Research Article

Knowledge, Attitude and Practice of Minimally Invasive Dentistry Among Dental Graduates: A Cross-Sectional Survey from Saudi Arabia

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ABSTRACT

Irrespective of the growing evidence and emphasis on MID practice, limited data is available to evaluate the knowledge and attitude towards MID practice among the dental students within Saudi Arabia. Minimally invasive dentistry (MID), advocates a holistic approach focused on primary and secondary prevention unlike the traditional surgical practice. It acknowledges the evidence-based more conservative medical model of caries management. Even though the dental curriculum involves didactic training of MID in conservative dentistry, the question arises whether the knowledge student possess translates into practice. The study aimed firstly, to assess the knowledge about MID technique among the undergraduate students and interns from the dental schools situated in the Northern region of Saudi Arabia. Secondly, it also investigated whether the knowledge acquired by the students reflects in the form of a positive attitude towards practice of MID principles. This was a cross-sectional online survey involving 355 dental students and interns of three government dental colleges situated in the northern region of Saudi Arabia. The questions assessed the respondents' levels of agreement regarding diagnostic, preventive and minimally invasive restorative techniques. Descriptive data, chi square and bivariate correlations were computed using SPSS software. Total of 355 participants responded with a response rate of 78.88%. Gender, Year of study and City showed significant difference in knowledge at $p< 0.05$. Lectures were the most prominent ways of obtaining knowledge for 48% of the respondents while 42% obtained it from lectures and hands-on both. A high percentage of 37% respondents still used sharp explorer for caries detection whereas 50% did not use contemporary methods of caries detection. Only 10% used magnification (loupes/microscope). Greater part of 43.4% strongly agreed to do CRA and 55.5% would plan restorative techniques accordingly. Likewise, 91% and 58.7% respectively agreed that use of tropical fluoride and sealants was effective. Majority of the participants possessed knowledge about MID and demonstrated positive attitude towards MID practice/techniques. Although dearth of application was observed in their attitudes towards contemporary caries detection methods as many participants still followed traditional caries diagnosis methods. The year of study significantly affected the knowledge acquired by dental interns and students ($p<0.05$). This difference was more prominent ($p= 0.00$) among the cities.

Keywords: Caries risk assessment, dentistry graduate knowledge, Minimally invasive dentistry (MID), Saudi Arabia.

INTRODUCTION

The dental caries symposium of the 14th Makkah Dental Conference 2017 brought together leaders from the different academic and clinical stakeholders. The group established consensus on implementing various measures in the Kingdom of Saudi Arabia that could help reduce the overall dental caries burden. Various recommendations were put forth by the group to explore the role of dental economics in preventive dentistry program implementation in view of the "vision 2030" of the Kingdom of Saudi Arabia.

The group acknowledged that hundreds of the students graduate from dental schools in Kingdom of Saudi Arabia annually. Majority amongst these graduates are employed in government establishments especially Ministry of Health, which accounts for 40% of the healthcare professionals employed in the Kingdom of Saudi Arabia. The work group realized an urgent need to utilize this emerging workforce in the promotion of preventive dental care.

Amongst the recommendations the most prominent were:

1. Introducing evidence-based learning at the undergraduate level by promoting preventive dentistry into the curriculum of dental schools.
2. Implementation of preventive practices like role of fluoridation, caries risk assessment, dietary counselling and minimally invasive caries management practices.
3. Establishment of national preventive workshops and collaborative symposia for the training of faculty and students in the clinical aspects of preventive dentistry in Saudi Arabia were emphasized [1].

In lieu of emerging evidence on effectiveness of preventive caries protocols, the dental curriculums especially in Europe and Australia have undergone a paradigm shift towards teaching the Medical model of caries

management, based on caries risk assessment and Minimal invasive strategies to treat dental caries [2,3]. In contrast, dental schools in the Middle East and Asia still follow the traditional G.V. Blacks classification at the undergraduate level which is based on the principles of cavity designs. This influences their clinical outlook, especially contemporary caries management principles because the same students become future clinicians. They continue doing what they learned in their dental school [4].

