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A scoping review of the impact of COVID-19 on dentistry: financial aspects

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Abstract

Background The technological advancements of the past few decades in various aspects that are directly or indirectly related to health, along with the emphasis on public health in societal development, have improved the quality of life.

However, the occurrence of pandemics and crises underscores how various aspects of individual life can be impacted. The financial consequences resulting from the COVID-19 pandemic have particularly affected the field of dentistry and public oral health. This study aims to investigate the financial effects of the COVID-19 virus on dentistry through a scoping review.

Methods A comprehensive literature search was conducted across four databases (Medline through PubMed, Embase, Scopus, and Cochrane Central) using keywords such as COVID-19 and its equivalents, dentistry, oral health, dental education, dental services, dental clinics, financial impact, financial opportunities and economic impact. Articles addressing the financial impact of COVID-19 on dentistry and oral health were then screened and reviewed.

Results Out of 1015 articles related to COVID-19 and dentistry, 84 were focused on the financial impact of COVID-19 on dentistry. The majority of these articles originated from the United States, Brazil, and Saudi Arabia, with a prevalence of cross-sectional and review articles. The review categorized the articles into two main themes: financial problems and proposed solutions. Moreover, the following themes were extracted: the effects of practice closure on dentists and staff, increased treatment costs and impacts on oral health, personal protective equipment and unforeseen costs, psychological effects of financial issues, and financial challenges within the dental education system.

Conclusions While many high-income countries seem able to mitigate COVID-19-induced financial problems, the economic effects on dentistry might persist despite the pandemic's end. These financial challenges have spurred new opportunities and infrastructure development but can pose significant risks to community oral health. This study aimed to highlight these problems and propose solutions, contributing to efforts to improve the oral health of communities globally. Further research is needed to understand long-term impacts.

Keywords COVID-19, Dentistry, Oral health, Financial impact, Scoping review

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Background

The increasing progress of technology in the last few decades and the importance of maintaining and promoting public health in the development of a society has made people experience a better standard of living and the life expectancy of people has increased [1, 2]. But in the meantime, the occurrence of pandemics and crises in different stages of life reminds the governments

and individuals that how different aspects of individual life can be affected by these crises and how vulnerable a health system in a country can be [3]. One of the crises that has particularly challenged the entire world is the COVID-19 pandemic. Consequently, numerous problems have arisen, affecting people in society for an extended period. Various jobs have been endangered, and the way governments operate has been altered [3]. The challenges that arose in the dental profession and receiving oral health services, as well as the financial consequences created as a result of COVID-19 and its impact on the field of dentistry and the public oral health, can also be mentioned in this regard [4, 5].

The Pandemic has not only resulted in oral and dental public health problems but has also caused significant financial difficulties for dentists, dental schools, and dental clinic owners [6–8]. In a study conducted on the people of the Middle East, a noticeable decrease in maintaining oral health was found to be related to the unemployment of about 60% of people [9]. In the United States, it was found that there was a significant relationship between the 16% decrease in children's oral health and the decrease in income or job loss of 40% of family heads [10]. Additionally, according to another study conducted in Saudi Arabia, the income of nearly half of the dentists in the study was cut off with the start of the pandemic [6].

These financial problems have been so serious that, even after more than two and a half years since the outbreak of the pandemic and with the announcement of the end of the COVID-19 pandemic in many countries, the financial problems caused by the COVID-19 virus still persist, and countries are grappling with them [11, 12]. Despite all the efforts that have been made to investigate the various dimensions of financial problems in the field of dentistry, there are still ambiguous points related to this issue. The magnitude and dimensions of the financial consequences of COVID-19 in dentistry, as well as possible solutions, need to be explored to prepare the dental community for future pandemics or crises.

Therefore, the purpose of the current study is to investigate the financial effects of COVID-19 virus on dentistry through a scoping review.

Methods

The five steps in the present study were carried out following the instructions for conducting a scoping review study [13].

First, a comprehensive literature search was conducted to explore various effects of the COVID-19 pandemic on dentistry and oral health. In brief, the search strategy involved querying multiple databases, including Google Scholar, Medline through PubMed, Embase, Scopus, and Cochrane Central, for articles published between January 2019 and March 1, 2021. We used a combination of keywords such as 'COVID-19', 'Coronavirus', 'dentistry', and 'oral health'. Data extraction was then performed, and the articles were categorized into specific themes: 'Transmission'; 'Risk factors, diagnosis, and treatment'; 'Oral health care'; 'Mental and psychological influence'; 'Future dentistry'; 'Multimedia and tele-dentistry'; 'Dental education'; and 'Financial effects on dentistry'. which has been detailed elsewhere [14].

