






# The impact of COVID-19 on Italian dentists: A cross-sectional survey on 2443 participants

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## Abstract

**Objective:** To evaluate the impact of COVID-19 pandemic among a sample of Italian dentists in terms of infection, strategies for infection control, organization of the dental clinic, attitude, and behavior.

**Material and Methods:** This was a cross-sectional survey. The sample consisted of 8000 Italian dentists selected among 63,375 using a computerized random sampling method.

An electronic informed consent had to be signed. The questionnaire categories were on demographic, infection risk management, organization, and dentists' attitude and behavior. Geographic macro-areas were used for subgroup analysis.

**Results:** Among 8000 invited dentists, 2443 agreed to participate to the survey (30.6%). Mean age was 51.2 years, women were 34.5%. A total of 6.1% self-reported COVID-19 experience and higher rate of infection was reported in north Italy compared to the south ( $p < 0.05$ ). FFP2/FFP3 respirators (97.1%) and visors (97.4%) were used by almost all dentists. While, natural ventilation and mouthwashes were the most frequent approaches used to reduce the infection risk. Most of the dentists reported positive attitude, nevertheless 83.6% felt an increased responsibility.

**Conclusion:** The self-reported COVID-19 prevalence was 6.1% with some differences among geographic areas. COVID 19 had a deep impact on preventive strategies, dental office organization, and behavior within this sample.

## KEYWORDS

COVID-19, FFP2/FFP3 respirators, personal protective equipment, SARS-Cov-2



## 1 | INTRODUCTION

During the last years, we have been facing the COVID-19 that is caused by SARS-Cov-2 virus.

Route of transmission for SARS-Cov-2 are direct contact with respiratory droplets ( $>5\ \mu\text{m}$ ) and airborne transmission (droplet nuclei  $\leq 5\ \mu\text{m}$ ). (Atkinson et al., 2009; Chan et al., 2020; Li et al., 2020; Meselson, 2020). Infection by indirect contact through fomites is possible too, but the risk is generally considered to be low (Kampf et al., 2020; Meyerowitz et al., 2020).

Dentists are supposed to be at high biological risk by direct contact with respiratory droplets. (Clementini et al., 2022; Ionescu et al., 2020; Volgenant et al., 2021). Additionally, dentists may be highly exposed to airborne during aerosol-generating procedures (AGPs). (Harrel & Molinari, 2004; Zemouri et al., 2017).

Rate of COVID-19 infection on dental communities on June 2020 was 1% in different countries (Estrich et al., 2020; Kluytmans-Van Den Bergh et al., 2020; Lai et al., 2020). While the antibody prevalence in a sample of dental health workers in Lombardia (Italy) was around 10% (Gallus et al., 2021).

A cross-sectional survey reported data on 790 Italian dentists (members of the Italian Society of Periodontology and Implantology, SIdP) during the period January–February 2021. The self-reported infection rate was 4.7% and in the Northwest of Italy, COVID-19 experience was twice as higher compared to southern regions (Discepoli et al., 2022).

Public health strategies adopted by national health's institution around the world varied greatly. Recommendations, quarantines, testing, restrictive measures, and vaccines were adopted heterogeneously with the common aim of minimizing the biological risk and partially contain the clinical phenotype of the disease. Besides the epidemiological achievements obtained, the restriction of individual freedom proposed underpins profound psychological and emotional alterations (Fiorillo & Gorwood, 2020).

This investigation was aimed to describe the self-reported infection rate among a sample of Italian dentists during the first and second wave of recrudescence and the related medico-legal issues. Moreover, we want to describe the changes in terms of dental office organization, occupational, and safety health measures, and finally the attitude and behavior of both dentists and patients.

## 2 | MATERIALS AND METHODS

### 2.1 | Study design and setting

STROBE guidelines were used to prepare the manuscript (von Elm et al., 2014).

This study was designed as cross-sectional survey administered to a sample of Italian dentists from March 23 to October 14, 2021. Questionnaire is available in Appendix S1

### 2.2 | Participants

Participants were dentists officially listed in the Italian Register of dentistry. Both owners of dental office and collaborators could participate. Before starting the survey, an electronic informed consent had to be signed. Participants were categorized in the following geographic areas: northwest (Piemonte, Liguria, Valle d'Aosta), north east (Lombardia, Veneto, Friuli-Venezia Giulia, Trentino Alto Adige), center (Toscana, Emilia-Romagna, Marche, Lazio, Abruzzo), and south and island (Campania, Basilicata, Molise, Puglia, Calabria, Sardegna, Sicilia).

### 2.3 | Variables

The items of this survey were grouped into six categories.

Category 1: Demographic characteristics include age, gender, professional status (collaborator, clinic owner, public or private employee), and information on COVID-19 experience (self-reported disease, clinical characteristic of the disease; supposed place of infection, and dental team infection).

Category 2: Reports on the adherence to recommendations, biological risk management, administration of the control measures, the role of the occupational physician for surveillance, data on civil or criminal claims or accident complaints and insurance coverage changes.

Category 3: Comprises information on personal protective equipment use (FFP2/FFP3 respirators, surgical mask, visors, goggles, TNT gowns and suit, boot cover, scrub cap, and behavior in case of FFP2/FFP3 reuse).

Category 4: Strategies to reduce the biological risk in dental setting (risk assessment, aerosol reduction, and surface disinfection) and changes in the organization of the dental practice induced by the pandemic (schedule, appointment duration, and costs).

Category 5: Focus on personal attitude toward the pandemic and the future (patient attitude, dental team attitude, and future perspective).

Category 6: Reports on vaccination status, intention to vaccine or not, and testing for infection.

Finally, additional information on occupational physician by age and professional status were reported also.

### 2.4 | Sample size

The sample size was outlined by a pragmatic approach without any "a priori" calculation.

The survey was proposed to 8000 randomly selected dentists among 63,375 registered in the Italian Register of Dentistry. The Research Randomizer software (<https://www.randomizer.org>) was used to generate the random sampling. The final list of participants was divided according to the four geographic areas (northwest, north east, center, south and island).

## 2.5 | Statistical methods

Stata software (Stata© 15 IC) was used for the statistical analysis. Continuous variables were described as mean and confidence interval at 95%. Categorical and dichotomous variables were described as proportions and Wilson's confidence interval at 95%. The normal distribution of variables was evaluated with Shapiro–Wilk test for normality. A subgroup analysis between geographic areas was performed using analysis of variance for continuous variables and chi-squared tests for categorical variables. Statistical significance was set at 0.05.

