INTRODUCTION

In December 2019, a considerable number of patients were diagnosed with atypical pneumonia with unknown cause in the Wuhan city, China. Later, in January 2020, the Chinese Centre for Disease Control and Prevention revealed the causality to be a new member of coronaviruses named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Infection with this virus (termed as COVID-19) is characterized by high person-to-person transmission rates, representing a serious threat to public health. The pandemic has had a significant impact on various aspects of society, including healthcare systems, economic stability, and individual lifestyles. Oral health is no exception, and the pandemic has led to changes in oral health awareness, attitude towards dental treatment, fear of infection, and economic impact. This study aims to assess the impact of COVID-19 on oral hygiene awareness, attitude towards dental treatment, fear of infection, and economic impact in the Middle East.
situation facing healthcare institutions. With the rapidly increasing rates of the infection worldwide, the World Health Organization (WHO) declared COVID-19 infection as a pandemic on 12 March 2020. Consequently, many countries imposed strict regulations to reduce the infection rate which included partial or complete lockdown of cities.

In due course of time, individuals started to feel insecure while fear and worry about the infection rose steeply as collateral outcomes of the COVID-19 crisis. Moreover, asymptomatic individuals with varied incubation periods constituted a hidden source through which the virus could be disseminated. This has led to psychosocial challenges such as stigmatization and discrimination. The fear of COVID-19 has been reported to be associated with anxiety, depression and perceived infectability. On the other hand, the ongoing COVID-19 crisis negatively influenced the global economy. At the household level, many individuals have lost their jobs and income after the imposition of lockdown in many countries. The fraction of consumer expenditure has dropped particularly in the travel and clothing sectors. However, individual expenditure on medical supplies and hygiene materials has significantly increased over the same time.

Despite the widespread debate on the possibility of airborne routes of COVID-19 transmission, only droplets and contact transmission have been confirmed. The oral cavity is considered as one of the main portals of entry of the virus. This has been confirmed by the presence of numerous angiotensin-converting enzyme 2 for SARS-CoV-2 in the oral epithelium. Therefore, optimizing oral health (OH) is pivotal in preventing infection with COVID-19.

It is well documented that aerosol-generating procedures during dental treatment could be potential sources of infection. Thus, the risk of cross-infection during dental sessions is inevitable unless adequate precautions are taken, which might have a negative impact on the willingness of the individuals to visit the dentists.

All these unusual COVID-19-associated events have raised several questions. For instance, the pandemic resulted in an improvement of OH level as part of general hygiene practices or the same could be true due to escalating stress. In addition, the attitude towards dental visits and the priority of dental treatment(s) were also significantly affected. To the best of our knowledge, this aspect of the COVID-19 pandemic has not been thoroughly investigated yet. Therefore, the aim of this survey was to assess the impact of the COVID-19 pandemic on OH awareness and the attitude towards dental treatment as well as fear and economy in association with demographic/geographic variables in the Middle East.

2 | METHODS

2.1 | Study Design

The current observational study was an online-based questionnaire which was available online for two weeks between 10/08/2020 and 24/08/2020. The study was conducted in accordance with the Tokyo and Helsinki declaration after obtaining due approval from the ethics committee of the College of Dentistry, University of Baghdad (Ref. Number 190 in 09/08/2020).

The Google platform was used to construct the questionnaire and the valid link was distributed through social media, as previously described. All participants completed the questionnaire anonymously. The form included a consent statement that was required to be read and acceded to before continuing with other sections of the questionnaire. Unless this was done, the questionnaire was discarded.

2.2 | Study Population

A total of three representative countries from the Middle East were selected: Jordan, Iraq and Egypt. The inclusion criteria were subjects of any age from these countries who provided consent to complete the questionnaire. The excluded subjects were any respondents from countries other than the pre-specified ones, incomplete responses, dentists and those who were not willing to sign the consent form.

