

# Nanotechnology Knowledge and Attitude among Undergraduate Dental Iraqi Students

Zainab Mahmood Al-Jammali<sup>1</sup>, Anas Moez Al-Yasiry<sup>2</sup>, Azad Mohamed AlMuthaffer<sup>1</sup>

<sup>1</sup>Lecturer, Department of Prosthodontics/ College of Dentistry, University of Babylon, Iraq,

<sup>2</sup>Lecturer, Department of Basic Science, University of Babylon, Iraq

## Abstract

**Objective:** Nanotechnology is “a term that involve a spectrum of technologies, techniques and processes that can deal with a matter at the nanoscale”. Many new diagnostic modalities and nano-delivery systems that have been introduced by improvement of the materials mechanical and physical properties’ in the field of dentistry. The aim of study was to evaluate undergraduate dental student perceptions of nanotechnology in Iraq. **Method:** This study was based on an online questionnaires distributed to students of dentistry for the five stages, a number of students (417), the questioner include general information and then questions distributed into four axes. The generation of a single variable in the second, and third axes was analyzed by five point of Likert scale. **Result:** 58% of students had an idea about nanotechnology, while 42% of students did not had an idea about nanotechnology. the largest percentage of students have difficulties in accessing information about nanotechnology. The largest percentage of the student want to introduce the nanotechnology in the curriculum, also largest percentage of the student wish to search information about the nanotechnology and support the use of nanotechnology in clinic. **Conclusion:** Based on the results of this study, the dental students of University of Babylon have inadequate knowledge about nanotechnology and its applications in field of Dentistry. We think that the incorporation of nanotechnology in the dentistry curriculum of colleges in Iraq was mandatory.

**Key word:** nanotechnology, dentistry field, dental student, curriculum, awareness.

## Introduction

Nanotechnology is “a term that involve a spectrum of technologies, techniques and processes that can deal with a matter at the nanoscale – fall in between 1 nanometer to 100 nanometers in size”. [1] Many new diagnostic modalities and nano-delivery systems that have been introduced by improvement of the materials mechanical and physical properties’ in the field of dentistry and medicine [2]

The nanoscale is using to measure atoms which are consider the building blocks in biological tissue. An interaction on a molecular level can be produced by introducing nano-sized particles and this will result in increasing the total effectiveness and affinity when compared to interacting of biological molecules with micro or macro sized particles [3]. In the nanoparticle,

there are more atoms on the surface than deep within its core, this due to the high surface to core ratio which is a unique physical characteristic for nanoparticles. And this physical characteristic is useful because the atoms on the surface have unbound when compare with atoms on the core, and have a potential for making new and strong bonds, and this why the nanoparticles are more reactive when compare with micro and macro particles which have more atoms with its core than that on the surface.[4]

In the field of prosthodontics, nanoparticles and nanotechnology has been incorporated in numerous aspects of removable and fixed prosthodontics. Addition of metal oxide nanoparticles to conventional PMMA ( polymethyl methacrylate) will improve the flexural strength, antimicrobial property and reduced porosity , and the addition of carbon nanotubes into heat cure

monomer will reduce the polymerization shrinkage and also the mechanical properties will improve [5]

Incorporation of silver and platinum nanoparticles into the denture base materials which is considered as an effective antimicrobial agent that acting by improving the viscoelastic property of resins, and this will prevent many oral pathological condition like denture stomatitis which is caused by adherence of biofilm onto the denture base of the prosthesis [6-8]

The impression materials like vinyl poly siloxanes can produce with improved hydrophilic properties because of fewer voids at margin, better model pouring and with better flow by integrations of nanofillers. [9]

The use of silica nanofiller nanotechnology contributes to higher bond strength performance and provides a stable, filled adhesive. When used as coating agent over esthetic restorations, it produces stain and wear resistant surface with smooth luster [10,11]

Though, a study to evaluate undergraduate dental student in Dentistry perceptions of nanotechnology has never been achieved in Iraq. So, to assess their awareness and concern about nanotechnology, we conducted this survey and its purposes were: 1) to understand students' awareness concerning nanotechnology; 2) to understand the students' need for suitable information and education about nano materials; and 3) to understand students' needs for developing suitable statement about the applications and risks of nano materials.