## 3 | RESULTS

A total of 2443 dentists participated to the web-based survey. Thus, the rate of response was 30.5%. The geographic distribution of the sample was as follows: 697 were from northwest, 437 from north-east, 515 from center, and 794 from south/islands.

### 3.1 | Category 1: Demographic/ COVID-19 experience

Mean age was 51.2 years, women were 34.5%. Dental clinic owners accounted for 61.3%, collaborators for 31.4%, private employees 1.4%, and public employees 5.9% with a significant difference among geographic areas ( $p < 0.05$ ).

A total of 6.1% participants self-reported COVID-19 experience after first lockdown. The majority declared no or mild symptoms. Only seven were hospitalized while four were admitted to ICU. Higher rate of infection was reported in north Italy compared to the south ( $p < 0.05$ ). Among the participants, 8.3% reported that one member of the dental team experienced the COVID-19 while the 6.4% reported COVID-19 for more than one member. (Table 1).

### 3.2 | Category 2: Recommendation, occupational physician, and complaint

Clinical recommendations were completely followed by almost all participants and protective and preventive measures were considered necessary and effective by 64.2% of participants. Very few (4.8%) dentists deemed these measures excessive.

In most cases (92.7%) dental team members received information regarding the biological risk and on the related protective and preventive procedures to be followed.

In case of positiveness to SARS-CoV-2, control measures were administered by Department of Prevention of the Local Health Authorities in half of the cases, with a significant difference between geographic areas ( $p = 0.004$ ).

Less than 50% of clinics had already an occupational physician, while 4.9% turned to this expert during pandemic. Employees and

collaborators were surveilled by the occupational physician in 17.6% and 24.1% of the cases, respectively.

There were 13 COVID-19 claimed as at work infections and then reported as occupational accidents; 4 civil and 4 criminal claims filed by employees against employers, deeming them liable for the infection at work, were reported. (Tables 2 and 7).

### 3.3 | Category 3: Personal protective equipment (PPE)

FFP2/FFP3 respirators and visors were the most used PPE followed by scrub cap. Respirators were changed every 5–6 h by 65.6% of the participants while only 8% used a new one for every patient. Only 17.3% of dentists reconditioned the FFP2 one or more times and 59.7% add a surgical mask together with the FFP2. The use of single-use TNT gowns and suit and washable TNT gowns differed between areas (Table 3).

### 3.4 | Category 4: Biological risk management and related organization

Natural ventilation and mouthwashes were the most frequent approaches used. Almost half of the participants used additional high-speed suction system, while HEPA filters and forced ventilation were used only by 20% of the participants. Reduction of high-speed rotatory instruments and air abrasive were considered preventive strategies by a third of the participants. Only the 6.2% of dentists decided to quit the use of ultrasonic instruments. Update of the medical history was considered appropriate to check risk factors for severe COVID-19. General treatment costs were maintained steady as before the pandemic for 81.5% of the dental clinics, instead single treatment optimization was adopted by 57.5% for improving the clinics management. Increased working daily hours and working days were considered suitable strategies in particular across the center and south/island areas ( $p < 0.05$ ) (Table 4).

### 3.5 | Category 5: Attitude and behavior

Most of interviewed dentists reported patients' positive attitude toward the dental team, which highlights a proactive and positive professional behavior. Moreover, 83.6% of dentists felt an increased responsibility, associated with a concrete belief that the pandemic will negatively impact on the future profession's horizons (Table 5).

### 3.6 | Category 6: Vaccine

Higher number of participants in the south/island area were vaccinated compared to other areas. Nevertheless, the mean percentage of vaccination was high (89.6%). Almost all the



TABLE 1 Demographic characteristic and information on COVID-19 experience.

Questions	Variables/answers	Total	North west	North east	Centre	South/island	p-Value
How old are you?	Number of participants (n/%)	2443 (100%)	697 (28.5%)	437 (17.9%)	515 (21.1%)	794 (32.5%)	p = 0.1
	Mean age (mean; 95% CI)	51.2 (50.7-51.6)	53.4 (52.5-54.3)	52 (50.9-53.2)	51.7 (50.6-52.7)	49.9 (49-50.8)	p = 0.802
Gender?	Female (%; 95% CI)	34.5 (32.6-36.4)	44.2 (31.4-57.9)	45.2 (28.7-62.7)	28.1 (15.2-46)	35.3 (21.2-52.6)	
Which is your professional status?	Dental clinic owner (%; 95% CI)	61.3 (59.3-63.2)	48.1 (34.9-61.6)	48.3 (31.5-65.6)	71.9 (54-84.6)	73.5 (56.3-85.7)	p < 0.05
	Consultant/collaborator (%; 95% CI)	31.4 (29.5-33.2)	36.5 (24.6-50.4)	35.5 (20.8-53.6)	25 (13-42.8)	17.6 (8.1-34.3)	
	Private employee (%; 95% CI)	1.4 (1.1-2)	1.9 (0.3-12.6)	6.5 (1.6-22.6)	-	2.9 (0.4-18.4)	
	Public employee (%; 95% CI)	5.9 (5-6.9)	13.5 (6.5-25.8)	9.7 (3.1-26.2)	3.1 (0.4-19.4)	5.9 (1.5-20.9)	
Did you experience COVID-19 after first lockdown?	Yes (%; 95% CI)	6.1 (5.2-7.1)	7.5 (5.8-9.7)	7.1 (5-9.9)	6.2 (4.4-8.7)	4.3 (3.1-5.9)	p < 0.05
	No symptoms (%; 95% CI)	1.9 (1.4-2.6)	2.4 (1.5-3.9)	1.4 (0.6-3)	1.6 (0.8-3.1)	2 (1.2-3.3)	p = 0.1
If you experienced COVID-19, did you suffer from symptoms?	Symptoms no hospitalization (%; 95% CI)	3.7 (3-4.6)	4.6 (3.3-6.4)	5.5 (3.7-8.1)	3.7 (2.4-5.7)	2 (1.2-3.3)	p = 0.1
	Symptoms and hospitalization (%; 95% CI)	0.3 (0.1-0.6)	0.2 (0.07-1.1)	0.2 (0.03-1.6)	0.6 (0.01-0.9)	0.1 (0.01-0.9)	p = 0.1
	Admission to intensive care (%; 95% CI)	0.2 (0.06-0.4)	0.1 (0.01-0.9)	-	0.3 (0.1-1.5)	0.1 (0.02-0.9)	p = 0.1
Where do you suppose to be infected?	Unknown (%; 95% CI)	33.3 (26.1-41.4)	40.4 (27.9-54.2)	32.3 (18.2-50.4)	28.1 (15.2-46)	29.4 (16.5-46.7)	p = 0.251
	Work (%; 95% CI)	19 (13.4-26.3)	26.9 (16.8-40.6)	19.4 (8.9-37.1)	15.6 (6.6-32.6)	11.8 (0.4-27.6)	
	Family/community (%; 95% CI)	47.6 (39.6-55.8)	32.7 (21.3-46.6)	48.4 (31.5-65.6)	56.3 (38.9-72.2)	58.8 (41.8-74)	
Did you have member of the dental team experiencing COVID-19?	No members (%; 95% CI)	85.3 (83.8-86.6)	80.4 (77.3-83.2)	78.6 (74.5-82.2)	88 (84.9-90.5)	91.4 (89.3-93.2)	p < 0.05
	One member (%; 95% CI)	8.3 (7.3-9.5)	9.4 (7.5-11.9)	11.5 (8.8-14.9)	7.2 (5.2-9.8)	6.2 (4.7-8.1)	
	More than one (%; 95% CI)	6.4 (5.5-7.5)	10.1 (8-12.5)	9.9 (7.4-13.1)	4.9 (3.3-7.1)	2.4 (1.5-3.7)	

