3)	78.7 (5.6)	74.1 (5.3)	75.0 (5.0)	.902
≠ DBP rest	+ 6.6	+7.9	+3.6	+5.5	

PC, partial confinement; SC, strict confinement.

P value indicates the differences amid changes between pre- and postdata in the 2 periods (SC and PC). ≠ rows indicate the mean of differences between values and the rest data of every endodontist.

apprehension of contracting the disease and their professional future. However, the levels of anxiety observed in our study fell gradually over the subsequent weeks and as the confinement restrictions were lifted, which is in accordance with the data reported by Lei et al<sup>25</sup>.

Dental assistants reported higher levels of anxiety over a longer period than endodontists did. In addition, some assistants experienced moderate or even higher levels of anxiety, especially in the first 2 working weeks in the present study. Furthermore, dental staff in Israel exhibited elevated psychological distress associated with the disease<sup>11</sup>; this was particularly high in dental professionals who feared being infected by their patients and those with underlying medical conditions or a heightened subjective overload<sup>11</sup>. After the first few weeks, in which a few experienced severe anxiety levels, levels of anxiety in the dental staff observed in the present study were similar to those reported in Korean dentists in a nonpandemic context<sup>20</sup>. General anxiety levels

reported in the present study were lower than those reported by medical staff<sup>26</sup>. Hospital medical workers are in the front line of the disease and, accordingly, suffer higher levels of psychological distress.

In order to improve the welfare of oral health professionals, early detection of psychological distress is essential, especially in risky and abnormal situations. Recommendations to address distress include introducing safety protocols, a broader understanding of mental health issues, and enhancement of dental staff's self-efficacy<sup>10</sup>. Consequences of psychological distress can affect dental professionals, hindering their ability to cope with pressures and potentially lowering the quality of the treatment they provide. However, both dental assistants and endodontists in the present study did not believe that the treatment result was related to the pandemic.

Dental professionals come into close contact with their patients, which increases

the risk of contagion through exposure to blood and saliva, as well as aerosols and droplets<sup>17,18</sup>, which appear to remain suspended in the air for lengths of time<sup>27</sup>. For cavity access tissue removal, the endodontists in the present study used rubber dam isolation, a routine measure that potentially reduces cross infection and the production of airborne particles in the operational area by 70%<sup>28</sup>. The perception of dental staff using isolation procedures probably helps to lower their levels of anxiety more during anesthesia inoculation, when the patient's oral cavity is most exposed to the dental team, thus posing a higher risk of contagion according to the results of this study.

The Health and Safety Executive of the United Kingdom recommended the use of a filtering facepiece respirator (FFR) of type FFP3 for protection against the influenza virus in 2008 for activities that were likely to generate aerosols<sup>29</sup>. The Health and Safety Executive

**TABLE 4** - Heart Rate (HR), Systolic (SBP) and Diastolic (DBP) Blood Pressure of Endodontists in the Different Time Points in the 2 Time Periods (Mean ± Standard Deviation)

Value	Period	Arriving to the clinic	Finish workday	Arriving home	Rest	P value
HR	SC	74.1 ± 10.1	69.3 ± 10.6	66.9 ± 9.0	62.5 ± 6.2	.0019
≠ rest	PC	+10.9 (10.4) <sup>*,a</sup>	+6.1 (6.9) <sup>b</sup>	+3.7 (9.3) <sup>b</sup>		
	PC	69.1 ± 6.0	68.1 ± 10.1	64.7 ± 6.4	63.5 ± 6.4	<.001
≠ rest		+6.4 (4.9) <sup>*,a</sup>	+6.0 (6.3) <sup>a</sup>	+2.3 (3.9) <sup>b</sup>		
SBP	SC	117.6 ± 14.4	119.3 ± 12.2	112.3 ± 8.5	110.8 ± 8.8	<.001
≠ rest	PC	+6.8 (8.3) <sup>a</sup>	+8.5 (6.2) <sup>a</sup>	+1.5 (3.4) <sup>b</sup>		
	PC	114.8 ± 8.8	117.4 ± 10.1	112.7 ± 7.6	110.2 ± 8.1	<.001
≠ rest		+3.8 (5.7) <sup>a</sup>	+6.4 (6.7) <sup>b</sup>	+1.7 (3.4) <sup>c</sup>		
DBP	SC	74.8 ± 7.8	76.3 ± 6.4	70.8 ± 5.5	70.3 ± 3.2	.001
≠ rest	PC	+5.1 (8.4) <sup>a</sup>	+6.7 (6.1) <sup>a</sup>	+1.2 (4.6) <sup>b</sup>		
	PC	71.8 ± 5.2	74.4 ± 5.0	70.4 ± 4.2	68.7 ± 3.8	<.001
≠ rest		+3.7 (5.6) <sup>a</sup>	+6.4 (4.8) <sup>b</sup>	+2.5 (3.5) <sup>a</sup>		

