

Original Research Article

Assessment of the Knowledge and Attitude of Dental Students and Intern Practitioners about the Nanotechnology in Dentistry at KSA

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	International Archives of Integrated Medicine, Vol. 5, Issue 10, October, 2018. Copy right © 2018, IAIM, All Rights Reserved. Available online at http://iaimjournal.com/	
	ISSN: 2394-0026 (P)	ISSN: 2394-0034 (O)
	Received on: 25-09-2018	Accepted on: 01-10-2018
	Source of support: Nil	Conflict of interest: None declared.
How to cite this article: Ola M. Sakr and Alhablain E.A. Assessment of the Knowledge and Attitude of Dental Students and Intern Practitioners about the Nanotechnology in Dentistry at KSA. IAIM, 2018; 5(10): 87-94.		

Abstract

Background: Nanotechnology can be defined as the science involved in the design, synthesis, characterization, and application of materials and devices whose smallest functional organization in at least one dimension is on the nanometer scale.

Aim: The aim of this cross-sectional study was to assess the knowledge and attitude of dental students and intern practitioners about the nanotechnology in dentistry at KSA.

Materials and methods: An online questionnaire was distributed through the link shared to dental students and intern practitioners via social networking websites. A simple random sample comprised of 306 participants almost distributed across the five geographical regions of Saudi Arabia. The questionnaire was designed to obtain information about the basic knowledge and attitude about nanotechnology being used worldwide for better dental treatment. It consisted of two parts: Part A: Biographic and demographic data of the participants. Part B: Knowledge and Attitude towards nanotechnology in dentistry was focused. Statistical analysis of the data was performed. Frequency distribution and Chi-square analysis were used to determine if there were any relationships and statistically significant differences between knowledge and attitude of nanotechnology in dentistry with biographic and demographic factors.

Results: Out of the 306 participants' response, 213 (69.3%) had heard about the nanotechnology and the main source of information about nanotechnology in dentistry was Internet (32.1%). Only (26.4%) of participants use nanomaterial in their university and (73.6 %) didn't use it. (52.1%) of them strongly disagree with nanotechnology will have a wide application in future.

Conclusion: This study revealed that there is lack of awareness on Nanotechnology application in dentistry among the dental students and intern practitioners at Saudi Arabia.

Key words

Nanotechnology, Nanodentistry, Bioactive composite, Nanorobot, Dentistry, KSA.

Introduction

The concept of nanotechnology was introduced in 1959 by Richard P Feynman, a Nobel winning physicist, with the fundamental idea of employing machines to make even smaller machine tools until we reach the nano, or atomic level [1]. Nanotechnology can be defined as the science involved in the design, synthesis, characterization, and application of materials and devices whose smallest functional organization in at least one dimension is on the nanometer scale [2, 3].

It is an emerging field that has contributed to the development of novel diagnostic and therapeutic agents, with the advantage of enhancing drug accumulation at the site of interest and avoiding side effects common to small molecule drugs [4]. The small size, improved chemical stability and apparent solubility of the encapsulated molecules, as well as the multi functionality of nanoparticles, are features that open up new perspectives for biological research [5]. Nanomaterial properties vary majorly from other materials due to two reasons: the increase in surface area and quantum effects. Nanoparticles due to their small size have a much increased surface area per unit mass compared to bigger particles. In addition, quantum effects become more dominant at the nanoscale [6]. The disadvantages of the use of nanotechnology in dentistry are the high costs of the products and insufficient knowledge about the toxicity of such formulations [7].

One hardly comes across the concepts on nanotechnology or nanodentistry in the curriculum

being followed at different dental education level. A need was felt to carry out a research survey to measure knowledge and attitude application of nanotechnology in the field of dentistry. The rationale of this survey research was to evaluate The Knowledge and Attitude of Nanotechnology in Dentistry among Dental Students and Intern Practitioners at Saudi Arabia.

Materials and methods

A cross-sectional study based on a self-administered online questionnaire was distributed through the link shared to dental students and intern practitioners via social networking websites such as Facebook, Twitter. The data were collected in the period from February 6, 2017 to August 16, 2017. A simple random sample comprised of 306 participants almost distributed across the five geographical regions of Saudi Arabia (central, northern, southern, eastern and western). The participants first and second year BDS students were excluded from this study.