## Method

This study was based on an online questionnaires distributed to students of dentistry for the five stages from the first to the fifth stage in the College of Dentistry/ University of Babylon during (June-July) 2020 and the way of choosing the sample was stratified random sampling. The participation included a number of students (417), the age range was 18-23 years old, included both gender males(166) and females (251), the questioner include general information and then questions distributed into four axes: first; evaluation of students' general nanotechnology knowledge, second; evaluation of knowledge concerning the application of nanotechnology in the field of dentistry, third; assessment of attitude to learn and know more about the nanotechnology, fourth; to know the student attitude about the source of information he/she prefer about nanotechnology (table 1). The generation of a single variable in the second and third axes was analyzed by five point of Likert scale (scoring as 5 = strongly agree to 1 = strongly disagree). A pilot study was conducted on 50 students to evaluate the questionnaire questions reliability by cronbach's alpha test and validity was analyzed by Pearson's correlations. The result of pilot study was excluded from the study. Ethical approval was obtained from the Institutional Review Board (IRB) and the Scientific Committee of Prosthodontics in College of Dentistry/University of Babylon.

**Table (1):Questionnaire – Nanotechnology knowledge and attitude among dental students in Iraq (2-3 min.)**

|   |
|---|
| Demographic information<br>.<br>What is the year of study? (1st , 2nd , 3rd , 4th, and 5th ).<br>.<br>What is the sex? (Male and female). |
| First axes: evaluation of students' general nanotechnology knowledge<br>Do you have an idea about nanotechnology? (Yes, No)               |

**Cont... Table (1):Questionnaire – Nanotechnology knowledge and attitude among dental students in Iraq (2-3 min.)**

|   |   |
|---|---|
| <p>Second axes: evaluation of knowledge concerning the application of nanotechnology in the field of dentistry:</p>   |   |
| 1.  | Do you think that you have enough information about nanotechnology, nanoparticles and nanomedicine to enable you to attend and understand a scientific panel discussion on the topic? |
| 2.  | You think you have a sufficient understanding about the application of nanotechnology used in the Dentistry field.  |
| 3.  | There are difficulties in accessing information about what nanotechnology is and its applications in dental sciences due to the novelty of the topic.                                 |
| 4.  | The incorporation of nanoparticles into composite fillings and dental materials in general improves their properties.   |
| 5.  | You think nanotechnology treatment does not cause long-lasting side effects.  |
| 6.  | The applications of nanotechnology have a used effectively in dentistry field sciences at the present time.   |
| <p>Third axes: assessment of attitude to learn and know more about the nanotechnology:</p>  |   |
| 1.  | Promoting nanotechnology education in medical colleges improves the efficiency of services provided in the future.  |
| 2.  | you supports the inclusion of essentials of nanotechnology topics in the curriculum .   |
| 3.  | Enhancing the role of the media, research centers and scientific studies to provide and disseminate information about nanotechnology and its effects on society.                      |
| 4.  | You had some knowledge about nanotechnology and now, you are being eager to learn more.   |
| 5.  | You will actually use nanotechnology in your clinical work if it is already proven that is greatly improves the work.   |
| 6.  | After this survey, you will review your information and search for additional information on a broader and deep understanding of nanotechnology.                                      |
| <p>Fourth axes: the student attitude about the source of information preferences:<br/>The source that provide you a reliable and scientific information about nanotechnology will be:</p> |   |
| .   | The college and its seminars and conferences.   |
| .   | Browse to scientific sites specialized in nanotechnology.   |
| .   | Science journals, cultural magazines, scientific programs and reports.  |
| .   | All of them.  |

### Statistical analysis

Data were analyzed by using Statistical Package for Social Studies (SPSS 22; IBM Corp., New York, NY,USA), percentages and frequencies were used to expresses the variables.