Note: Significant p-value are given in bold.

TABLE 2 Recommendation, infection risk control, administration of the infection control measure, and data on complaint.

Questions	Variables/answers	Total	North west	North Est	Centre	South/Island	p-value
In case of COVID-19 dental team experience, the infection control measures were administered by	Department of Prevention of the Local Health Authorities (%; 95% CI)	45.2 (41.1–49.4)	26.8 (16.8–40)	61.8 (48.4–73.7)	50 (35.6–64.4)	48.9 (34.7–63.3)	<b>p = 0.004</b>
	Occupational physician (%; 95% CI)	26 (22.5–29.8)	41.1 (29–54.4)	14.5 (7.4–26.6)	9.1 (3.4–22)	33.3 (21.1–48.3)	
	Dental clinic owner (%; 95% CI)	23 (19.7–26.8)	26.8 (16.8–39.9)	21.8 (12.8–34.7)	31.8 (19.8–46.9)	15.6 (7.6–29.3)	
	Unknown (%; 95% CI)	5.8 (4.1–8.1)	5.4 (1.8–15.4)	1.8 (0.3–11.9)	9.1 (3.4–22)	2.2 (0.3–14.3)	
Did you have the occupational physician before the pandemic?	Yes (%; 95% CI)	38.6 (36.6–40.5)	38.9 (35.3–42.6)	37.3 (32.9–41.9)	37.1 (33–41.3)	39.9 (36.6–43.4)	<b>p = 0.346</b>
	Choose during pandemic (%; 95% CI)	4.9 (4.1–6)	4.3 (3–6.1)	6.2 (4.3–8.9)	6.2 (4.4–8.7)	3.8 (2.7–5.4)	
Were the dental clinic members surveilled by the occupational physician?	No (%; 95% CI)	58.3 (56.3–60.2)	50 (37.1–62.9)	50.9 (37.9–63.8)	43.2 (29.4–58.1)	22.2 (12.3–36.7)	<b>p = 0.713</b>
	Only employee (%; 95% CI)	17.6 (16.2–19.2)	25 (15.4–38)	14.5 (7.4–26.6)	22.7 (12.6–37.4)	24.4 (14–39.1)	
	Consultant/collaborator (%; 95% CI)	24.1 (22.4–25.8)	25 (15.4–38)	34.5 (23.2–48)	34.1 (21.6–49.2)	53.3 (38.8–67.3)	
	Partially (%; 95% CI)	4.9 (4.1–5.8)	5.5 (4–7.5)	5.4 (3.6–8.1)	4 (2.6–6.1)	3.6 (2.5–5.2)	<b>p &lt; 0.05</b>
Official preventive measures were	Completely (%; 95% CI)	57.2 (55.2–59.1)	60 (56.2–63.6)	62.9 (58.2–67.4)	57.7 (53.4–62)	51.6 (48.1–55.1)	
	Completely and improved (%; 95% CI)	37.9 (36–39.8)	34.5 (31–38.2)	31.7 (27.4–36.3)	38.3 (34.1–42.6)	44.8 (41.3–48.3)	
	Excessive (%; 95% CI)	4.8 (3.8–6)	4.2 (2.9–5.9)	5 (3.3–7.5)	4.9 (3.3–7.1)	3.9 (2.8–5.5)	<b>p = 0.692</b>
	Necessary but with too high cost (%; 95% CI)	31 (28.7–33.4)	28.7 (25.5–32.2)	28.6 (24.6–33)	29.5 (25.7–33.6)	32.2 (29.1–35.6)	
Did the dental clinic member receive information about the risk of COVID-19 infection?	Necessary and effective (%; 95% CI)	64.2 (61.7–66.6)	67.1 (63.6–70.5)	66.4 (61.8–70.6)	65.6 (61.4–69.6)	63.9 (60.4–67.1)	
	Yes (%; 95% CI)	92.7 (91.6–93.7)	94.2 (92.2–95.7)	93.1 (90.3–95.2)	93.3 (90.7–95.1)	91.6 (89.4–93.4)	<b>p = 0.283</b>
Do you have the risk assessment document?	No (%; 95% CI)	6.2 (5.3–7.2)	5.2 (3.7–7.1)	2.7 (1.6–4.8)	5.6 (3.9–8)	9.3 (7.5–11.5)	<b>p &lt; 0.05</b>
	Yes, updated for SARS-CoV-2 (%; 95% CI)	70.9 (69–72.6)	72.7 (69.3–75.9)	68.6 (64.1–72.8)	66.6 (62.4–70.5)	73.2 (70–76.1)	
	Yes, not updated for SARS-CoV-2 (%; 95% CI)	7.9 (6.9–9.1)	8.2 (6.4–10.5)	9.2 (6.8–12.2)	8 (5.9–10.6)	7.1 (5.5–9.1)	
	Unknown (%; 95% CI)	15 (13.7–16.5)	13.9 (11.5–16.7)	19.5 (16–23.4)	19.8 (16.6–23.5)	10.5 (8.5–12.8)	
Were there civil, criminal claims, or accident at work due to COVID-19 in the dental office?	No (%; 95% CI)	91.1 (89.9–92.1)	90.7 (88.3–92.6)	89.2 (86–91.8)	91.5 (88.7–93.6)	92.2 (90.1–93.9)	<b>p = 0.772</b>
	Unknown (%; 95% CI)	8.1 (7–9.2)	8.6 (6.7–10.9)	9.8 (7.3–13)	7.6 (5.6–10.2)	6.9 (5.3–8.9)	
	Accident at work (%; 95% CI)	0.5 (0.3–0.9)	0.6 (0.2–1.5)	0.7 (0.2–2.1)	0.4 (0.1–1.5)	0.5 (0.2–1.3)	
	Civil claims (%; 95% CI)	0.2 (0.06–0.4)	–	0.2 (0.03–1.6)	0.4 (0.1–1.5)	0.1 (0.01–0.8)	
	Criminal claims (%; 95% CI)	0.2 (0.06–0.4)	0.1 (0.02–1)	–	0.2 (0.02–1.3)	0.3 (0.1–1)	