The questionnaire was designed to obtain information about the basic knowledge and attitude about nanotechnology being used worldwide for better dental treatment. All participants who filled the questionnaire were informed about the survey. It consisted of two parts: Part A: Biographic and demographic data of the participants. In this part, information regarding nationality, region, gender, academic level, collage type. Part B: Knowledge and attitude towards nanotechnology in dentistry was focused starting from basic knowledge to some

latest advancement related questions were included.

The data was entered into the computer in an MS Excel sheet. Statistical analysis of the data was performed using the SPSS Window Version 21 Package program (Chicago, IL, USA). Frequency distribution and Chi-square analysis were used to determine if there were any relationships and statistically significant differences between knowledge and attitude of nanotechnology in dentistry with biographic and demographic factors. The significance level for the analysis was set at $p \leq 0.05$.

Results

A sample of 306 participants almost distributed across the five geographical regions of Saudi Arabia (middle, northern, southern, eastern and western) were 122 (39.9%) middle region, 99 (32.4%) south region, 53 (17.3%) west region, 25 (8.2%) east region and 7 (2.3%) north region. The sample consisted of 175 (57.2%) female, and male were 131 (42.8%).

79 (25.8%) 3rd year students, 61 (19.9%) 4th year students, and 90 (29.04%) 5th year students and 76 (24.8%) intern were in the study. Most of participants were governmental collage 257 (84%) and 49 (16%) private collage.

Out of the 306 participants' response, 213 (69.3%) had heard about the nanotechnology and 93 (30.7%) didn't (**Table - 1**) displays their sources of information.

1.4 % of the respondents consider that they had excellent knowledge about the applications of nanotechnology in dental practice. 3.8% thought that they had good knowledge. 24.1% of the respondents assess their knowledge was fair, while 34.4% of the respondents consider their knowledge as a poor and 36.3% consider their knowledge bad.

The nanocomposite takes the higher percentage (29.20%) of dental student and interns'

knowledge the compared to other application (**Chart - 1**). Most of participants didn't know (70%) about the uses of nanorobot in dentistry (**Chart - 2**).

Table - 1: Sources of information about the nanotechnology.

Sources	N	%
Lectures/seminars at the University	106	23.1%
Books	29	6.3 %
Journals	34	7.4%
Newspaper	25	5.5%
Internet	147	32.1%
Radio / TV	42	9.2%
Group mates/ collages	48	10.8 %
Other	27	5.9 %

Distribution of responses of participant's knowledge about the nanotechnology in dentistry and its relation to academic level was as per (**Table - 2**). Distribution of responses of participant's knowledge about the uses of nanotechnology in dentistry and its relation to academic level was as per (**Table - 3**). Distribution of responses of participant's knowledge about the safety of nanotechnology in dentistry was as per (**Table - 4**).

Only (26.4%) of participates use nanomaterial in their university and (73.6 %) didn't. (52.1%) of them strongly disagree with nanotechnology will have a wide application in future (**Table - 5**). Most of participants (92.2%) want to get more information about the application of nanotechnology in dentistry.

Discussion

Knowledge is usually necessary to make intelligent decisions upon which to act. This is the first study to survey the knowledge and attitude of nanotechnology in dentistry among dental students and intern practitioners at Saudi Arabia. A simple random sample comprising of 306 participants distributed across the five geographical regions of Saudi Arabia (middle, northern, southern, eastern and western). The

data collection instrument was an online questionnaire. This method was an appropriate way of gaining information from a large number of population and increasing sample size [8, 9]. Also, it kept the time with lower cost. Providing online questionnaire allowed respondents to answer questions in their own time and decreased

bias created in interviews where random and systematic error can occur [10]. However, using a questionnaire rather than interviews to gain information relies on respondents being honest in their answers. Data is also limited by the questions provided and answers given.

Chart.1: Which of the following applications of nanotechnology do you think used in dentistry?