Focusing on financial consequences, we then developed the following search inquiries:

((COVID-19 virus OR Coronavirus OR SARS-CoV-2 virus) AND (Dentistry OR Oral health care OR Dental health OR Oral health OR Dental emergencies OR Oral emergencies OR Oral OR Dental OR Oral manifestation OR Dental health care OR Dental services OR Dental office OR Dental clinics OR Dental education OR Dental academics OR Dental students OR Dental schools OR Dental universities OR Dentists OR Dental assistants)) AND (Financial impact OR Financial burden OR Financial implication OR Financial hazard OR Financial challenges OR Financial problems OR Financial consequences OR Financial concerns OR Financial uncertainty OR Financial loss, Financial crisis OR Funding problems OR Financial opportunities OR Tuition fee OR Education cost OR Treatment cost OR Material cost OR Economic impact OR Economic crisis OR Students salary OR Staff salary OR Assistant salary OR Monetary implication OR Payment status OR Payment decrease OR Income status OR Income decrease OR Unemployment insurance OR Dental expenditure OR Educational expenditure OR University expenses OR Dental office expenses).

We searched four databases: PubMed (via Medline), Embase, Scopus, and Cochrane Central.

The inclusion criteria for our study were studies published in English, pertaining to the financial effects of COVID-19 on dentistry, and published between January 2019 and September 2023. Exclusion criteria included duplicate publications, and irrelevant studies like unrelated and medical studies.

Screening was conducted separately by F. F and MR. K to select studies related to the financial effects of COVID-19 on dentistry. Discrepancies in the inclusion or exclusion of studies were resolved through discussion and consensus. In cases where consensus could not be achieved, a third researcher was consulted to make the final decision. This consensus process ensured consistency and reliability in the screening of studies.

Preferred Reporting Items for Systematic reviews and Meta- Analysis (PRISMA) flow chart [15] (Fig. 1) was used to report search results.

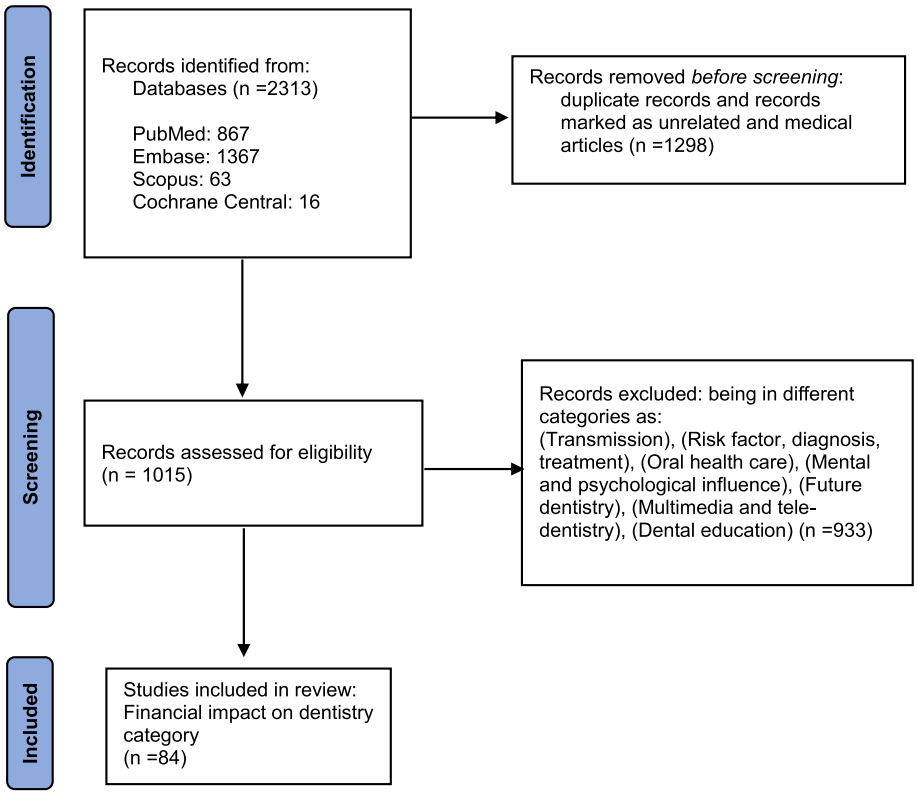

Fig. 1 PRISMA flowchart of the study

In the next stage, the studies were reviewed separately to prepare a table containing the following data of each article: title, country where the study was conducted, date of publication, field of study, type of study, purpose of the study, number of samples participating in the study, and duration of the data collection.