PC, partial confinement; SC, strict confinement.

Values with different superscript letters have statistically significant differences. Between parentheses indicates the mean of differences between values and the rest data of every endodontist. ≠ rest rows indicate the mean of differences between values and the rest data of every endodontist.

also highlighted the frequent misperception that surgical masks provide sufficient protection against aerosols. However, national and international health authorities have reported contradictory information related to mask wearing during the present pandemic. Also, the shortage of available PPE material and the difficulty of obtaining adequate equipment in the current pandemic made safe dental assistance measures practically impossible, especially during the first 4 weeks of confinement.

In a recent study, 87% of dentists reported feeling afraid of contracting the disease in the dental clinic<sup>30</sup>. However, the majority of those did not wear an FFP2/N95 FFR, ask their patients to rinse with an antibacterial mouthwash before treatment, or use rubber dam isolation. Notwithstanding, most of the participants in that study were from 1 country, Pakistan. All of the endodontists in the present study wore an FFP2/N95 FFR and a surgical mask on top, ensured that patients rinsed with an antibacterial mouth rinse, and used rubber dam isolation during the procedure. Wearing a surgical mask over the FFP2/N95 FFR does not result in a psychological impact compared with an FFP2/N95 FFR alone<sup>31</sup>. Wearing 2 masks was not shown to affect breathing resistance significantly<sup>32</sup> and did not affect HR or SpO<sub>2</sub> measurements<sup>31</sup>. In addition, the use of a surgical mask reduces the cost efficiency in extending the useful life of the FFP2/N95 FFR, which is particularly essential in times where demand exceeds supply<sup>31</sup>.

The balancing activity between the sympathetic and the parasympathetic nervous systems regulates HR. An increase or decrease in one or the other system's action results in cardioacceleration or deceleration<sup>33</sup>. Stress and anxiety also result in a sympathetic stimulation that causes HR to increase<sup>33</sup>. Accordingly, stressed surgeons have shown higher intraoperative HR than nonstressed

surgeons<sup>34</sup>. In our study, HR was shown to increase in endodontists in the clinic and before and after the RCT procedure compared with rest values ( $P < .05$ ). These results are in accordance with the data reported by Gortzak et al<sup>22</sup>. Also, a higher increase was observed in endodontists arriving at the clinic during the strict confinement period ( $P < .05$ ). Working during the first weeks resulted in a higher increase in HR, which was related to the reported higher levels of anxiety.

Significant hemodynamic changes were found during the workday compared with the measurements taken at the end of the workday and the rest data ( $P < .05$ ). Similar results were reported by Gortzak et al<sup>22</sup> in normotensive dentists; they also observed that dentists might be exposed to higher cardiovascular stress during the workday than nondental workers and associated these differences to dentists' self-perception of their work being more stressful than that of other professions. Greater levels of stress may subject the cardiovascular system to a substantial strain, raising the HR and blood pressure<sup>22</sup> and explaining why, in the present study, these levels increased during the workday, especially when arriving at the clinic.

When treating more anxious patients, the endodontists' HR and blood pressure (SBP/DIBP) rose<sup>35</sup>. These results are in agreement with data reported by Borea et al<sup>36</sup> when performing a tooth extraction in anxious patients. These increases were significant during strict confinement (+6 beats/min, +8 mm Hg, and + 5.7 mm Hg) and only for SBP during the partial confinement (+5 mm Hg). Because patient anxiety seems to affect dentists' cardiovascular response, it is important for the dentist to detect and manage anxious patients in order to provide a more comfortable experience and decrease the cardiovascular reaction of both the patient and the dentist<sup>37</sup>.