Note: Significant p-value are given in bold.



TABLE 3 Information of personal protective equipment (PPE) usage.

Questions	Variables/answers	Total	North west	North Est	Centre	South/island	p-Value
Which of the following PPE were used by the clinic staff?	FFP2/FFP3 respirator (%; 95% CI)	97.1 (96.3–97.7)	96.4 (94.7–97.6)	96.8 (94.7–98.1)	97.9 (96.2–98.8)	97.4 (96–98.3)	<i>p</i> = 0.465
	Surgical mask (%; 95% CI)	51.6 (49.6–53.6)	52.5 (48.7–56.3)	48.9 (44.2–53.7)	53.2 (48.8–57.5)	47.5 (44–51)	<i>p</i> = 0.151
	Visors (%; 95% CI)	97.4 (96.7–97.9)	97.5 (96–98.4)	96.9 (94.8–98.2)	97.8 (96.1–98.8)	98.1 (96.8–98.8)	<i>p</i> = 0.596
	Goggles (%; 95% CI)	67 (65.2–68.9)	67.4 (63.8–70.9)	64.5 (59.9–69)	68.3 (64.1–72.2)	68.8 (65.5–72)	<i>p</i> = 0.443
	Single-use TNT gowns (%; 95% CI)	82.5 (81–84)	86.5 (83.7–88.8)	82.3 (78.3–85.6)	84.7 (81.3–87.6)	79.3 (76.3–82)	<i>p</i> = 0.001
	Single-use TNT suit (%; 95% CI)	24.4 (22.8–26.2)	17.3 (14.6–20.3)	16.1 (12.9–19.9)	26.2 (22.5–30.2)	35.3 (32–38.8)	<i>p</i> < 0.05
	Washable TNT gowns (%; 95% CI)	29.6 (27.8–31.4)	25 (21.9–28.4)	31.2 (27–35.8)	32.3 (28.4–36.6)	31.3 (28.1–34.7)	<i>p</i> = 0.007
	Disposable boot cover (%; 95% CI)	57.6 (55.6–59.4)	54.5 (50.7–58.2)	45.4 (40.7–50.2)	63.7 (59.4–67.8)	63.8 (60.3–67.1)	<i>p</i> < 0.05
For FFP2/FFP3 use, did you use a surgical mask to cover the respirator?	Scrub cap (%; 95% CI)	90.8 (89.6–91.9)	92.3 (90–94.1)	91.5 (88.4–93.8)	92.7 (90–94.6)	89.5 (87.2–91.5)	<i>p</i> = 0.170
	Yes, FFP2 wear under a surgical mask (%; 95% CI)	59.7 (57.7–61.7)	61.5 (57.7–65.1)	61.9 (57.2–66.4)	59.5 (55.1–63.7)	57.1 (53.5–60.1)	<i>p</i> = 0.261
For FFP2/FFP3 use, which is your behavior?	Changed every day (%; 95% CI)	26.4 (24.7–28.2)	29 (25.7–32.6)	32.6 (28.3–37.2)	26 (22.3–30)	21 (18.2–24)	<i>p</i> < 0.05
	Changed every 5–6 hours (%; 95% CI)	65.6 (63.7–67.5)	65 (61.3–68.5)	58.6 (53.9–63.2)	64.9 (60.6–68.9)	70.4 (67.1–73.5)	
	Changed every patient (%; 95% CI)	8 (7–9.2)	6 (4.4–8)	8.7 (6.4–11.8)	9.1 (6.9–12)	8.7 (6.9–10.9)	
For FFP2/FFP3 use, did you recondition the respirators?	No (%; 95% CI)	82.9 (80.3–85.8)	83.3 (80.3–86)	82.9 (79.1–86.3)	82.7 (79.2–85.8)	82.4 (79.6–84.9)	<i>p</i> = 0.994
	Reconditioned (alcohol, UV, autoclave) one time (%; 95% CI)	10.7 (9.5–12)	10.6 (8.5–13.1)	11.1 (8.4–14.5)	10.5 (8.1–13.5)	10.7 (8.7–13.1)	
	Reconditioned (alcohol, UV, autoclave) more than one time (%; 95% CI)	6.4 (5.5–7.5)	6.1 (4.5–8.1)	5.9 (4–8.6)	6.7 (4.9–9.3)	6.9 (5.3–8.9)	

Note: Significant *p*-value are given in bold.



TABLE 4 Information on strategies to reduce the risk of infection in dental setting and changes in the organization of dental practice induced by the pandemic.