The process of preparing the table was done by two researchers (F. F and Fz. F), and if there were any disagreements regarding the content of the table, it was discussed among all members of the research team. Then, as mentioned in previous studies [14, 16], according to the titles of the articles, data from prepared table, and also after separate reviewing of each study, results were narratively discussed under certain categories.

The results were categorized through an iterative process of data extraction and thematic analysis. Initially, relevant data were extracted from each included study and organized into preliminary themes based on the focus of the research. These preliminary themes were reviewed and refined through discussions among the research team, resulting in the final categories. Due to the heterogeneous nature of the included studies in terms of methodologies, outcomes, and study designs, quantitative synthesis or meta-analysis was not feasible. Therefore, we chose a narrative synthesis approach. This method allowed us to comprehensively summarize and interpret the diverse range of study designs, methodologies, and findings included in our review. By identifying emerging themes and integrating these varied results, we provided a holistic understanding of the financial effects of COVID-19 on dentistry.

Results

The number of articles obtained from all data bases were 2313 (PubMed: 867 articles, Embase: 1367 articles, Scopus: 63 articles and Cochrane Central: 16 articles), which was reduced to 1015 articles by removing duplicate and unrelated articles, as well as those completely in the field of medicine. Out of 1015 articles obtained, 84 articles were related to financial impact of COVID-19 on dentistry (Fig. 1).

These 84 articles were from different countries including Egypt (1 article), Myanmar (1 article), Indonesia (1 article), UK (5 articles), Saudi Arabia (11 articles), India (9 articles), Yemen (1 article), Pakistan (7 articles), Iraq (3 articles), UAE (2 articles), Italy (3 articles), Germany (3 articles), US (20 articles), Jordan (2 articles), Spain (4 articles), Hong Kong (2 articles), Brazil (14 articles), Nepal (3 articles), Palestine (2 articles), Kuwait (1 article), Japan (1 article), Ireland (1 article), Slovakia (1 article), Turkey

(1 article), Poland (1 article), Wales (1 article), Switzerland (2 articles), Australia (2 articles), Canada (4 articles), Singapore (1 article), China (1 article), Nigeria (1 article), Romania (1 article), Bosnia and Herzegovina (1 article), Iran (1 article), and Malaysia (1 article). In some articles, the authors were from more than one country. So the total number mentioned in this section will be more than the number of articles (84). The most active country in this field was the United States with 20 articles, followed by Brazil and Saudi Arabia with 14 and 11 articles, respectively. The highest number of articles related to the financial impacts of COVID-19 on dentistry were published in 2020 (Fig. 2).

Regarding study design and article type, various formats were identified: cross sectional, review articles (critical, narrative, descriptive), letter to the editor, editorial, commentary, qualitative, report, communication (special, brief, short), perspective, interventional (before/after), technical note, modelling study, ecological study and case study. Most of the articles (41) were cross sectional, and review articles (18) (Table 1).

In cross-sectional articles, the maximum number of samples was 25,482, in a study entitled "Dental Pain and Worsened Socioeconomic Conditions Due to the COVID-19 Pandemic" which were conducted in Japan, with a data collection period of 35 days. The article was published on April 2021. The next cross-sectional article with the largest number of samples was a study entitled "Oral health awareness, attitude towards dental treatment, fear of infection and economic impact during COVID-19 pandemic in the Middle East" that was from Iraq and UAE. The number of samples in this study was 3782. Completion of questionnaires in this study took two weeks and the article was published on April 2021. The lowest number of samples in cross-sectional studies belonged to a study entitled "An analysis of experiences and problems faced by the dentists during COVID-19 pandemic: a questionnaire-based survey" which was conducted in Pakistan on January 2022: the number of samples were 78, and it took 11 days to collect this data.

Table 1 Number of articles by type (Results from 84 articles)

Type of article	Number of articles
Cross-sectional	41
Review Articles (Critical, Narrative, Descriptive)	18
Letter to the Editor	4
Qualitative	3
Editorial	3
Descriptive Observational Study	2
Policy Paper	2
Commentary	2
Communication (Special, Brief, Short)	2
Interventional (Before/After)	1
Modelling Study	1
Ecological Study	1
Chapter	1
Research Brief	1
Retrospective Secondary Data Analysis	1
Embedded Mixed-methods Study	1