### Result

Distribution of the dental students studying at University of Babylon is listed in table (2) which showing that the least number of the student responses (58) were for fifth year students and the largest number (122) were for first year of the study. The majority of the sample were female (60.2%).

Regarding evaluation of students’ general nanotechnology knowledge , 58% of students had an idea about nanotechnology, while 42% of students did not had an idea about nanotechnology (fig. 1).

The second axes of the questioner, regarding evaluation of knowledge concerning the application of nanotechnology in the field of dentistry, the student answered six questions, first question: do you think that you have enough information about nanotechnology, to enable you to attend and understand a scientific panel discussion on the topic, the largest percentage of student answers were disagree (33.3%), the second question: you think you have a sufficient understanding about the application of nanotechnology used in the dentistry field, the largest percentage of student answers were

disagree (42.4%), the third question: about difficulties in accessing information about nanotechnology, the largest percentage answers' agree (36.7%). The last three questions, which are direct about material and its applications and the side effects, the largest percentage of student answers were neutral (table 3).

The third axes of the questioner, regarding assessment of attitude to learn and know more about the nanotechnology, the student also answered six questions, the first and second questions given to see if the student want to introduce the nanotechnology in the education system (curriculum), and the largest percentage were agree (40.3%, 41.2% ) and strongly agree (33.3%, 27.8% ) respectively. The third, fourth and sixth questions given to see if the student wish to search information about the nanotechnology and largest percentage were agree (46.3%, 40.0%, 44.4%) and strongly agree (28.5%, 22.1%, 24.7%) respectively. The fifth question about the use of nanotechnology in clinic, the largest percentage of students (about 75%) believe that the use of nanotechnology in work and clinic will improve performance by a high rate (36.9 % were agree and 38.1% were strongly agree) (table 4).

Figure (2) shows the source that the student prefer to search for reliable and scientific information about nanotechnology, largest percentage were for fifth (66% ) and forth stage (64.9%) prefer browsing to scientific sites specialized in nanotechnology, while the first three stages prefer the college and its seminars and

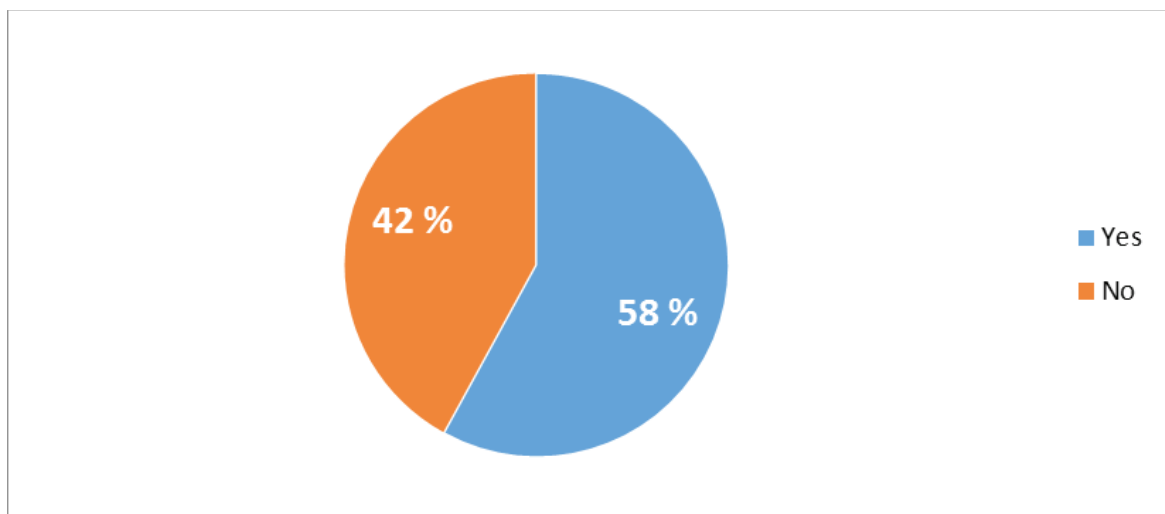
conferences (first stage 63.1%, second stage 58.6% and third stage 64.4%) .