Minimal intervention dentistry (MID), a contemporary concept introduced by Mount and Humes in the late twentieth century propagates non-invasive principles of operative dentistry. The MID concept emphasizes a new dimension for caries management primarily focused on early diagnosis, risk assessment, prevention, and control [5]. The concept of minimal intervention dentistry has evolved as a consequence of evidence-based decision making and scientific understanding of the etiology, prevention, cessation of caries progression and the development of modern adhesive restorative technology [6].

The century-old surgical method of "extension for prevention" as proposed by Black is no longer applied [7]. MID aims to sustain intact caries-free functional teeth. The most important elements are attained through executing the important strategies for the prevention of carious lesions. These strategies are considered to be: a) early caries detection and risk assessment; b) Remineralization of demineralized enamel and dentine; c) optimal caries preventive measures; d) minimally invasive operative interventions and; e) repair rather than replacement of restorations [8-10]. MID is not synonymous with cutting smaller cavities than before, as many dentists thought. The central idea of caries management is focused on Patient-centered care (PCC) and minimal intervention dentistry (MID) [11].

Dental caries continues to affect populations of all ages, gender, and socioeconomic factors. Irrespective of the advances in dental technologies, material sciences the Global Burden of Disease reported untreated caries affecting the permanent dentition as most prevalent in the last decade [12]. Similar observations are reported for the Kingdom of Saudi Arabia concerning dental caries [13].

The outcome of the studies conducted in Saudi Arabia regarding the practice of MID principles has revealed a lack of knowledge and implementation of MID principles [14, 15]. Although most of these studies involved general dental practitioners who belong to different nationalities, educational backgrounds and follow different schools of thought, thus vary in their outlook and practices. The conventional practice of caries management not only has a biological cost but financial burden also, as most of the time and effort in general dental practices are spent on restoration, repair, and replacement of existing failing restorations as also revealed in a study done in Hail, Saudi Arabia[16].

Irrespective of the growing evidence, demand and emphasis on MID practice, no study was found that investigated the absorption of this contemporary learning and the concepts among dental graduates within Saudi Arabia.

With this background, this study aimed to assess the knowledge about MID techniques among the undergraduate students and interns from the dental schools situated in the Northern region of Saudi Arabia. Secondly, whether the knowledge obtained reflects as positive attitude towards the practice of MID principles.

MATERIAL AND METHODS

Study design

It was a survey study having a cross-sectional design.

Study population

The study population was both male & female dental students and interns belonging to the government dental institutes situated in the northern region of Saudi Arabia.

Study tool: Questionnaire-based online survey

Sample size: a purposive sample of about 450 dental students & interns was taken in the northern region, Saudi Arabia.

Inclusion criteria: Dental interns and students in clinical training years (Year 4th to year 6th)

Data collection procedure

A pre-validated questionnaire[12,17,18] consisting of questions on knowledge and attitude toward MID practice was employed. The questionnaire was circulated online among the dental students and interns of government colleges in Hail, Al Qassim and Al Jouf situated in the northern region of Saudi Arabia. However, 355 respondents with the response rate of 78.8% of the study returned the questionnaires. The study was conducted from September 2019 to December 2019.

The questionnaire comprised of two sections. All the questions were close-ended.

The first section assessed the demography of the respondents – gender, age, region, year of study. The second part of the questionnaire consisted of 15 questions. Six questions assessed the knowledge, five questions assessed the attitude and four questions assessed the practice- based on screening, prevention, and curative measures.

The Ethical Committee of institutional review board under approval number H-2018-096 approved the study. Informed consent was obtained from participants who volunteered for the study.

Data analysis

Data analyses were done using statistical software (SPSS version 25, Chicago, IL). Descriptive and inferential statistics were reported in the form of frequency counts

and percentages. Frequencies cross tabulations and bar charts were used in descriptive statistics. Chi-square test were used for respondents based on whether or not they had MID training and/or education by comparing qualitative data.