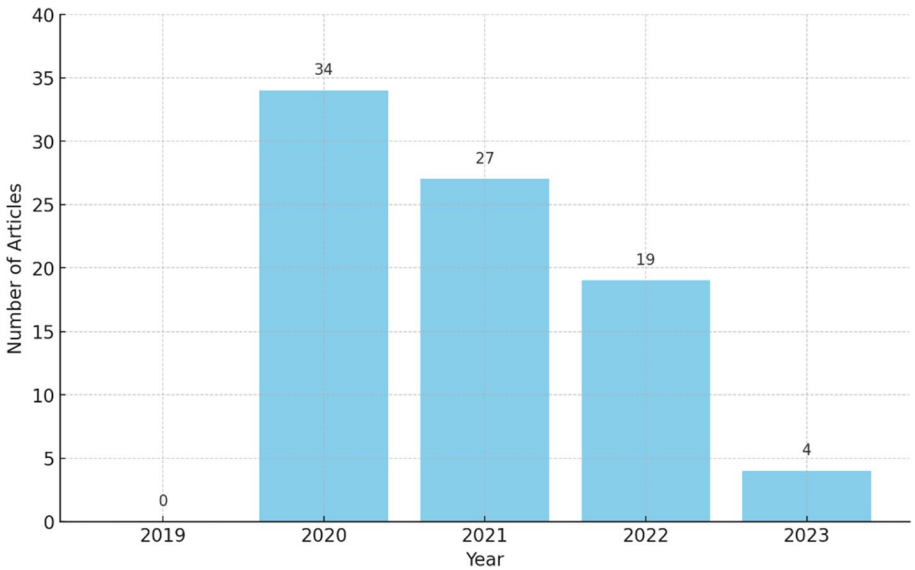

Fig. 2 Number of studies related to the financial impacts of COVID-19 on dentistry by year

The details of all 84 articles can be found in Appendix 1 (See Additional file 1).

The content and outcome of 84 articles were reviewed and these articles were divided into two main categories: 1: Financial problems caused by COVID-19 pandemic; and 2: Proposed solutions for Covid-19 induced financial problems.

Financial problems caused by Covid-19 pandemic:

Effects of closure of practice on dentists and staff

Due to the nature of dentistry that dentists have to work in a very close position to the patients during treatment and its high risk of disease transmission, dental offices and centers were widely shut down [9, 17–22]. This closure was more in private centers than in governmental centers [20, 23] and dentists working in these private centers were more affected [5]. In the data collected from 4,000 people, 42% of dentists mentioned that their income was completely cut off with the start of the pandemic, which was significantly more than lawyers, pharmacists, and doctors [6]. Many dentists reduced their working hours [24, 25] and limited their work to emergency dental treatments or closed their dental clinics [6, 19, 26–29]. Emergency treatments included: acute dental pains, dental traumas or traumas related to the mouth, jaw, and face; abscess, and cellulitis [30]. In a study, limitation of dental surgery work to emergency cases in clinics covered by insurance compared to those without insurances has been reported to be 75% to 25% [31]. The number of surgeries and hospital income were lower compared to private practice, even though the hospital had a lower infection rate [32, 33]. The closure of dental centers and as a result the decrease in the number of patients has had a direct and indirect impact on the life and financial planning for the future career of dentists and employees [18, 22, 34–39], and it has caused inconsistency between their work and life [40]. To such an extent that 75% of Palestinian dentists [28], 96% of Pakistani dentists and more than 95% of Nepali dentists [41] expressed their concern about the sharp decrease in their income and the need to use other financial resources [42]. Also, the financial effects on the dental community in Iraq have been mentioned up to 50% [43]. This has been also shown in the surveys conducted in Ireland, England, America and Germany [6]. For example, the closing of orthodontic offices in America in 2020 has reduced the income of these Orthodontists by 50% [44]. In a study conducted by the University of Michigan, more than half of the study participants believed that the coronavirus pandemic had a negative impact on their daily lives and relationships with others [45]. In a survey conducted from the members of the British Dental Association, only less than 10% of dentists believed that the ongoing condition did not lead to economic instability in their work [46]. Many dentists took various loans to reduce the financial pressure caused by the COVID-19 virus (for example, small business loans under the CARES Act program) [27, 47]. Governments of high income countries (HIC) such as England, Canada and Ireland have considered financial support and loans to help businesses (from allocation of 27 billion dollars to support loans of 5 thousand to 50 thousand dollars). Meanwhile, the governments of low income countries (LIC) and middle income countries (MIC) have not considered any significant support for dentists [47]. More than 90% of the dentists participated in a study were not satisfied with the financial support provided to them [28]. With the reduction of these supports, the potential of dentists to manage oral and dental problems during the pandemic was overshadowed [48]. Young dentists and dentists who were working in the city center were more affected by financial problems than dentists with a long working history and those who were working in the outskirts of the city [22]. On the other hand, smaller dental centers had less financial problems than larger ones [49]. The annual salary of employed dentists decreased by about 5% from 2020 to 2021, which in total caused a decrease in income of approximately 660 million dollars [50]. Many centers were forced to lay off staff as a result of the shutdown [51, 52]. Many employees in governmental centers had received long-term paid vacations [4], and on the other hand, there were employees of private centers whose salaries were either not paid or were paid incompletely, which caused severe concerns [4, 53]. It has been stated that the salary increase of dental center employees was lower than the average salary increase in America (3.2%) [50]. Similarly, dentists themselves had problems paying clinic rent and various expenses [26]. These concerns affected dentists and medical center employee's quality of life, especially in relation to financial issues [54–57] and it caused their income to decrease [58]. There are different reasons for this matter; among them, the unwillingness of hospitals to pay more due to the decrease in the number and variety of operations, the inability of the government and insurance for reimbursements due to financial problems, and the costs imposed due to the pandemic for creating a safe therapeutic environment can be mentioned [59].