Questions	Variables/answers	Total	North west	North Est	Centre	South/island	p-value
Which of the following strategies were applied to improve infection control?	Natural ventilation (%; 95% CI)	86.4 (84.9–87.7)	85.8 (83–88.2)	85.8 (82.2–88.8)	86.6 (83.4–89.2)	87 (84.5–89.2)	p = 0.891
	HEPA filters (%; 95% CI)	19.1 (17.6–20.7)	18.2 (15.5–21.3)	18.5 (15.2–22.5)	19.6 (16.4–23.3)	19.9 (17.3–22.8)	p = 0.837
	Forced ventilation system (%; 95% CI)	20.3 (18.8–22)	22.2 (19.3–25.5)	18.3 (15–22.2)	21.2 (17.8–24.9)	19.3 (16.7–22.2)	p = 0.328
	Additional high-speed suction system (%; 95% CI)	44.3 (41.8–46.9)	43 (39.4–46.8)	47.1 (42.5–51.8)	37.4 (33.4–41.7)	41.7 (38.3–45.1)	<b>p = 0.025</b>
	Preoperative mouthwashes (chlorhexidine, hydrogen peroxide, cetylpyridinium chloride, povidone iodate) (%; 95% CI)	80.4 (78.8–82)	81.5 (78.4–84.2)	83.8 (78–86.9)	79.4 (75.7–82.7)	78.3 (75.3–81.1)	p = 0.106
Regarding ultrasonic instruments usage:	Use of rubber dam (%; 95% CI)	65.9 (64–67.7)	69.7 (66.2–73)	72.1 (67.7–76.1)	64.5 (60.2–68.5)	60 (56.5–63.3)	<b>p &lt; 0.05</b>
	High-speed rotatory instruments elimination/reduction (%; 95% CI)	38.3 (36.4–40.2)	37.9 (34.3–41.5)	36.2 (31.8–40.8)	36.1 (32.1–40.4)	41.2 (37.8–44.6)	p = 0.192
	Ultrasonic instruments elimination/reduction (%; 95% CI)	34 (32.1–35.9)	33.3 (29.9–36.9)	33.2 (28.9–37.7)	34.4 (30.4–38.6)	34.8 (31.5–38.1)	p = 0.913
	Air abrasive instruments elimination/reduction (%; 95% CI)	43.8 (41.8–45.8)	42.6 (39–46.3)	46.7 (42–51.4)	44.1 (39.8–48.4)	43.1 (39.7–46.5)	p = 0.560
	Ultrasonic are used as before (%; 95% CI)	21.1 (19.1–23.2)	23 (20–26.2)	27.5 (23.5–31.8)	21.2 (17.8–24.9)	21.2 (18.5–24.1)	p = 0.467
Did you update the anamnestic protocol to search risk factors for severe COVID-19?	Ultrasonic are used only in selected case (%; 95% CI)	32.1 (29.8–34.5)	32.7 (29.3–36.3)	30.2 (26.1–34.7)	31.7 (27.8–35.8)	32.1 (29–35.4)	
	Ultrasonic are used adding antimicrobial solutions (%; 95% CI)	40.5 (38.1–43)	37 (33.5–40.7)	35.5 (31.1–40.1)	40.4 (36.2–44.7)	39.8 (36.4–43.2)	
	Ultrasonic are not used anymore (%; 95% CI)	6.2 (5.1–7.6)	7.3 (5.6–9.5)	6.9 (4.8–9.7)	6.8 (4.9–9.3)	6.9 (5.3–8.9)	
	Yes (%; 95% CI)	80.7 (78.6–82.6)	79.8 (76.6–82.6)	77.8 (73.7–81.5)	77.1 (73.3–80.5)	79.8 (76.9–82.5)	p = 0.557
The rate table due to preventive measures adoption, were	As before (%; 95% CI)	81.5 (79.5–83.4)	82.5 (79.5–85.1)	76.9 (72.7–80.6)	82.1 (78.6–85.2)	78.6 (75.6–81.3)	p = 0.193
	Increased for specific treatment (%; 95% CI)	13.4 (11.8–15.3)	10.9 (8.8–13.4)	15.6 (12.5–19.3)	11.2 (8.8–14.3)	15.4 (13–18)	
	Globally increased (%; 95% CI)	3.3 (2.5–4.3)	4.4 (3.1–6.3)	5.7 (3.9–8.3)	4.7 (3.1–6.9)	4.5 (3.3–6.2)	
	Fixed ticket for each procedure (%; 95% CI)	1.7 (1.2–2.5)	2.2 (1.3–3.5)	1.8 (0.9–3.6)	1.9 (1–3.6)	1.5 (0.9–2.6)	
Which of the following strategies were used to improve the schedule of the dental office?	Increased working daily hours (%; 95% CI)	24.5 (22.4–26.7)	21.8 (18.9–25)	20.8 (17.3–24.9)	26.4 (22.8–30.4)	26.6 (23.6–29.8)	<b>p = 0.033</b>
	Increased working days (%; 95% CI)	9.6 (8.2–11.2)	7.3 (5.6–9.5)	5.7 (3.9–8.3)	9.7 (7.4–12.6)	11.8 (9.8–14.3)	<b>p = 0.001</b>
	Single treatment time optimization (%; 95% CI)	57.5 (55–60)	56.1 (52.4–59.7)	59.3 (54.6–63.8)	54.6 (50.2–58.8)	57.8 (54.3–61.2)	p = 0.458
	As before (%; 95% CI)	24.9 (22.8–27.1)	27.1 (23.9–30.5)	26.5 (22.6–30.9)	26.2 (22.6–30.2)	22.9 (20.1–26)	p = 0.248

Note: Significant p-value are given in bold.



TABLE 5 Information on behavior about the pandemic and the future.