## CONCLUSIONS

High levels of general anxiety were found in the first weeks, but they significantly reduced from week 4 of work. The risk of contagion and the protection measures were perceived as the 2 major factors related to anxiety in endodontists and dental assistants, especially during anesthesia and disinfection of equipment and the dental unit. Higher levels of HR and blood pressure were found during the workday, especially when arriving at the clinic, compared with finishing the workday and the rest values. No statistical difference was found between the pre- and postoperative RCT data differences in the 2 time periods evaluated.

## CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

**Juan Gonzalo Olivieri:** Conceptualization, Methodology, Investigation, Writing - original draft. **Carlota de España:** Methodology, Investigation, Resources, Writing - original draft. **Marc Encinas:** Methodology, Investigation. **Xavier-Fruituós Ruiz:** Resources, Investigation. **Queralt Miró:** Formal analysis, Validation. **Jordi Ortega-Martinez:** Resources, Writing - review & editing. **Fernando Durán-Sindre:** Writing - review & editing.

## ACKNOWLEDGMENTS

*The authors thank Dr Masip Utset (associate professor of cardiology, Universitat de Barcelona), Dr Manito Lorite (Cardiology Service, Hospital Clínic de Barcelona), and Mark Lodge (language consultant) for their advice and support.*

*The authors deny any conflicts of interest related to this study.*

## REFERENCES

1. Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus infected pneumonia. *N Engl J Med* 2020;382:1199–207.
2. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. Available at: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>. Accessed April 15, 2020.
3. Sistema de monitorización de la mortalidad diaria (MoMo). Centro Nacional de Epidemiología del Instituto de Salud Carlos III (ISCIII), España. Available at: [https://momo.isciii.es/public/momo/dashboard/momo\\_dashboard.html](https://momo.isciii.es/public/momo/dashboard/momo_dashboard.html). Accessed May 24, 2020.

4. What constitutes a dental emergency? American Dental Association. Available at: [https://success.ada.org/~media/CPS/Files/Open%20Files/ADA\\_COVID19\\_Dental\\_Emergency\\_DDS.pdf](https://success.ada.org/~media/CPS/Files/Open%20Files/ADA_COVID19_Dental_Emergency_DDS.pdf). Updated March 31, 2020. Accessed May 24, 2020.
5. Guo H, Zhou Y, Liu X, Tan J. The impact of the COVID-19 epidemic on the utilization of emergency dental services. *J Dent Sci* 2020 Mar 16 [Epub ahead of print].
6. Work context: exposed to disease or infections. O\*NET OnLine, National Center for O\*NET Development. Available at: [www.onetonline.org/find/descriptor/result/4.C.2.c.1.b](http://www.onetonline.org/find/descriptor/result/4.C.2.c.1.b). Accessed May 20, 2020.
7. Harrel SK, Molinari J. Aerosols and splatter in dentistry: a brief review of the literature and infection control implications. *J Am Dent Assoc* 2004;135:429e37.
8. Zemouri C, de Soet H, Crielaard W, Laheij A. A scoping review on bio-aerosols in healthcare and the dental environment. *PLoS One* 2017;12:e0178007.
9. Cottone JA, Terezhalmay GT, Molinari JA. *Practical Infection Control in Dentistry*. Baltimore, MD: Williams & Wilkins; 1996. p. 139–40.
10. Hollinshead R, Tyrour L, Ward D, et al. Modifications of emergency dental clinic protocols to combat COVID-19 transmission. *Spec Care Dentist* 2020;40:219–26.
11. Shacham M, Hamama-Raz Y, Kolerman R, et al. COVID-19 factors and psychological factors associated with elevated psychological distress among dentists and dental hygienists in Israel. *Int J Environ Res Public Health* 2020;17:2900.
12. Chong MY, Wang WC, Hsieh WC, et al. Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. *Br J Psychiatry* 2004;185:127–33.
13. Gouliou P, Mantas C, Dimitroula D, et al. General hospital staff worries, perceived sufficiency of information and associated psychological distress during the A/H1N1 influenza pandemic. *BMC Infect Dis* 2010;10:322.
14. Wang C, Pan R, Wan X, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (covid-19) epidemic among the general population in China. *Int J Environ Res Public Health* 2020;17:1729.
15. Tsamakidis K, Rizos E, Manolis AJ, et al. COVID-19 pandemic and its impact on mental health of healthcare professionals. *Exp Ther Med* 2020;19:3451–3.
16. Kroenke K, Spitzer RL, Williams JB, et al. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med* 2007;146:317–25.
17. Ather A, Patel B, Ruparel NB, et al. Coronavirus disease 19 (COVID-19): implications for clinical dental care. *J Endod* 2020;46:584–95.
18. Meng L, Hua F, Bian Z. Coronavirus disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. *J Dent Res* 2020;99:481–7.
19. Chipchase SY, Chapman HR, Bretherton R. A study to explore if dentists' anxiety affects their clinical decision-making. *Br Dent J* 2017;222:277–90.
20. Song KW, Choi WS, Jee HJ, et al. Correlation of occupational stress with depression, anxiety, and sleep in Korean dentists: cross-sectional study. *BMC Psychiatry* 2017;17:398.
21. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med* 2006;166:1092–7.
22. Gortzak RA, Stegeman A, Ten Brinke R, et al. Ambulant 24-hour blood pressure and heart rate of dentists. *Am J Dent* 1995;8:242–4.
23. Pappa S, Ntella V, Giannakas T, et al. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Brain Behav Immun* 2020;88:901–7.
24. Consolo U, Bellini P, Bencivenni D, et al. Epidemiological aspects and psychological reactions to COVID-19 of dental practitioners in the northern Italy districts of Modena and Reggio Emilia. *Int J Environ Res Public Health* 2020;17:3459.
25. Lei L, Huang X, Zhang S, et al. Comparison of prevalence and associated factors of anxiety and depression among people affected by versus people unaffected by quarantine during the COVID-19 epidemic in southwestern China. *Med Sci Monit* 2020;26:e924609.
26. Lu W, Wang H, Lin Y, Li L. Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study. *Psychiatry Res* 2020;288:112936.
27. Peng X, Xu X, Li Y, et al. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci* 2020;12:1–6.