Increase in treatment costs and impact on oral health

After the onset of the COVID-19 pandemic, there was an increase in the cost of dental materials, equipment, and Personal Protective Equipment (PPE). Simultaneously, many public and private dental centers closed [29]. Consequently, the costs of preventive services and dental treatments, including restorative, endodontics, prosthetics, and surgery, rose significantly. As a result, the

number of patients seeking dental care decreased, and their utilization of dental services declined [56, 60–63]. Increasing in costs, along with the unemployment of a large number of employees, caused people to face problems in meeting dental expenses [7, 9, 19]. In this situation, prevention of oral and dental diseases and dental treatments would not be among the priorities of families, except in cases of dental emergencies [7]. Oral and dental care in many countries, including the United States, is closely related to insurance, so that about 70 percent of dental patients in the United States have private insurance, and having reliable insurance depends on the person being employed [21]. In a study, it has been stated that, the first unmet health care need in children is oral and dental care (3 times more than medical care), the main reason for which is job loss and reduced household's income [10]. Patients suffering from head and neck cancer were under pressure in two ways: in terms of the high costs of cancer treatment and in terms of financial pressure related to COVID-19 virus [64]. For this reason, cancer patients who are at a low financial level, compared to normal people in the society, were among the high-risk groups in terms of facing financial problems during the COVID-19 pandemic [64]. Dealing with pandemic for a long time has resulted in economic problems, which have caused negative effects on public oral and dental health [4], and households income decrease has had a direct effect on the increasing toothache [65]. Many people believed that dental treatments are expensive even in normal conditions and should not be more expensive [17]. People whose dental treatments were not covered by insurance had to pay this increased cost out of pocket [46]. Some of them postponed their dental treatments, which resulted in a more complicated treatment [46]. There is a belief that the financial support for oral public health systems is currently insufficient. In such a scenario, not only may the oral and dental issues in society fail to decrease, potentially becoming problematic during critical times such as the COVID-19 pandemic, but also the existing public perception, viewing dentistry as an additional and luxury treatment, may intensify [48].

Personal protective equipment and unforeseen costs

During the pandemic, the demand for disinfectants and PPE such as masks increased significantly [52, 57, 58] and many dentists had to deal with the problem of providing them [41]. Temporarily halting voluntary and non-emergency treatments to some extent enabled the healthcare staff to allocate available PPE for emergency treatments. However, this supply proved insufficient due to the widespread impact of the pandemic [21, 61]. To illustrate, a study revealed that only approximately 12% of participating dentists, managed to secure an adequate supply of PPE [31]. On the other hand, in a study conducted on dentists in Kenya, it was stated that the amount of PPE available for public and teaching hospitals was 13% less than private centers [5]. In a study conducted in Brazil, the cost of infection control before COVID-19 was estimated at R$ 3,400. After COVID-19 and the addition of PPE and other protective equipment, this cost increased to R$ 32,600 [66]. The price for a face mask was offered 10 times more expensive during this time [67]. Due to the fact that the balance between the supply and demand of these equipment and materials in the world was significantly lost, as well as the inability of the companies to supply the required amount (about 40% more than before) and also the transportation costs from the manufacturing countries [20] caused the cost of providing these PPEs to raise by 75% [37, 43]. The increase in the cost of providing PPE in the Aneurin Bevan oral and maxillofacial unit in Wales is estimated at 32,292 pounds for one year [68]. On the other hand, the reduction in the PPE number was the reason for many treatments to be postponed [69, 70]. In a study, it is stated that 86% of dentists had problems for providing PPE and 97% of dentists were forced to provide protective equipment at a more expensive price [42]. Many dentists have been aware of the importance of using PPE, despite being dissatisfied with the increase in PPE costs [71]. This increase in personal protective equipment and devices cost in dental offices and clinics has significantly increased treatment costs [17, 26, 29, 39, 60, 63, 72, 73], and as a result, the number of patients reduced substantially [73]. This alone became a threat to dentistry and affected the quality of life of dentists [46, 54, 67]. However, many dental clinics decided to buy more advanced equipment to take care of staff and patients against the virus, despite the high cost of personal protective equipment [28]. Dentists and managers of dental clinics had concerns, both for lack of protective equipment for daily use in dental offices, and unpredictable and imposed costs of providing it [22].