Questions	Variables/answers	Total	North west	North Est	Centre	South/island	p-value
In your opinion, which is the attitude of the majority of the patients toward the dental team?	As before (%; 95% CI)	6.2 (5.7-5)	7 (4.9-9.9)	5 (2.9-8.6)	5.8 (3.6-9.2)	6.2 (4.5-8.6)	p = 0.930
	Negative, they are afraid of contagion (%; 95% CI)	4.9 (3.9-6.1)	4.8 (3.1-7.3)	5.4 (3.2-9.1)	3.8 (2.1-6.7)	5.3 (3.7-7.5)	
	Positive, they trust on the dental team (%; 95% CI)	68.8 (66.4-71.1)	69 (64.3-73.2)	67.1 (60.9-72.3)	71.9 (66.5-76.8)	67.8 (63.8-71.6)	
	Positive, but they ask more on preventive measures (%; 95% CI)	20.1 (18.2-22.2)	19.2 (15.7-23.3)	22.5 (14.4-23.3)	18.5 (14.4-23.3)	20.7 (17.5-24.2)	
Which is your and dental team attitude in this moment?	We are tired and have some concern for the future (%; 95% CI)	8.8 (7.5-10.4)	7.2 (5.1-10.2)	9.2 (6.1-13.5)	6.2 (3.9-9.6)	11.3 (8.9-14.2)	p = 0.152
	Proactive, motivated and confident for the future (%; 95% CI)	66.4 (64-68.8)	68.3 (63.6-72.6)	67.1 (60.9-72.7)	67.1 (61.5-72.3)	64.4 (60.2-68.3)	
	Less motivated, if the emergency will continue (%; 95% CI)	24.7 (22.6-27)	24.5 (20.6-28.9)	23.8 (18.8-29.5)	26.7 (21.9-32.1)	24.3 (20.9-28.1)	
	Yes (%; 95% CI)	83.6 (81.6-85.4)	80.3 (76.2-83.8)	83.8 (78.5-87.9)	84.6 (80-88.3)	85.6 (82.4-88.2)	
As dental office owner, did you feel increased responsibility in terms of infection risk for collaborator/consultant?	No (%; 95% CI)	5.6 (4.5-6.8)	6.5 (4.5-9.3)	4.1 (2.3-7.6)	5.8 (3.6-9.2)	5.3 (3.7-7.5)	p = 0.534
	Yes, but we can react (%; 95% CI)	34.6 (32.3-37.1)	34.9 (30.4-39.6)	32.9 (27.3-39.1)	36.3 (31-42)	34.4 (30.5-38.5)	
	Yes, a lot (%; 95% CI)	46.2 (43.7-48.8)	44.2 (39.5-49)	49.2 (42.9-55.5)	43.8 (38.2-49.6)	47.7 (43.6-51.9)	
	Doubtful/Unknow (%; 95% CI)	13.6 (11.9-15.4)	14.4 (11.4-18.1)	13.8 (9.9-18.7)	14 (10.5-18.5)	12.6 (10.1-15.7)	
How long will last preventive measures adopted under COVID-19 pandemic?	Do not know (%; 95% CI)	15.3 (13.5-17.2)	15.4 (12.2-19.2)	15 (11-20)	14 (10.5-18.5)	15.9 (13.1-19.2)	p = 0.444
	About 6 months (%; 95% CI)	3.1 (2.4-4.2)	2.9 (1.6-5)	4.1 (2.3-7.6)	3.1 (1.6-5.8)	2.9 (1.8-4.7)	
	About 1 year (%; 95% CI)	22.3 (20.3-24.5)	22.6 (18.8-26.9)	24.6 (19.5-30.4)	21.6 (17.2-26.7)	21.6 (18.3-25.2)	
	About 2 years (%; 95% CI)	25.4 (23.3-27.7)	21.3 (17.7-25.6)	27.9 (22.6-33.9)	22.2 (17.9-27.4)	29.1 (25.4-33)	
	Forever (%; 95% CI)	33.8 (31.5-36.3)	37.7 (33.2-42.5)	28 (23-34.4)	39 (33.6-44.8)	30.5 (26.8-34.5)	

Note: Significant p-value are given in bold.

participants suggested patients to undergo the vaccination for SARS-CoV-2, while only 0.7% declared that nor they will get the vaccine neither 0.5% will suggest the patients to get it. (Table 6).

## 4 | DISCUSSION

COVID-19 pandemic stressed dental health care workers system in terms of organization, worrying for increased responsibility toward dental staff employees and patients, general negative emotions, and concerns about the future of the profession (Fiorillo & Gorwood, 2020). Additionally, the impact on patient oral health must be considered also. The current cross-sectional survey provided data on 2443 Italian dentists during the pandemic period from March 23 to October 14, 2021. At the best of our knowledge is the largest sample of dentists evaluated in a single country in Europe during the pandemic period. Nevertheless, the response rate for this survey was 30.5%, and this should be carefully considered for the evaluation of results' generalizability.

The self-reported infection rate was 6.1%, higher than 4.7% reported in a previous cross-sectional survey on 790 Italian dentists during the previous period January–February 2021 (Discepoli et al., 2022). A recent systematic review included 17 studies accounting for 54,585 dentists from 14 countries showing a mean infection rate of 9.56% with a high heterogeneity among the included studies, from 0.79% to 31.56% (Bitencourt et al., 2022). These differences could be explained by different data collection period, geographic areas of the world, and testing methods.

The first detected case of COVID-19 in Italy was in Lombardia on February 20, 2020 and the north was the most affected area. During the period January–February 2021 dentists from the north area showed a 2–4 times higher infection proportion compared to south/island (Discepoli et al., 2022). The difference in COVID-19 prevalence between north and south/island areas within the participants to this survey during the period March–October 2021 was less pronounced, but still significant. ( $p < 0.05$ ) Very interestingly these observations may depict the outbreak of COVID-19 in Italy during the first period of pandemic and during the introduction of vaccines and the subsequent manifestation of SARS-CoV-2 variants.

The Italian Ministry of Health introduced some recommendations to be followed in dental practice to reduce the biological risk of SARS-CoV-2. ([https://www.salute.gov.it/imgs/C\\_17\\_pubblicazioni\\_2917\\_allegato.pdf](https://www.salute.gov.it/imgs/C_17_pubblicazioni_2917_allegato.pdf)).

Vaccination was first available at the end of December 2020, with its obligation for health professionals and dentists introduced in April 2021. In particular, 95% of the participants followed the clinical recommendations issued by the Italian Ministry of Health and the majority adhered to vaccine campaign: 89.6% had received the vaccine and 4.6% had booked a vaccine appointment. This is in line with data observed in a meta-analysis investigating the acceptance rate of COVID-19 vaccination (81.1%) among dental practitioners from both the Middle East and high-income countries

TABLE 6 Information on vaccination and testing.

Questions	Variables/answers	Total	North west	North Est	Centre	South/island	p-Value
Did you get a vaccination or you already booked one?	I will not have vaccine (%; 95% CI)	0.7 (0.4–1.2)	0.5 (0.1–1.9)	2.5 (1.1–5.4)	0.3 (0.04–2.4)	0.2 (0.03–1.3)	$p < 0.05$
	I have not already booked (%; 95% CI)	5.1 (4.1–6.4)	6.5 (4.5–9.3)	3.3 (1.7–6.5)	6.2 (3.9–9.6)	4.4 (3–6.5)	
	I have booked a vaccine appointment (%; 95% CI)	4.6 (3.7–5.8)	5.5 (3.7–8.2)	6.3 (3.8–10)	6.8 (4.5–10.4)	2 (1.1–3.6)	
Will you suggest collaborator, employee, family, and patients to have vaccine for SARS-CoV-2?	I have received vaccine (%; 95% CI)	89.6 (87.9–91)	87.5 (84–90.3)	87.9 (83.1–91.5)	86.6 (82.2–90.1)	93.4 (91–95.2)	$p = 0.058$
	No (%; 95% CI)	0.9 (0.5–1.5)	0.5 (0.1–1.9)	2.1 (0.9–4.9)	1.4 (0.5–3.6)	0.4 (0.1–1.5)	
	Doubtful (%; 95% CI)	4.1 (3.2–5.3)	3.8 (2.4–6.2)	5 (2.9–8.6)	5.1 (3.1–8.3)	3.5 (2.2–5.4)	
In your dental office are tests for SARS-CoV-2 infection administered?	Yes (%; 95% CI)	95 (93.8–96)	95.7 (93.2–97.3)	92.9 (88.9–95.6)	93.5 (90–95.8)	96.2 (94.2–97.5)	$p = 0.112$
	Yes (%; 95% CI)	29.6 (27.3–31.9)	27 (23.3–31.9)	28.3 (23–34.3)	27.1 (22.2–32.4)	33.1 (29.3–37.1)	

Note: Significant p-value are given in bold.