RESULTS

A total of 355 questionnaires were filled and analyzed with a response rate of 78.88%. (Table/Figure 1) represents the demographic characteristics of the participants. Out of 355 respondents, 208(58.6%) were male and 147 (41.4%) were female. The majority 36.9% respondents ranged between 24 to 26 years of age. The respondents from the hail city were 42.6% [n=150] followed by 37.4% (n = 133) from Al Qassim and 20.1 % (n = 71) from Al Jouf. The Year of study wise distribution was 26.2% (n=93) year 4th, 37.2% (n= 132) for year 5th, 20.8% (n=74) year 6th and 16% (n=57) were interns (Table 1).

Table 1: Representing the demographic characteristics of the study population

Variables	Number (n=355)	Percentage %
Gender		
Male	208	58.6%
Female	147	41.4%
Age		
20-23	220	61.9%
24-26	131	36.9%%
27-30	4	1.2%
City		
Hail	150	42.6%
Al jouf	71	20%
Al Qassim	133	37.4%
Years of Study		
4th year	93	26.1%
5th year	132	37.1%
6th year	74	20.8%
Internship	57	16%
Method of obtaining knowledge about MID		
Lectures only	170	48%
Hands on	14	4 %
Lectures and hands-on both	150	42 %
Others (education seminars, conferences)	21	6 %

Figure 1 represents the methods of obtaining knowledge/ training about MID principles, (48%) of the respondents received knowledge/training about MID practice from lectures only and (42%) obtained it from lectures and hands-on both. Whereas few (4%) had obtained it as hands-on training while (6%) had obtained from other sources like educational seminars and conferences.

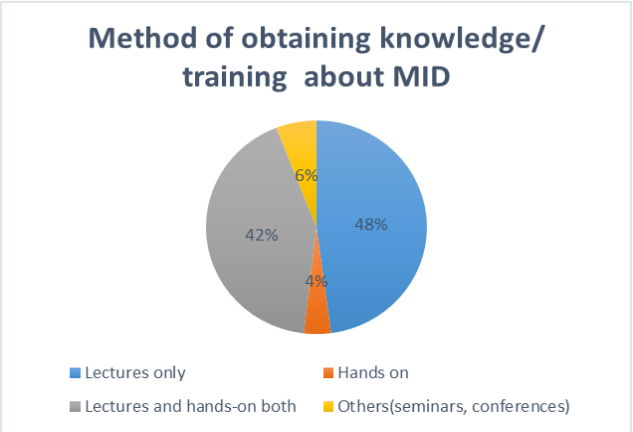

Figure 1: Representing method of obtaining knowledge/ training

Table 2 represents the response to the level of knowledge possessed by the participants regarding MID. A significant difference (p< 0.5) was observed amongst the participants in response to the level of knowledge possessed about MID with respect to gender and the year of study [chi-square test]. However, this difference was highly significant (p = 0.00) when compared for the city.

Table 3 represents the knowledge of participants about MID related to etiology, prevention, and application of MID principles for dental caries control. Majority 239(67.3%) strongly and 78 (22%) respondents agreed that there is a direct relationship between carbohydrate diet and the etiology of dental caries. Majority 228 (64.2%) participants strongly agreed that fluoride helps remineralize carious lesions, while 244(68.7%) had similar opinion for effectiveness of pit and fissure sealants for caries prevention. Most of the participants, (78.8%) collectively expressed agreement for conducting a caries risk assessment and plan restorative materials and techniques accordingly. Similarly 118(33.2%) strongly agreed and 147(33.2%) agreed that conservative cavity design like tunnel and box preparation are effective. However, 10.7 % collectively were uncertain about the role of carbohydrates in etiology of dental caries and further 25% expressed their disagreement for effectiveness of conservative cavity designs like tunnel preparations and box.

Table 4 represents the attitude of the participants towards the application of MID principles and concepts. Large percentage 37% and 34% respondents respectively continue the use of a sharp explorer while another 36% “never” use a blunt instrument for caries detection. Use of magnification and contemporary caries detection tools like Electric caries monitor (ECM), Quantitative light-induced Fluorescence (QLF), Infra-Red Laser Fluorescence (IRLF), and Fibre-Optic Trans-Illumination (FOTI)] was not applied by half 51% and 50% of participants respectively.