The active Facebook users in these countries were the targeted population in the current survey. The number of Facebook users and the per cent of the total national population constituted by these users until July 2020 were as follows: Jordan, 6,461,000 (35%); Iraq, 24,843,000 (39.9%); and Egypt, 49,940,000 (34%). The sample size was calculated according to the aforementioned figures using the following formula:

\[ n = N / (1 + N \cdot d^2) \]

where \( n \) is the sample size, \( N \) is the total population, and \( d \) represents the margin of error. The calculated sample size at 95% confidence interval and 5% precision rate was 399, which could statistically represent the targeted population. However, to avoid the possibility of dropout as the questionnaire could be viewed by many users; a low percentage was expected to respond. Therefore, the sample size was further adjusted according to the following formula:

\[ S = n / (1 - (z/100)) \]

where \( S \) is the adjusted sample size, \( n \) is the calculated sample size which was 399 (rounded to 400), and \( z \) was equal to 75%, representing the hypothesized attrition rate. The final targeted sample from each country was constituted by 1600 respondents.

2.3 | Components and scoring of the questionnaire

Questions for the current survey were adapted and modified from previously validated and predicted questionnaires. These questions were translated into Arabic language and used in a pilot study that included subjects from both genders with different ages and education levels (\( n = 25 \)). The purpose was to evaluate the degree of
understanding of the translated version by the population and the time required to complete the questionnaire before conducting the study.

The questionnaire (Table 1) consisted of five sections:

The first section was aimed at collecting demographic data such as country of origin, gender, age, occupation, level of education and income level.

The second section included five questions (#1 to #5) that were dedicated to evaluation of OH awareness. Each question had multiple choice answers from which only one was considered as a ‘positive’ response that was given a score ‘1’, while other answers were scored as ‘0’.

The third section consisted of eight (#6 to #13) closed-end questions (‘Yes’ was marked with ‘1’ and ‘0’ for ‘No’). The responses for this section were used to assess the attitude towards dental treatment during the COVID-19 pandemic.

The fourth section (#14 to #18) was constructed using a 5-point Likert scale and used to assess the degree of fear from COVID-19. The responses were ‘Strongly disagree’, ‘Disagree’, ‘Neither agree nor disagree’, ‘Agree’ and ‘Strongly agree’ which were accordingly scored as ‘1’, ‘2’, ‘3’, ‘4’ and ‘5’, respectively.

The last section (#19 to #23) was aimed at evaluating the impact of COVID-19 on the economic status of the population. It was also based on a 5-point Likert scale, similar to the previous section, and the responses were ‘Never’, ‘25%’, ‘50%’, ‘75%’ and ‘100%’. These responses also received scores ‘1’, ‘2’, ‘3’, ‘4’ and ‘5’, respectively.

The responses for every question in each section were summed together, and the total scores were used to calculate the mean for the corresponding section. Accordingly, the degree of OH awareness, attitude towards dental treatment, fear of contracting infection and economic impact of the pandemic were determined for the whole population as per different demographic variables.

2.4 Statistical Analysis

Descriptive statistics were used to present the demographic variables and frequency distribution of responses per question in each section. For inferential analysis, the chi-square test was used to compare frequencies between the groups. The Mann-Whitney test was used to compare the differences for binary variables. These included genders (male, female) and age, which was dichotomized according to the median (≤ 25, >25 years). For multiple group comparisons of the same sections, the Kruskal-Wallis test followed by Dunn's test was used. The strength of the association between OH awareness and attitude towards dental treatment (dependent variables) with different demographic variables, country, degree of fear and economic impact of the pandemic (independent variables) was also calculated. For this purpose, multiple linear regression and stepwise methods were used. The results were considered significant when the p < 0.05. All statistical procedures were performed using SPSS® software (version 25, IBM, USA), while the figures were generated using GraphPad Prism (version 8, GraphPad Software, San Diego, CA, USA).

3 RESULTS

This online-based questionnaire was viewed by 120124 Facebook users from the three countries. The total number of respondents for this questionnaire was 3782. The specific number of respondents from the specific countries was as follows: Jordan 826, Iraq 1535 and Egypt 1421, thereby representing 52%, 96% and 89% of the calculated sample, respectively. This was considered a satisfactory sample to represent these populations (Figure 1). The demographic data of the respondents are shown in Table 2.