Psychological effects of financial issues

The COVID-19 pandemic itself has caused many negative psychological effects related to the worry of getting infected with this virus or to a greater extent of transmitting it to family members [23, 28, 34, 40]. In addition to all these concerns, the financial problems as a result of medical centers shutdown increased the burden of these concerns even more [4, 27, 46, 57, 69, 74] and dentists stated that they were not happy [75] to the extent that some medical staff thought of suicide [18]. In a study, more than 70% of the participants were worried about the financial problems created during the pandemic for themselves or their family members [45], and in another study, about 66% of the dentist participants had concerns

about their future income, which is also their only source of income [24]. A Slovak study reported that dentists who followed the pandemic news several times during the day and were worried, were more involved in financial problems [54]. Many dentists decided to continue working in their clinics due to the fear of financial problems and the inability to pay their employees' salaries [6]. Dental students were also under pressure and stress of financial issues in different ways [76–78]. The change in teaching methods due to the pandemic has put a lot of stress on students who spend 300,000 dollars for a full dentistry course [77], and also the students who needed to work to continue their studies endured a lot of mental and emotional pressure during this period [76].

Financial problems of dental education system

Due to the closure of colleges and the conversion of face-to-face training to virtual during the pandemic, the number of patients visiting university clinics quickly decreased by half, and the income of the university from patient's referrals decreased by 42% [79–82]. In order to deal with Corona virus, the faculties spent a lot on chairside evacuators for aerosol mitigation, ventilation and air condition systems, facility sanitation and cleaning [79, 82]. This issue, along with the decrease in the number of patients, has caused dental specialty training such as orthodontics to be very expensive, like other dental specialties [83]. The non-attendance and registration of new students and the delay of the academic semester, as well as the reimbursement of clinic fees to students, have created many financial problems for dental schools [8, 80, 84]. To these cases, the postponement of grant programs and scientific conferences and changes in the recruitment program for new professors can be added [80, 81]. On the other hand, due to the fact that many dental students who are studying do not have a good financial level and need to work to cover the high costs of studying in the field of dentistry, were under pressure to cover their expenses with the onset of Corona virus and with the loss of the possibility to work [76] as it was stated in a study that more than 50% of dental students participating in this study were worried about not being able to afford their expenses [85, 86] (Table 2).

Appendix 2 shows which of the articles was discussed in each category (See additional file 2).

Table 2 Financial impact of Covid-19 pandemic on dentistry and proposed solutions (Results from 84 articles)

Categories	Number of articles
Effects of closure of practice on dentists and staff	53 articles
Personal protective equipment and unforeseen costs	33 articles
Increase in treatment costs and impact on oral health	20 articles
Psychological effects of financial issues	19 articles
Financial problems of dental education system	13 articles

Proposed solutions for COVID-19 induced financial problems

Effects of closure of practice on dentists and staff

For the issue of financial losses caused by the COVID-19 pandemic, it was recommended that the responsible authorities have to have the necessary support for dental offices [6, 69]. One of the most important measures was financial assistance or loans to the dental profession by governments [6]. In this regard and in response to the created economic problems, we can mention the Canadian government's 27 billion dollars in support of businesses, the Irish government's support of 5 to 50 thousand euros for the damaged businesses, the Saudi Arabian government's 70 billion riyals for tax exemption and 50 billion Riyals for banks to support private companies, including dental offices, and assistance from the United Kingdom (UK) government by providing loans or credits to pay salaries, supplies, or consumables to business owners. In America, it was also recommended that small businesses such as dental offices get help from the Economic Injury Disaster Loan program [6, 59]. In addition to providing direct financial aid, the government can offer assistance in various ways, including measures such as reducing work hours and workload, negotiating with suppliers of materials and equipment to minimize costs [19], and supporting individuals with payments for mortgages and rents [20]. In a study it was mentioned that, around half of the respondents would increase the staff if there were a tax exemption [35]. The Paycheck Protection Program is a loan forgiveness program that was created to encourage small businesses and reduce costs [27]. Building an emergency reserve fund and considering business insurance was important to sustaining that business when earnings drop significantly [19, 20]. Since the improvement of the work situation in dentistry was gradual, one of the suggestions was to maintain sufficient liquidity for a period of one year and to suspend unnecessary services [51].