TABLE 7 Additional information on occupational physician by age and professional status.

Questions	Variables/answers	24–29 years	30–39 years	40–49 years	50–59 years	60–69 years	70–79 years	80+ years
Did you have an occupational physician before pandemic?	Yes (%; 95% CI)	43.6 (35.4–52.1)	37.3 (32.7–42.2)	40 (35.6–44.2)	38.9 (35.4–42.6)	36.2 (32.6–40)	45.8 (32.4–60)	-
	Choose during pandemic (%; 95% CI)	5.3 (2.5–10.6)	7.2 (5.1–10.3)	5.2 (3.6–7.5)	4.9 (3.5–6.8)	3.1 (2–4.7)	4.2 (1–15.2)	-
Were the dental clinic members surveilled by occupational physician?	No (%; 95%CI)	40.6 (32.6–49.1)	52.6 (47.7–57.5)	55.7 (51.4–59.9)	60.8 (57.1–64.4)	65.2 (61.4–68.7)	54.2 (40.1–67.6)	-
	Only employee (%; 95%CI)	12.8 (8.1–19.6)	15 (11.9–18.9)	17.7 (14.7–21.3)	19.7 (16.9–22.8)	17.3 (14.6–20.4)	25 (14.8–39.1)	-
	Also, consultant/collaborator (%; 95%CI)	46.6 (38.3–55.1)	32.4 (27.9–37.1)	26.6 (23–30.6)	19.5 (16.7–22.7)	17.4 (14.8–20.6)	20.8 (11.6–34.6)	-
Questions	Variables/answers	Dental clinic owner	Consultant/Collaborator	Private employee	Public employee			
Do you have an occupational physician before pandemic?	No (%; 95% CI)	61.4 (58.9–63.8)	54.8 (51.3–58.3)	50 (34.2–65.8)	17.4 (12–24.4)			
	Yes (%; 95% CI)	37.9 (32.6–37.4)	37.9 (34.5–41.4)	41.7 (26.9–58.1)	79.2 (71.8–85)			
	Choose during pandemic (%; 95%CI)	3.7 (2.8–4.8)	7.3 (5.7–9.4)	8.3 (2.7–22.9)	3.4 (1.5–8.1)			

(Lin et al., 2022) and with data provided by the California Dental Association (<https://www.cda.org/Home/News-and-Information/Newsroom/Press-Releases/94-of-surveyed-california-dentists-vaccinated-against-covid-19>).

Within the participants only 0.7% declared they refused the vaccine. Nevertheless, in Italy, some hundreds of medical doctors and dentists were suspended, as ruled by national law decree 44/2021 issued on April 1, 2021, as they refused to undergo COVID-19 vaccination without valid health reasons. (<https://portale.fnomc eo.it/fnomceo-1913-medici-sospesi-per-mancata-vaccinazione/>). Although the time frame examined (March–October) largely overlaps with the months in which the legal obligation to vaccinate against SARS-CoV-2 was applied to health care workers, it is not possible to understand whether the intention to non-vaccination relates to the period when the obligation was in place or not.

Dental practices are at higher risk of cross infection due to the aerosol spread during operative procedures (Harrel et al., 1998; Szymańska, 2007). Additionally, dentists operate very close the mouth of the patients. Thus, to control infection routes (aerosols, fomites), specific changes in dental office organization were suggested in several countries providing modifications in terms of the usage of protective personal equipment (PPE), strategies to reduce the biological risk, and organization of the dental office (Becker et al., 2021). In particular, data highlight that the most frequently modified strategies relate to the use of respirators and the routine surface disinfection (Barbato et al., 2022).

FFP2/FFP3 respirators were used by 97.1% of the survey participants and visors by 97.4%. These data perfectly agree with those reported in similar cross-sectional studies (Cagetti et al., 2020; Discepoli et al., 2022). In a Brazilian survey, it was shown that surgical masks were used by 96% of participants before the COVID-19 pandemic and FFP2/FFP3 respirators were almost not used. On the contrary, the use of FFP2/FFP3 was strongly increased (82.2%) during the COVID-19 pandemic (July–June 2020). Similar data were reported for the visors also in the same Brazilian sample (Sentone Rossato et al., 2021). Hence it can be hypothesized that respirators and visors were considered the most relevant PPE against the SARS-CoV-2 infection.

During the initial period of the pandemic there was a lack of respirators and PPEs (<https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangerin g-health-workers-worldwide>). Nevertheless, the majority of the participants avoided reconditioning of the respirator and changed it every 5–6 hours (65.6%) or every day (26.4%). On this way, wearing a surgical mask over FFP2 respirator as the reconditioning of the respirator were proposed. The use of ultraviolet germicidal irradiation at proper dose may be effective in log reduction of viral titer >3 (O’Hearn et al., 2020); however, the safety of these procedures needs further investigation (Vernez et al., 2020).

Finally, even though there are some items used more than others, the whole protocol and the proper usage (donning/doffing) of the PPEs is more important than the single items (Reske et al., 2022; Verbeek et al., 2020).

In this sample of dentists, the most used strategies to reduce the risk of infection were natural ventilation and preoperative mouthwashes, in agreement with previously reported data (Cagetti et al., 2020; Discepoli et al., 2022). Mouthwashes indeed, were considered promising in reducing SARS-CoV-2 viral load in COVID-19 patients. A recent RCT compared the efficacy of four different mouthwashes: 1% povidone-iodine; 1.5% hydrogen peroxide, 0.075% cetylpyridinium chloride, and 80ppm hypochlorous acid. Authors concluded that 1.5% hydrogen peroxide mouthwashes were associated to a significant viral load reduction in the saliva of the patients at all observation points (5, 30 and 60min) (Alzahrani et al., 2023). Two RCT showed that cetylpyridium chloride rinse may increase virus lysis in the mouth of patients compared to a placebo (Alemany et al., 2022; Tarragó-Gil et al., 2022), while chlorhexidine and povidone-iodine rinses improve viral load reduction after 5 minutes compared to distilled water in another RCT (Elzein et al., 2021). These data suggest that mouth rinses may be effective in reducing SARS-CoV-2 viral load in the saliva, nevertheless it is not possible to clearly state the superiority of a specific protocol and the clinical significance.