Overall, the OH awareness of the respondents was relatively low (mean ±SD; 1.84 ± 1.03), while moderate level was observed on the attitude towards dental treatment (5.04 ± 1.68) and economic impact (11.29 ± 4.37). Regarding the fear of COVID-19 infection, the results indicated moderately high level among respondents (14.04 ± 4.11) (Table 3).

Analysis of individual responses showed that most of the respondents brushed their teeth on daily basis (Q1, 88%), whereas few of them brushed their teeth twice daily on regular basis and used interdental aids (Q2 and Q4, 20%) (Figure 2A). Majority of the respondents expressed their choice to leave the clinic, consequent upon the fear of contracting the infection (Q10, 87%). This was complemented by answers to questions on whether the dental clinic is a high-risk environment (Q8, 79%). The least positive responses were associated with the tendency of the respondents to visit the dentist if they had dental problems that might compromise their appearance (Q7, 30%) (Figure 2B). The respondents reported high fear of contracting COVID-19 infection (Figure 2C). In addition, the respondents also reported an increased expenditure on hygiene materials (25-100%) (Figure 2D).

For OH awareness, attitude towards dental treatment and impact of COVID-19 on the economic status, all subgroups of the included variables showed significant differences among them (Figure 3A, B, D). However, responses to the fear section showed only significant differences between gender and age groups. The female respondents expressed significantly higher fear levels than male, while older subjects (> 25 years) were more afraid of COVID-19 infection than their younger counterparts (Figure 3C).

Results from the regression model showed that country, gender, age, employment status, education level, income and fear significantly modified the level of OH awareness (R = 0.195; R² = 0.036), while country, gender, age, education level, income, economy and fear significantly influenced the level of attitude (R = 0.375; R² = 0.141) of the respondents. Among the modifiable variables, fear was found to boost the attitude towards dental treatment, in contrast to the income (Table 4).

4 DISCUSSION

This online survey indicated a low OH awareness but the attitude towards dental treatment exhibited a moderate level of sensitization among populations in the Middle East during the pandemic. The
## Table 1 Components of the questionnaire.

| Country: | Gender: | Male | Female |
|----------|---------|------|--------|
| Age: | Occupation: | | |
| Level of Education: | Postgraduate | University graduate | High school or less |
| Income: | < enough | Enough | Enough and exceed |
| 1. Do you brush your teeth on daily basis? | Yes | No |
| 2. How often do you brush your teeth? | 2/day regularly | 1/day regularly | 1 or 2 irregularly | Sometimes |
| 3. How long do you spend on brushing your teeth? | <1 min | 1 min | 2–3 min | > 4 min |
| 4. Do you use any type of interdental aids? | No | Yes | Sometimes |
| 5. How often do you use mouthwash? | As instructed by the dentist | Twice/day for 2 weeks | 1/week | Never |
| 6. Is teeth bleaching, esthetic veneers/crowns still represent priority to you? | Yes | No |
| 7. If you have a dental problem that may compromise your esthetic, do prefer to postponed visiting your dentist? | Yes | No |
| 8. Do you think that dental clinic is a high-risk environment for COVID–19 transmission? | Yes | No |
| 9. Have you canceled or postponed dentist appointments in the last 5 months? | Yes | No |
| 10. Would you leave the clinic if you feel a potential threat of infection? | Yes | No |
| 11. Is the economic impact of COVID–19 outbreak adversely affecting your commitment/desire to visit the dentist? | Yes | No |
| 12. Depression associated with the current COVID–19 crisis influences your desire to obtain dental treatment. | Yes | No |
| 13. You think twice before going to the dentist due to social distancing and strict quarantine/infection-control measures. | Yes | No |
| 14. Are you most afraid of coronavirus disease–19? | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |
| 15. Are you afraid of losing your life because of coronavirus disease–19? | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |
| 16. Do you have any physical reactions when thinking about coronavirus disease–19? | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |
| 17. When watching news and stories about coronavirus disease–19 on social media, do you become nervous or anxious? | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |
| 18. You cannot sleep because you are worrying about getting coronavirus disease–19. | Strongly disagree | Disagree | Neither agree or disagree | Agree | Strongly agree |
| 19. To which extent your monthly income has been reduced during COVID–19? | Never | 25% | 50% | 75% | 100% |
| 20. If applicable, is the governmental financial support is sufficiently covering your medical or life needs during COVID–19? | (Continues) |
range of variables such as socio-economic characteristics and degree of fear of contracting the infection influenced the outcomes of this study. Selection of Egypt, Iraq and Jordan from Middle East countries for this survey was based on similarities socially and in annual per capita together with high number of populations in these countries. There were certain limitations to this survey: majorly, the difficulty in finding similar previous studies that were conducted during pandemics on a global level. As an alternative, studies on specific populations that suffered from a crisis that significantly crippled most aspects of life were selected for comparisons. Further, respondents’ social desirability might affect their responses to these self-reported questions. Nevertheless, this work revealed strong points that were represented by a large sample size with no missing data. Since the declaration of COVID-19 as a global pandemic, the main obsession of the populations and health authorities was focused on the treatment/preventive methods that were directed towards general rather than oral hygiene. This notion was consistent with the results of the regression analysis from this survey, wherein geographic location was significantly and negatively associated with