Table 5 represents attitude of respondents towards the practice of MID techniques performed. The collective response of the dental students towards techniques for MID practice revealed that the majority 91% of

respondents consider the use of conservative restorative techniques such as the Sandwich Technique and Atraumatic Restorative Technique (ART) 86% as "effective" over the conventional restorative methods. Similarly, majority 91% were affirmative to the use of varnish and tropical fluoride for remineralization protocol for caries lesions. However, 33% did not hold the same view for high concentration fluoride Duraphat.

Table 2: Representing characteristics of the Participants and the respective knowledge about MID. Significant at $p < 0.05$ (Pearson's chi-square test)

	Participants knowledge about MID				
Variables	**Very much**	**Much**	**Little**	**None**	**p. value**
Gender	n (%)	n (%)	n (%)	n (%)	
Male	36 (10.1)	90 (25.4)	70(19.7)	12 (3.4)	0.097
Female	31 (8.7)	76(21.4)	31(8.7)	9 (2.5)	
City					
Hail	31 (8.7)	56(15.8)	53(14.9)	10 (2.8)	0.00
AlQassim	20 (5.6)	84 (23.7)	20(5.6)	9 (2.5)	
AlJouf	16 (4.5)	26 (7.3)	28 (7.9)	2 (0.6)	
Year of Study					
4th year	14 (3.9)	41 (11.5)	25 (7.0)	13 (3.7)	0.016
5th year	22 (6.2)	55 (15.5)	50 (14.1)	4 (1.1)	
6th year	16 (4.5)	44 (12.4)	12 (3.4)	2 (0.6)	
Internship	15 (4.2)	26 (7.3)	14 (3.9)	2 (0.6)	
Over all (total) N=355 (100%)	67 (18.9)	166 (46.8)	101 (28.5)	21 (5.9)	

Table 3: Representing the participants knowledge regarding minimally invasive dentistry.

What is your opinion on the basis of your knowledge about the under given statements	**Strongly agree**	**Agree**	**Uncertain**	**Disagree**	**Total**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**N(%)**
There is a direct relationship between carious lesions and carbohydrate intake	239 (67.3%)	78 (22%)	29(8.2%)	9 (2.5%)	355(100%)
Fluoride is an essential agent in the tooth remineralization process	228(64.2%)	90(25.4%)	27(7.6%)	10(2.8%)	355(100%)
Sealants are effective for pit and fissure caries prevention	244(68.7%)	73(20.6)	25(7%)	13(3.7%)	355(100%)
Caries risk assessment should be conducted with all patients	154(43.3%)	126(35.5%)	62(17.5%)	13(3.7%)	355(100%)
Conservative cavity designs like tunnel and box preparations are effective	118(33.2%)	147(41.4%)	68(19.2%)	22(6.2%)	355(100%)
Plan restorative materials and techniques based on patients caries risk assessment	197(55.5%)	112(31.5%)	37(10.4%)	9(2.5%)	355(100%)

Table 4: Representing the attitude of participants toward minimally invasive principles for caries diagnosis

How frequently do you use these methods/ techniques for caries detection/ diagnosis on patients.	**Always**	**Most times**	**Never**
	n (%)	**n (%)**	**n (%)**
Use of a sharp explorer	132(37%)	120 (34%)	103 (29%)
Use of blunt instrument	96 (27%)	132(37%)	127 (36%)
Use of magnification	35 (10%)	139 (39%)	181 (51%)
Use of radiographs	124 (35%	220 (62%)	11 (3%)
Use of newer methods like (ECM.QLF.IRLF, FOTI)	25 (7%)	153 (43%)	177 (50%)

Table 5: Representing the attitude of participants towards minimally invasive techniques in clinical practice