Timetable of daily practice was also changed in terms of single treatment optimization, increased working daily hours and increased working days. Differences between geographic areas were found. These changes, alongside with the increased use of disposable PPE (e.g., single-use TNT suit or gowns) and infection control strategies (e.g., extraoral suction, HEPA filters, and forced ventilation), contributed to create financial problems to private dental clinics. In fact, different studies reported increased cost during the pandemic (Cimilluca et al., 2021; Wolf et al., 2022). Even if the participants of the survey seem to have rapidly reacted to the pandemic, 81.5% of respondents did not charge patients with extra-costs due to preventive measures adoption.

The attitude of dentists resulted to be affected by pandemic due to worsening of private lives and member of the dental team interactions. Even though under pressure, Italian dentists participating to this study showed proactive behavior. In fact, up to 70% reported positive attitude and trust in the capability of dental team to respond to this specific crisis. Nevertheless, 83.6% of them felt increased responsibility due to the pandemic, and one out four of the components of the dental team was less motivated. An increase in level of stress was reported in 75% of 132 dentists in Wales that answered not to be mentally well enough (Owen et al., 2022). Similarly, higher level of stress was reported also among a sample of Brazilian dentists (de Melo Alencar et al., 2021).

Adherence to specific protocols and proper preventive and protective measures seem to be effective in minimizing the risk of COVID-19 infection among dentists. Very interestingly, the efficacy of a SARS-CoV-2 infection protocol was tested in Lombardia from February 20 to April 30, 2020. Among 11 dentists, 3 dental assistant, and 13 nurses, no dentists experienced the infection and only 1 nurse had COVID-19 (Nardone et al., 2022). According to the current survey, 6.1% of dentists self-reported COVID-19 infection and 8.3% of respondents reported the infection for another member of

the dental team. These differences could be explained by different period of the pandemic, the related limitations enacted on citizens and health facilities and professionals, apart from different testing methods. Very interestingly in this survey only one out of five supposed to be infected at work and almost half of the participants which suffered from COVID-19 supposed to have been infected at family/community.

Nevertheless, dentists have perceived the largely increased responsibility towards patients and employees, who could assume to have been infected during dental sessions or at work for a lack of precaution and preventive measures. (Rini & D'Urso, 2022) The serious concerns of dentists were reported by previous literature (Pinchi et al., 2020), thus the present data on criminal and civil claims may be expected. Even if the number of cases is quite low (four civil and four criminal proceedings against dentists), this data must be considered as very serious. In fact, it means that four dentists will be at least investigated as suspected to be liable for SARS-CoV-2 infection of patients or employees and four of them have been sued for compensation for such infections (Pinchi et al., 2020).

The thirteen cases in which the infection was reported as accident at work by dental staff employees, should be differently regarded, because in these cases nor criminal fault neither civil responsibility burden the dentist as employer. If the infection emerged as due to work accident, the compensation to the employee is awarded by the Italian National Institute for Insurance against Accidents at Work (INAIL) which, could fall back on the employer if it was proven that he/she had not put in place all the preventive and protective measures required by the regulations.

These findings should be interpreted with caution and the generalizability is affected by some limitations. In a systematic review on safety culture questionnaires that are used to explore the behavior of people at work, the response rate varied from 4.2% to 100% (Ellis et al., 2022). The response rate in this study was 30.5%. Different features may affect the response rate as survey length, content, mode of administration, and incentives.

On this way, this study may be affected by selection bias (i.e., nonresponse bias). Nonresponse bias is a common type of selection bias in cross-sectional studies survey with mail questionnaire. In particular, the characteristics of the responders may differ from non-responders. (Tripepi et al., 2010; Wang & Cheng, 2020) Unfortunately, in cross-sectional studies, it is not possible to know non-responders' characteristics. A simple random sampling was performed in this study, nevertheless the response rate was 30.5% and we do not know if we were able to control the selection bias. Finally, it has to be considered that 2443 dentists may not represent the more than 60,000 dentists listed in the Italian Register of dentistry. Thus, the external validity may be reduced as the generalizability of the results to all the Italian dentists.

The prevalence of self-reported COVID-19 in this sample of Italian dentists was 6.1%, but there were differences among geographic areas. COVID 19 deeply impacted dental office organization and behavior of Italian dentists. In particular, FFP2 respirators and



visors were the most used PPE while natural ventilation and preoperative mouthwashes the most used strategies to improve infection control.

## AUTHOR CONTRIBUTIONS

**Luigi Barbato:** Conceptualization; writing – original draft; methodology; writing – review and editing; data curation; formal analysis; validation; investigation. **Nicola Discepoli:** Conceptualization; methodology; writing – review and editing; validation; formal analysis; writing – original draft; investigation. **Marco Clementini:** Conceptualization; validation; writing – review and editing; methodology. **Ivo Iavicoli:** Conceptualization; writing – original draft; formal analysis; writing – review and editing; validation. **Luca Landi:** Conceptualization; validation; writing – review and editing; formal analysis. **Vilma Pinchi:** Conceptualization; writing – review and editing; writing – original draft; formal analysis; validation. **Mario Raspini:** Conceptualization; validation; writing – review and editing; data curation. **Maria Di Martino:** Validation; writing – review and editing; methodology; supervision. **Raffaele Cavalcanti:** Conceptualization; writing – review and editing; validation. **Alessandro Crea:** Conceptualization; writing – review and editing; validation. **Rodolfo Gianserra:** Conceptualization; writing – review and editing; validation. **Francesco Cairo:** Conceptualization; formal analysis; validation; writing – review and editing; writing – original draft; supervision. **Nicola Marco Sforza:** Conceptualization; project administration; writing – original draft; writing – review and editing; validation; formal analysis; methodology; supervision.

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## CONFLICT OF INTEREST STATEMENT

Regarding the present manuscript, there are no conflicts of interest to be disclosed by the authors.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## SUPPORTING INFORMATION

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

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