TABLE 1 (Continued)

| Question                                                                 | Never | 25% | 50% | 75% | 100% |
|--------------------------------------------------------------------------|-------|-----|-----|-----|------|
| 21. To which degree your expenditure for medical/dental check-ups was increased during COVID−19? |       |     |     |     |      |
| Never                                                                    | 25%   | 50% | 75% | 100%|      |
| 22. Have you amended your monthly budget for life needs during COVID−19?  |       |     |     |     |      |
| Never                                                                    | 25%   | 50% | 75% | 100%|      |
| 23. How much your expenditure on hygienic materials has increased in the last 5 months? |       |     |     |     |      |
| Never                                                                    | 25%   | 50% | 75% | 100%|      |

Note: Bold font indicates positive responses.

FIGURE 1 Flow diagram of the study.

TABLE 2 Demographic data of the respondents from Jordan, Iraq and Egypt.

| Variables                    | Total | p value | Jordan | Iraq | Egypt |
|------------------------------|-------|---------|--------|------|-------|
| Age mean (SD)                | 27.99 (9.44) |        | 30.11 (9.97) | 29.19 (9.45) | 25.47 (8.53) |
| Age groups<sup>a</sup>        |       |         |        |      |       |
| <25                          | 1763 (46.6) | 0.001   | 278 (7.4) | 585 (15.5) | 900 (23.8) |
| ≥25                          | 2019 (53.8) |         | 548 (14.5) | 950 (25.1) | 521 (13.8) |
| Gender<sup>a</sup>           |       |         |        |      |       |
| Male                         | 736 (19.5) | 0.001   | 96 (2.5)  | 496 (13.1) | 144 (3.8) |
| Female                       | 3046 (80.5) |        | 730 (19.3) | 1039 (27.5) | 1277 (33.8) |
| Employment status<sup>a</sup> |       |         |        |      |       |
| Unemployed                   | 2317 (61.3) | 0.001   | 518 (13.7) | 826 (21.9) | 972 (25.7) |
| Employed                     | 1465 (38.7) |         | 306 (8.1)  | 709 (18.8) | 448 (11.9) |
| Education<sup>a</sup>        |       |         |        |      |       |
| High school or less          | 536 (14.2) | 0.001   | 144 (3.8)  | 251 (6.6)  | 141 (3.7)  |
| University graduate          | 2677 (70.8) |        | 521 (13.8) | 1079 (28.5) | 1077 (28.5) |
| Postgraduate                 | 569 (15)   |         | 161 (4.3)  | 205 (5.4)  | 203 (5.4)  |
| Income<sup>a</sup>           |       |         |        |      |       |
| Less than enough             | 1937 (51.2) | 0.001   | 458 (12.1) | 780 (20.6) | 699 (18.5) |
| Enough                       | 1767 (46.7) |         | 353 (9.3)  | 711 (18.8) | 703 (18.6) |
| Enough and exceed            | 78 (2.1)   |         | 15 (0.4)   | 44 (1.2)   | 19 (0.5)   |