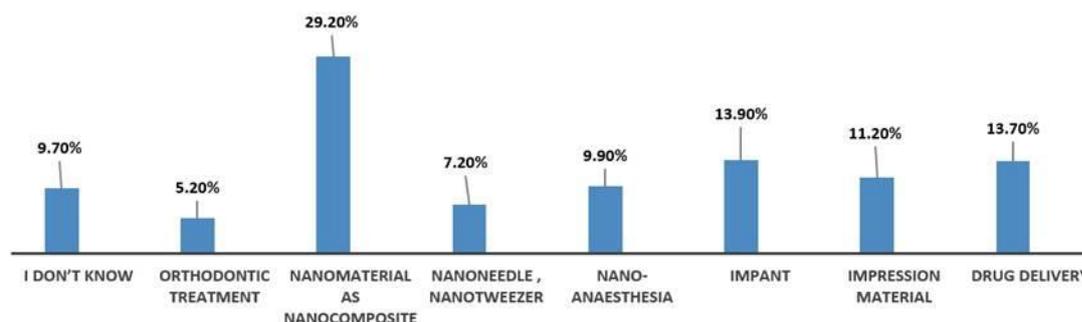


Chart.2: Do you know about the uses of nanobots in dentistry?

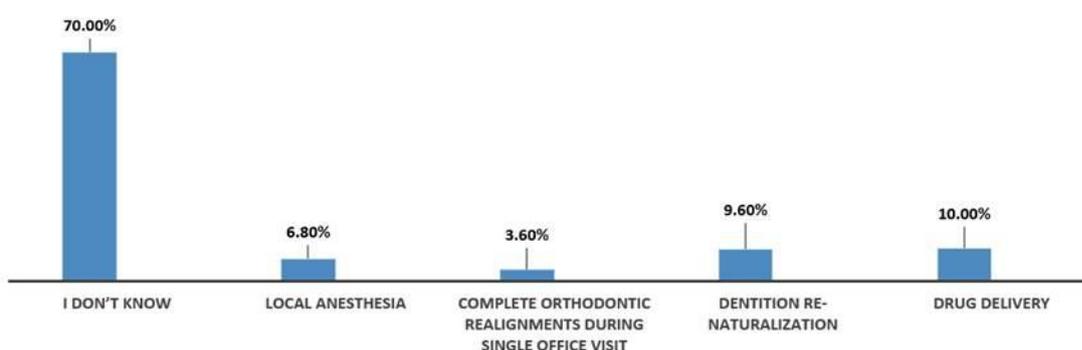


Table - 2: The distribution of responses of participant's knowledge about the nanotechnology in dentistry and its relation to academic level.

	Third, n (%)	Fourth, n (%)	Fifth, n (%)	Intern, n (%)	Total, n (%)	Significance
1-Nanoparticles in dentistry are described as particles that are less than 100nm in size.						
I agree	18 (39.1)	16 (42.1)	29 (44.6)	27 (42.9)	90 (42.5)	P=0.990
I don't agree	4 (8.7)	4 (10.5)	7 (10.8)	5 (7.9)	20 (9.4)	
I don't know	24 (52.2)	18 (47.4)	29 (44.6)	31 (49.2)	102(48.1)	
2-Nanoparticles are more toxic than the larger particles of the same material.						
I agree	4 (8.7)	4 (10.5)	4 (6.2)	11 (17.5)	23 (10.8)	P=0.310
I don't agree	26 (56.6)	20 (52.6)	33 (50.8)	24 (38.1)	103(48.6)	
I don't know	16 (34.8)	14 (36.8)	28 (43.1)	28 (44.4)	86 (40.6)	
3-Due to their small size nanoparticles can penetrate tissues and cells easier than larger particles of the same material.						
I agree	32 (69.6)	28 (73.7)	47 (72.3)	40 (63.5)	147(69.3)	P=0.411
I don't agree	4 (8.7)	1 (2.6)	2 (3.1)	8 (12.7)	15 (7.1)	
I don't know	10 (21.7)	9 (23.7)	16 (24.6)	15 (23.8)	50 (23.6)	

Table - 3: The distribution of responses of participant's knowledge about the uses of nanotechnology in dentistry and its relation to academic level.