Increase in treatment costs and impact on oral health

Considering the situation, which was unique in its own kind, new strategies such as new clinical approaches or new payment methods had to be tested [19, 87]. Tele-dentistry and mobile dental units can be very helpful in providing more access to dental services and reducing costs [4, 20]. In a study, it is stated that 51.9% of participating dentists used tele-dentistry [40]. In another study,

during the pandemic, when non-emergency dental services were canceled, 69% of hospitals offered free online consultations through software such as WeChat. Consultations to determine whether emergency treatment is necessary, as well as dental and oral health consultations [30]. Tele-dentistry can also be used for follow-up and comments on treatments. Even in remote places and villages, people can be provided with tele-dentistry by giving them timely advice on oral and dental health. Therefore, after removing the restrictions, tele-dentistry should not be forgotten [48]. Because during the epidemic period and after that, in medicine and dentistry, teleconsultation could be an alternative or a supplement to visiting the doctor's office [57, 60].

One of the important measures was contacting patients when they are not able to attend the office. Getting information about the condition of their oral health and declaring readiness for emergency treatment whenever they need it, can have a special effect on gaining the patient's trust [19].

After dental centers have started their work again, it seems that more focus had to be on preventive approaches and avoiding unnecessary and costly treatments. Because even after the pandemic, the society were still facing economic problems [4, 19].

Personal protective equipment and unforeseen costs

In order to reduce treatment costs, the government could subsidize PPE to dentists, or consider tax exemptions for dental products [17, 36], and also take necessary measures to standardize treatment costs [36].

In emergency situations, patient appointments had to be as limited as possible in terms of number, and more treatments could be performed in one session. This work leads to more affordable treatment due to the optimal use of protective equipment.

As an example, performing restorative treatments in each quadrant of the jaw in one session could be mentioned [88].

Also, clinicians had to be cautious about spending too much on new technologies that have been brought to market to combat COVID-19, as none of them were completely effective [27].

Psychological effects of financial issues

At a time when various challenges have caused psychological problems and stress for people, counseling with a psychologist would be considered as an effective solution [18]. Also, spending time with family members could improve relationships and reduce stress caused by these problems [40].

It is noteworthy that the stress and psychological pressures of economic problems during the pandemic for some dentists were reduced by announcing the continuation of NHS payments as well as other payment systems for providing emergency care [46].

Financial problems of dental education system

Emergency fund was something that was created to maintain academic activities and support students [80, 81].

In the case of student loans, the US Department of Education had set zero percent interest for these loans from March 13, 2020 to September 30, 2020 [51].

Using communication technologies and virtual learning to advance the educational goals of universities and scientific institutions in times of emergency and for cost reduction is of particular importance [80, 89].

Another practical solution for universities is to develop new programs to offset the costs of training and initiatives previously supported by sponsors. For instance, designing online courses is one such example [81].

Discussion

The present study was conducted to shed light on the financial effects of COVID-19 on dentistry and the strategies to cope with it, aiming to contribute to future research. In scoping studies, researchers try to provide an overview of all the studies conducted on a particular topic, irrespective of their quality and research type, to guide future research [90].

Unlike the time when the world was caught in the early days of the pandemic, where most studies were presented in the form of review studies, as time passed and with the reduction in the severity of the pandemic and increased access to individuals, this type of study gave way to cross-sectional research.

One of the significant events that quickly manifested its effects in terms of financial problems was the closure of dental clinics, leaving dentists and healthcare personnel unemployed. Due to the unknown nature of the disease and the rapid spread of it, this challenge was expected [18, 19, 21].

Because of the magnitude of the damage caused, various countries tried to mitigate these problems by providing financial assistance in the form of loans or grants [27, 47, 69]. Naturally, dentists working in government centers benefited more from this support [5, 20, 23]. These aids were mostly provided by governments in financially stable conditions, and dentists in LIC and MIC countries were almost deprived from these aids [69].