<sup>a</sup>Frequency, per cent.; *Significant difference at p < 0.05 by chi-square test.
OH awareness. In addition, our previous survey conducted a short time prior to the COVID-19 crisis has shown a higher mean of OH awareness (2.19 ± 1.29 vs. 1.97 ± 1.01) among the Iraqi population.\textsuperscript{17}

Indeed, confrontation with threats to life negatively affects the OH status, as demonstrated by a study on refugees from war zones despite their reasonable awareness of oral hygiene.\textsuperscript{22} In contrast, a positive relationship was observed with other independent variables such as gender and educational level.\textsuperscript{17,23-26}

Indeed, fear is a protective feeling that arises when facing a life-threatening condition such as infectious diseases.\textsuperscript{27} In this study, the respondents reported a fear of contracting COVID-19 at a slightly higher level than average on a scale of five questions. One can understand this elevated fear to have emanated from high rate of disease transmission with imminent person-to-person cross-infection potential and causality by an invisible virus.\textsuperscript{1-3} The presence of asymptomatic infected individuals cannot be neglected when accounting for the fear of COVID-19.\textsuperscript{8} This information is accessible to the public in media and TV news for the purpose of increasing public awareness. Logically, these should minimize psychological disturbances such as fear, but it is not the case with respect to COVID-19. The same scenario was

**TABLE 3** Means of the responses for the questionnaire’s sections.

| Questionnaire’s sections                      | Range of scores | Min. | Max | Median | Mean ±SD  |
|-----------------------------------------------|-----------------|------|-----|--------|-----------|
| Oral health awareness                         |                 | 0    | 5   | 2      | 1.84 ±1.03|
| Attitude towards dental treatment             |                 | 0    | 8   | 5      | 5.04 ±1.68|
| Degree of fear from COVID-19                  |                 | 5    | 25  | 14     | 14.04 ±4.11|
| Impact of pandemic on economic status         |                 | 5    | 25  | 11     | 11.29 ±4.37|

**FIGURE 2** Responses to the sections of the questionnaire. The highest positive responses to questions about OH awareness showed that 88% brush their teeth (Q1) but only 20% follow the correct frequency (Q2) and 32% brush their teeth for 2–3 min (Q3). About 80% were not using interdental aids (Q4) and almost similar per cent not following dentist’s instruction to use mouthwash (Q5) (A). For attitude to dental treatment, responses to most of questions (Q6, 8, 10, 12 and 13) were >60%. The highest positive answers were associated with tendency of the respondents to leave the clinic if any threat was noted (Q10, 87%). Responses to visiting the dentist in case of having serious non-urgent issues (Q7) and cancellation of dental appointments during pandemic (Q9) showed the lowest responses (B). Responses to fear section were relatively high for most of questions (C), while self-reported economic impact was reported to be moderately affected, between 25 and 50% for most of the respondents (D).
experienced with SARS epidemic which had affected a sizeable population of the world. During that time, fear and stigmatization were prominent. These factors potentially increased the reluctance of people to visit public places, including dental offices and hospitals. However, current studies have indicated that majority of dentists are keeping updated with guidelines issued by Centers for Disease Control and Prevention and the WHO for cross-infection control and having a good awareness about mode of COVID-19 transmission. The aforementioned guidelines together with using appropriate personal protection equipment highly helped in reducing COVID-19 infection among dentists and patients even with those having high-risk comorbidities associated with COVID-19 severity.