	Third, n (%)	Fourth, n (%)	Fifth, n (%)	Intern, n (%)	Total, n (%)	Significance
1-Nanoparticles are already being used in:						
A. Tooth pastes						
Yes	15 (32.6)	9 (23.7)	19 (29.2)	26 (41.3)	69 (32.5)	P=0.627
No	7 (15.2)	6 (15.8)	12 (18.5)	10 (15.9)	35 (16.5)	
I don't know	24 (52.2)	23 (60.5)	34 (52.3)	27 (42.9)	108(50.9)	
B. Mouth Rinses						
Yes	4 (8.7)	4 (10.5)	10 (15.4)	11 (17.5)	29 (13.7)	P=0.662
No	13 (28.3)	8 (21.1)	15 (23.1)	10 (15.9)	46 (21.7)	
I don't know	29 (63)	26 (68.4)	40 (61.5)	42 (66.7)	137(64.6)	
C. Resin composites						
Yes	28 (60.9)	33 (86.8)	55 (84.6)	54 (85.7)	170 (80.2)	P=0.010
No	2 (4.3)	0 (0.0)	1 (1.5)	3 (4.8)	6 (2.3)	
I don't know	16 (34.8)	5 (13.2)	9 (13.8)	6 (9.5)	36 (17)	
D. Bonding systems						
Yes	23 (50)	25 (65.8)	44 (67.7)	50 (79.4)	142 (67)	P=0.016
No	2 (4.3)	0 (0.0)	5 (7.7)	1 (1.6)	8 (3.8)	
I don't know	21 (45.7)	13 (34.2)	16 (24.6)	12 (19)	62 (29.2)	
2- Nanoparticles can improve the endodontic and prosthodontics filed with:						
A. Endodontic sealers						
Yes	24 (52.2)	19 (50)	47 (72.3)	44 (69.8)	134 (63.2)	P=0.086
No	4 (8.7)	3 (7.9)	2 (3.1)	6 (9.5)	15 (7.1)	
I don't know	18 (39.1)	16 (42.1)	16 (24.6)	13 (20.6)	63 (29.7)	
B. Root canal disinfection						
Yes	15 (32.6)	12 (31.6)	33 (50.8)	36 (57.1)	96 (45.3)	P=0.062
No	8 (17.4)	4 (10.5)	7 (10.8)	8 (12.7)	27 (12.7)	
I don't know	23 (50)	22 (57.9)	25 (38.5)	19 (30.2)	89 (42)	
C. Impression materials						
Yes	16 (34.8)	15 (39.5)	22 (33.8)	28 (44.4)	81 (38.2)	P=0.890
No	8 (17.4)	6 (15.8)	11 (16.9)	7 (11.1)	32 (15.1)	
I don't know	22 (47.8)	17 (44.7)	32 (49.2)	28 (44.4)	99 (46.7)	
D. Nano-composite denture teeth						
Yes	23 (50)	24 (63.2)	41 (63.1)	38 (60.3)	126 (59.4)	P=0.597
No	3 (6.5)	1 (2.6)	6 (9.2)	5 (7.9)	15 (7.1)	
I don't know	20 (43.5)	13 (34.2)	18 (27.7)	20 (31.7)	71 (33.5)	
3- Do you think the nanotechnology is useful in management of periodontal disease by drug delivery?						
Yes	18 (39.1)	17 (44.7)	30 (46.2)	31 (49.2)	96 (45.3)	P=0.809
No	4 (8.7)	1 (2.6)	3 (4.6)	2 (3.2)	10 (4.7)	
I don't know	24 (52.2)	20 (52.6)	32 (49.2)	30 (47.6)	106 (50)	
4- Do you think the implant success can be affected by using the Nano-titanium implant?						
Yes	19 (41.3)	14 (36.8)	40 (61.5)	40 (63.5)	113 (53.3)	P=0.012
No	1 (2.2)	2 (5.3)	0 (0.0)	4 (6.3)	7 (3.3)	
I don't know	26 (56.5)	22 (57.9)	25 (38.5)	19 (30.2)	92 (43.4)	

Table - 4: The distribution of responses of participant's knowledge about the safety of nanotechnology in dentistry.