What is your opinion about the usage of under given techniques in MID practice	Effective	In effective
	n (%)	n (%)
ART (Atraumatic Restorative treatment)	306 (86.2%)	49 (13.8%)
Sandwich Technique (Glass ionomer + composite)	323 (91%)	32 (9%)
Remineralization with fluoride varnish or any other tropical fluoride products	323 (91%)	32 (9%)
Remineralization with high concentration fluoride toothpaste at home (Duraphat, 2800/5000 ppm F)	238 (67%)	117 (33%)

DISCUSSION

The core principle of minimally invasive dentistry emphasizes the preventive aspect of caries management dissociating from the traditional concept of "drill and fill" to a more conservative holistic and biological concept of "seal and heal" [19]. The contemporary ideology of "Cariology" in itself is a result of advances in research and development, a better understanding of the etiological process on a molecular, histopathological and microbiological platform[20]. This paradigm shift in the concepts of caries management has received global recognition and acknowledgment leading to policymaking by organizations like the International Dental Association's Global Caries Initiative (GCI) [21] and the World Health Organization's Global Oral Health Program, which have acknowledged the significance of promoting a new paradigm among dentists, transiting from a restorative to preventive model [22]. These developments have evolved as the initiative of the "medical model" of caries management and transformation of dentist role as a dental physician substituting the traditional surgical model, thus minimizing the "restorative escalator" affects.

In the present study majority 65.7% among the participants, 18.9 % "very much" and 46.8% "much", agreed to have knowledge (principles) and training about MID during their graduate (BDS) learning (Table/figure3). Lectures appeared to be the major source of obtaining knowledge amongst 48% of the participants followed by 42% who had learned from lectures and hands on training both, a nominal 6% from conferences and seminars (Table/figure2). The results of our study were somewhat contrary to a study conducted in the Eastern region of Saudi Arabia wherein 59.9% of the participating dentists did not have any specific education or/ training in MID during their BDS curriculum [12].

The Federate Dentaire Internationale (FDI) recognizes the role of plaque and carbohydrates in caries etiology and advocates remineralization of non-cavitated lesions of enamel and dentine by use of fluoride supplements [23]. Although in the present study majority 67.3% "strongly" and 22% "agreed" but 10.7 % respondents were uncertain about role of carbohydrates in etiology of dental caries and another 19% had same view about remineralization ability of fluoride (Table/figure 4). Similar findings were observed in a study conducted in Chennai, India where 12.8% participants were in disagreement about role of carbohydrates in etiology of dental caries and 27% were uncertain about remineralization ability of fluoride [18].This uncertainty reflected a deficit in basic knowledge which is worth investigation in future.

In our study, overall 78.9% participants, 43.4% "strongly" and 35.5% "agreed" about importance of performing caries risk assessment (CRA) for all patients. Likewise 55.5% strongly and 31.5% would plan restorative treatment with materials and techniques based on individual caries risk assessment (Table/figure 4). These findings are in unison with the policies of AAPD [24] and reflected a positive attitude towards evidence based learning, contrary to a similar study conducted in Jaipur, India wherein only one-fourth of the study participants practiced CRA out of the 80% who were aware of it [25]. Unanimous agreement of 68.7% (Table/figure 4) was expressed for use of sealants in prevention and progression of pit and fissure and early non-cavitated carious lesions, which complies with the ADA recommendations and similar to as reported in other studies [26]. Importance of noninvasive techniques like CRA and use of pit and fissure sealants in caries control need to be strictly reinforced in undergraduate learning and clinical practice.

Similarly, the majority of respondents 41.4% (Table/figure 4) in our study agreed to the use of conservative techniques like tunnel and box preparations as a viable option compared to more aggressive conventional cavity designs. Nevertheless 19.2% and 10.4% of the participants in the present study respectively expressed uncertainty for the same. Although the use of tunnel preparation and box/slot preparations are widely used in the management of mild to moderate intensity proximal lesions, though a study found no significant difference in the survival rates between the tunnel and the conventional restorations [27].