The economic impact on individuals in this study was evident. Self-reported unemployment status was over 60%, which is consistent with previous reports by many international organizations and institutes about deteriorating economic condition during the pandemic. The impact of the economy on dental care was evident following the great economic recession. A study conducted in Spain indicated an increase in unmet dental care needs between 2007 and 2011, with the unemployed and those with low income being the worst affected. The relationship between the employment status and income with the ability to afford the cost of dental treatment was also indicated by earlier surveys. Similarly during the great economic recession, visits to general practitioners reduced by 34%, in 2010 in the United States, with no signs of significant recovery in this pattern after that date.

FIGURE 3 Comparison of response to the section of the questionnaire according to different demographic variables (gender, age, employment status, level of education and income). Analysis showed significant differences among all subgroups of all demographic variables in relation to OH awareness (A), attitude to dental care (B) and economic impact (D). The only exception was associated with analysis of fear section where significant differences were observed between males and females and older subjects (>25 years) than younger ones (C). Significance at * p<0.05, **p<0.01 and ***p<0.001.
The limited desire to obtain dental care reported in our study could be explained by the economic effect of the COVID-19 pandemic on the available household income. With the lack of defining when COVID-19 is terminated, individuals tend to prioritize their expenditure and keep their savings for essential things and postponing non-essential dental needs for the later.

The responses of the participants generally indicated their low desire to visit dentists. According to the answers, dental clinics were considered hazardous. A survey evaluating perceived vulnerability to COVID-19 infection showed that older subjects expressed a higher tendency to avoid dental care. In addition, non-urgent reasons were not reported as a priority in majority of the respondents. This concurs with the results from a recent study that observed a 20% increase in appointment for urgent dental and oral infections. In contrast, dental trauma and non-urgent cases were significantly decreased by 4% and 13%, respectively, in the same periods.

Further reasons that influenced attitude were attributed to strict lockdown/social distancing measures and, in certain times, the complete shutdown of dental clinics and centres in the private and government sectors. Obviously, these restrictions hindered many people from visiting the dentist, in the current survey, even if they could afford the cost of the treatment.

Although a high number of responses were received for this online questionnaire, participation from the older age groups was limited and the responses from IT-illiterate subjects were also lacking. Therefore, caution should be exercised before the generalization and interpretation of the results.

5 | CONCLUSIONS

The COVID-19 pandemic negatively impacted the OH awareness, while the attitude towards dental treatment was moderately affected. Increasing public fear and compromised economy were evident during COVID-19 pandemic and might influence OH awareness and the attitude towards dental treatment in populations from the Middle East.

6 | CLINICAL RELEVANCE

6.1 | Scientific rationale of the study

Studies exploring impact of COVID-19 pandemic on the level of personal oral hygiene and subjects’ attitude towards dental treatment are limited.
6.2 | Principal findings

Oral hygiene awareness among the Middle East populations was negatively affected by COVID-19 pandemic due to combined effect of different socio-economic variables. Similarly, the crisis changed the attitude towards dental treatment which was manifested by no longer considering non-urgent therapies as a priority.

6.3 | Practical implications

Oral cavity is a main portal of entry to different pathogens including COVID-19. Population-centred programmes and campaigns are necessary to educate the subjects about the importance of oral hygiene measures as an integral part of general hygiene to prevent infection from COVID-19.

ACKNOWLEDGEMENTS
This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

CONFLICT OF INTEREST
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS
A.A.A.: conception and design, analysis and interpretation of data, and drafting the article. H.R.A. and N.H.A.: conception, analysis and interpretation of data and revising the article. M.L.A. and N.H.A.: acquisition of data, and revising the article. All authors contributed in writing and approving the final draft of the manuscript.

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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How to cite this article: Abdulkareem AA, Abdulbaqi HR, Alshami ML, Al-Rawi NH. Oral health awareness, attitude towards dental treatment, fear of infection and economic impact during COVID-19 pandemic in the Middle East. Int J Dent Hygiene. 2021;00:1-10. https://doi.org/10.1111/idh.12502