In private centers, personnel and healthcare staff's salaries were directly related to patient visits. Therefore, with the complete shutdown and a significant reduction in working hours, resulting in a noticeable decrease in patient visits, these centers faced severe financial problems, leading to non-payment of employees' salaries or

their layoffs [4, 53]. On the other hand, most government center employees faced fewer financial problems in this regard [4].

After experiencing the pandemic and the government's failure to support private centers, it appears that the importance of the role of insurance and actions that can assist the private sector during unforeseen events has become more evident than ever [19, 20].

Another problem mentioned is the increase in healthcare costs during the pandemic and its impact on the oral health of the community. One significant solution mentioned is the use of tele-dentistry [4]. Tele-dentistry had been introduced and recognized before the pandemic, but the outbreak of the pandemic led to a more serious consideration of its use, emphasizing its benefits more than before [48, 57, 60]. These benefits include easier access to dental consultation and follow-up, alleviating commuting issues, timely treatment of oral and dental problems, and contributing to the improvement of oral and dental health while reducing costs [48]. It can be said that alongside all the challenges faced by the dental field during the COVID-19 period, the increased importance of tele-dentistry and its strengthening in the post-pandemic future may be one of the most significant achievements in dentistry.

Another aspect of financial problems in dentistry during the pandemic is related to the procurement of PPE and the significant expenses that dentists incurred for obtaining them. Perhaps, before the pandemic, many dentists paid less attention to the amount of PPE use and how to use it correctly, due to the cheap price and availability of these devices. However, limitations in acquiring these items made them reconsider how to use PPE properly, which is expected to be beneficial both financially and professionally in the long term [88].

During the pandemic, many countries importing PPE faced serious challenges as borders closed [20]. This prompted many importing countries to decide to produce PPE domestically and provide the necessary infrastructure to achieve this goal, which will have several positive aspects. It will help reduce the price and increase access to PPE in that country, as well as the possibility of exporting to other countries [91]. On the other hand, one cannot ignore the problems caused by the sudden increase in the price of PPE for dentists and, consequently, patients. This sudden price increase made dental services more expensive for patients, leading to a reduction in the level of their oral health due to patients avoiding dental visits because of the financial burden [56, 60–63].

Another important point regarding PPE is that the pandemic, despite all the challenges and risks it created for people and healthcare staff, had one important achievement: it identified effective PPE against such diseases. This awareness made dentists realize that, for the protection of themselves, healthcare personnel, and patients, it might not be necessary to incur significant expenses for costly products, which may have more commercial aspects [27].

Dental schools, which provided a part of their budget for faculty expenses and staff salaries through specialized courses and student admission faced great problems with the start of the pandemic and the closing of the centers. An effective solution that helped manage this challenge better than expected was the use of online platforms for education [80]. Online education, both for students' learning and the delivery of various specialized courses by faculty members and scientific seminars, became an efficient method that reduced costs and continued to be recognized as such even after the pandemic [81].

Conclusions

While many high-income countries seem able to mitigate the severity of the COVID-19-induced financial problems, and despite the declaration of the end of the COVID-19 pandemic, its economic effects on dentistry might persist. Although the financial challenges have led to the introduction of new opportunities in the field of dentistry and the development of its infrastructure, these economic problems for dental health providers and individuals can significantly affect the community's oral health. This study aimed to highlight these problems and propose potential solutions, contributing to efforts to improve the oral health of communities globally. However, it is important to note that the conclusions drawn are based on the available data, which may have limitations. Further research is needed to comprehensively understand the long-term economic impacts of the pandemic on dentistry.

Abbreviations

NHS	National Health Service of the United Kingdom
COVID-19	Coronavirus disease 2019

Supplementary Information

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Additional file 1. Summary of chosen articles about the impact of COVID-19 on dentistry: financial aspects. Information (Article title, country, year, design of study, aim of study, number of participants, data collection duration, summary) of 84 articles which are about the financial impact of COVID-19 on dentistry

Additional file 2. Financial impact of Covid-19 pandemic on dentistry and proposed solutions (Results from 84 articles). Articles that discuss about the financial problems imposed by COVID-19 pandemic on dentistry and proposed solutions

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Authors' contributions
Conceptualization: F.F. and MR.K. Study design: F.F. and MR.K. Data collection: F.F. and Fz.F. Supervision: MR.K. Writing manuscript: F.F. and MR.K. Literature review: F.F and MR.K. Preparation of tables and supplementary material: F.F. and Fz.F. Critical review: MR.K and SZ.M. All authors have read and approved the final manuscript.

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Declarations

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