28. Samaranyake LP, Reid J, Evans D. The efficacy of rubber dam isolation in reducing atmospheric bacterial contamination. *ASDC J Dent Child* 1989;56:442–4.
29. Health and Safety Executive. Evaluating the protection afforded by surgical masks against influenza bioaerosols: gross protection of surgical masks compared to filtering facepiece respirators. Available at: <https://www.hse.gov.uk/research/rrpdf/rr619.pdf>. 2008. Accessed March 1, 2020.
30. Ahmed MA, Jouhar R, Ahmed N, et al. Fear and practice modifications among dentists to combat novel coronavirus disease (COVID-19) outbreak. *Int J Environ Res Public Health* 2020;17:2821.
31. Roberge RJ, Coca A, Williams WJ, et al. Surgical mask placement over N95 filtering facepiece respirators: physiological effects on healthcare workers. *Respirology* 2010;15:516–21.
32. Vojtko MR, Roberge MR, Vojtko RJ, et al. Effect on breathing resistance of a surgical mask worn over a N95 filtering facepiece respirator. *J Int Soc Respir Prot* 2008;25:1–8.
33. Rajendra Acharya U, Paul Joseph K, Kannathal N, et al. Heart rate variability: a review. *Med Biol Eng Comput* 2006;44:1031–51.
34. Rieger A, Stoll R, Kreuzfeld S. Heart rate and heart rate variability as indirect markers of surgeons' intraoperative stress. *Int Arch Occup Environ Health* 2014;87:165–74.
35. Olivieri JG, de España C, Encinas M, et al. Dental anxiety, fear, and root canal treatment monitoring of heart rate, and oxygen saturation in patients treated during the coronavirus disease 2019 (COVID-19) pandemic: an observational clinical study. *J Endod* 2020.
36. Borea G, Montebugnoli L, Braiato A. The effects of patient anxiety on the cardiovascular stress of dentists. *Quintessence Int* 1989;20:853–7.
37. Brand HS, Abraham-Inpijn L. Cardiovascular responses induced by dental treatment. *Eur J Oral Sci* 1996;104:245–52.