	Strongly disagree, n (%)	Disagree, n (%)	Agree, n (%)	Strongly agree, n (%)	I don't know, n (%)
1-In my opinion nanotechnology in dentistry can help to:					
a. Diagnose diseases	18 (8.5)	35 (16.5)	63 (29.7)	23 (10.8)	73 (34.4)
b. Prevent and cure diseases	19 (9)	19 (9)	89 (42)	33 (15.6)	52 (24.5)
c. Improve dental materials	29 (13.7)	6 (2.8)	65 (30.7)	91 (42.9)	21 (9.9)
2-In my opinion restorative dental nanoparticles:					
a. can cause allergy	17 (8)	76 (35.8)	48 (22.6)	2 (0.9)	69 (32.5)
b. are dangerous for human health	31 (14.6)	90 (42.5)	27 (12.7)	1 (0.5)	63 (70.3)
c. are dangerous for environment	24 (11.3)	93 (43.9)	27 (12.7)	0 (0.0)	68 (32.1)
3-In my opinion, use of restorative dental nanoparticles:					
a. Will improve the quality of treatment in my future dental practice	20 (9.4)	8 (3.8)	89 (42)	76 (35.8)	19 (9)

According to our results, the little of respondents (69.3%) have heard about the nanotechnology while (30.7%) didn't which was higher result compared to other studies were done by Daoutsali E. [11] (13%) and Karen M. [12] (25%) of the students stated have never heard of nanotechnology. Analysis of the source of nanotechnology in dentistry knowledge revealed that Internet was the main source of information (**Table - 1**). Internet is repeated frequently and therefore can reach a wide public. Retzbach, et al. (2011) reported that the public, who had some knowledge, got it mainly from TV and the Internet [13]. On the other hand, the books and articles in newspapers accounted the lowest source of information about nanotechnology in dentistry for only (6.3%, 5.5%) which is probably due to lack or infrequent publication of such information in this form of media.

According to the thinking of the participants about the application of nanotechnology in dentistry, most of them agreed for nanomaterial as nanocomposite more than other applications. For nanorobot uses most of the dental students and intern practitioners didn't have any idea about its' uses. That also was conformed in last study done by Ali S. [14] (92.7%) of participants not familiar with nanorobot.

Table - 5: Agreement the participants about nanotechnology will have a wide application in future.

	N	(%)
Strongly disagree	7	3.3%
Disagree	5	2.3%
Neutral	40	18.8%
Agree	50	23.5%
Strongly agree	111	52.1%
Total	213	100%

The development in the use of nanocomposites patented in response to the persistent and discouraging issues of polymerization shrinkage, strength, microhardness, and wear resistance essential in posterior occlusive applications [15]. In our result there was significance difference in two points in relation to academic level of participants: use of nanoparticles in (Resin composites, Bonding systems), (P= P=0.010, P=0.016), which the fifth year students and intern practitioners' higher knowledge than other levels.

In addition, there was significance difference with "implant success can be affected by using the Nano-titanium implant?" in relation to level of participants (P=0.012), also the higher level

had more knowledge than others. Titanium nanopores have many advantages over conventional implants since they are more resistant because of their lower elastic modulus and improved mechanical adhesion to the bone, permitting the deposition of cells inside the nanopores [16, 17].

High percentage of the participants didn't have opinion about the dangerous of nanotechnology in dentistry for human health and environment. While (73.8%) of responses unsure about the nanotechnology cause some environmental problems [12]. On other hand, Sahin N.s' their participants think the benefits of nanotechnology more to the risks [18].

Most of participants (92.2%) want to get more information about the application of nanotechnology in dentistry. Also Daoutsali E. [11] (70%) of participants want to get more about this filed. There is a potential need for more teaching of nanotechnology in dentistry in dental schools.

Conclusions

This study reveals that there is lack of attention to Nanotechnology application in dentistry amongst the dental students and intern practitioners at Kingdom of Saudi Arabia. Nevertheless, despite lack of attention to nanotechnology application in dentistry amongst dental students and intern practitioners, there is a great interesting to learning nanotechnology and its application in dentistry.

Therefore, this study is just one step in that direction to stress on the need of realizing importance of knowledge, attitude and practice towards use of nanotechnology in dentistry. It can be expected in future that the science of dental materials may change significantly with better understanding and the introduction of new Nano biomaterials.

Acknowledgment

The authors would like to thank Dr. Ebtihal Alguraid (BDS, College of Dentistry, Qassim University, Kingdom of Saudi Arabia) for her help in proposal writing and questionnaire preparing.

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