The attitude of the participants in this study contradicted the contemporary MID principles based on evidence-based practice, which was apparent by a varied response towards the application of MID procedures and concepts (Table/figure 5). The majority of the students respectively exercised the option of "always" 37% and "Sometimes" 34% for use of a sharp explorer for caries detection. This disagreement was further reinforced with 36% participant's responding "never" to use blunt instrument for caries detection. These findings contradicts the evidence for use of sharp objects as caries diagnostic tools especially for

incipient lesions [28]. Moreover, it is well-accepted fact that use of magnification is an inherent aspect of contemporary dentistry and significantly enhances diagnostic ability [29]. Almost half 51% and 49.5% of the participants respectively negated the use of magnification and contemporary caries detection methods for caries diagnosis. Nevertheless, the cost and unavailability of these noninvasive contemporary diagnostic aids could be a factor. It is worth mentioning that similar observation was made in a study conducted amongst general dental practitioners of Saudi Arabia wherein 79.5% participants still use a sharp explorer for caries detection[12]. These findings reflect a wider discrepancy between the knowledge and attitude towards practice regarding caries detection methods in our study population.

A wide agreement was displayed by the respondents to the practice of minimally invasive techniques like the use of Atraumatic restorative treatment (ART) 86% and sandwich technique 91% for the management of caries lesions (Table/figure 6). Research has demonstrated that the ART approach is effective in both primary and permanent teeth[30]. Similarly, a consensus occurred for remineralization therapy by the use of tropical and high concentration fluoride toothpaste (2800/5000 ppm) for caries prevention (Table/figure 6). These findings displayed an emerging change in practice behavior towards the implementation of MID principles amongst the participants widely in agreement with the core minimal intervention principles and objectives [31,32].

The difference of opinion among participant's attitude and practice towards applying the MID principles especially for caries diagnosis is a concern and could be attributed to the fact that our sample population were from three different institutes and geographic locations, each following different practice ideologies. Moreover this was reinforced by the fact that although gender and year of studying (professional training) showed a statistically significant ($p<0.5$) effect on knowledge obtained, but comparison within the cities showed highly significant difference ($p=0.00$) existed for knowledge between participants (Table/figure 3).

A study conducted by the Brazilian Ministry of Education to evaluate the implementation of curricular in all 208 dental schools in line with the public health policies concluded that institutions where degree of innovation in curricula was implemented, those institutions were statistically different on the basis of health care delivery by students to society from institutions where traditional systems were practiced[33].

It is noteworthy to mention that there is a general need in dental teaching institutions within the kingdom of Saudi Arabia to adopt standardization of dental curriculum and introduce evidence-based teaching. Implementation of universal guidelines for caries detection, diagnosis, treatment decisions and treatment performance should be established and implemented in student clinics. This would largely help reinforce the students to apply the frequently changing evidence regarding the diagnosis and management in Operative Dentistry as recommended by the European Core Curriculum in Cariology constituting of the European Organization for Caries Research (ORC) along with the Association for Dental Education in Europe (ADEE)[34].

Limitation of the study was inability to include all public and private sector dental schools nationwide to have a more diverse spread of data, which would have given a broader perspective into the outcome of the study. Secondly, the sampling technique is non-probabilistic which has partiality towards the selection of the respondents. Another limitation was the design of the study whereby the data was collected through the self-reported measures which has inherent bias of inflating the scores mainly due to the lack of validation of the responses from other source. Longitudinal study planned and conducted to give better insights.

CONCLUSION

Majority of the participants possessed knowledge about MID and demonstrated positive attitude towards MID practice/techniques. Although dearth of the application was observed in their attitudes towards contemporary caries detection methods as many participants still followed traditional caries diagnosis methods. The year of study significantly affected the knowledge acquired by dental interns and students. This difference was more prominent Inter institutional ($p= 0.00$) based on the city where from the participants acquired knowledge.

Hence, need arises to universalize the curricula and reinforce implementation of evidence based learning attitude towards the implementation of MID principles into their clinical practice. Thus, we recommend that dental curriculums in professional institutes be periodically reviewed and updated.

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