Table (5) the Relative Importance Index (RII) for the questions shows the highest importance paragraphs the students liked are their belief that promoting nanotechnology education in medical colleges improves the efficiency of services and also the use nanotechnology in your clinical work is greatly improves the work, while the lowest importance paragraphs were that the student have enough information about nanotechnology and sufficient understanding about its application in Dentistry field.

Cronbach's alpha for the variables regarding attitudes towards nanotechnology was also measured that showed the internal consistency and reliability of the questionnaire. The second axes with Cronbach's alpha test for reliability equal 0.696 and the third axes with Cronbach's alpha test for reliability equal 0.886, it equal or more than 0.70 that mean the question is really and the questionnaire is stronger [12]. Also Pearson correlation coefficient for the questions of the second axis were (0.670, 0.670, 0.525, 0.723, 0.723, 0.723) and for the third axis questions (0.843, 0.824, 0.842, 0.765, 0.780, 0.747), the correlation is significant at the 0.01 level(2-tailed). Pearson correlation coefficient near to 0.5 that mean there is moderate relationship between them.

**Table (2): distribution of study sample:**

|                      | Number | Percentage |
|----------------------|--------|------------|
| <b>Year of study</b> |        |            |
| 1st stage            | 122    | 29.3%      |
| 2nd stage            | 87     | 20.9%      |
| 3rd stage            | 73     | 17.5%      |
| 4th stage            | 77     | 18.5%      |
| 5th stage            | 58     | 13.9%      |
| <b>Gender</b>        |        |            |
| Male                 | 166    | 39.8       |
| Female               | 251    | 60.2       |



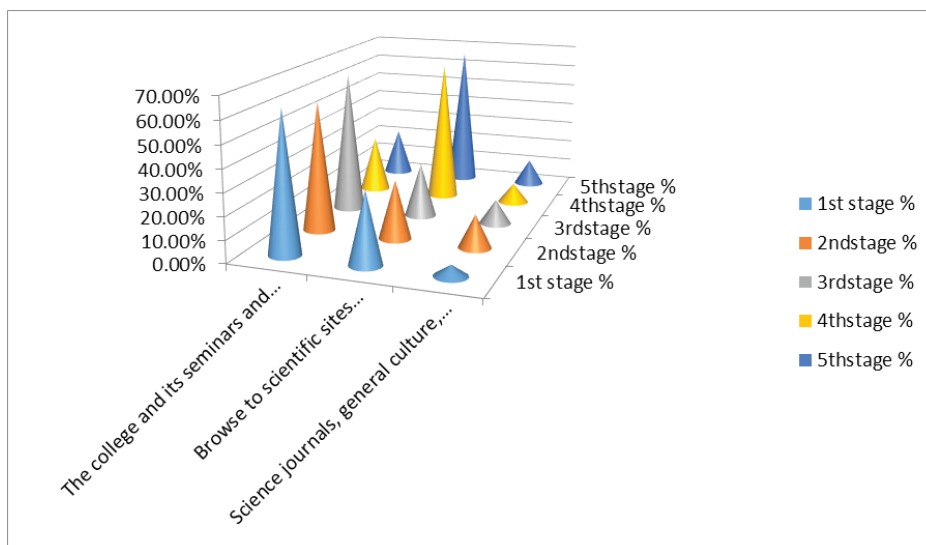
**Figure (1): First axes: Do you have an idea about nanotechnology?**

**Table (3): 2<sup>nd</sup> axes; evaluation of knowledge concerning the application of nanotechnology in the field of dentistry:**

| Type of question   | Strongly disagree (%) | Dis agree (%) | neutral (%) | agree (%) | Strongly agree (%) |
|--|-----------------------|---------------|-------------|-----------|--------------------|
| 1.Do you think that you have enough information about nanotechnology, to enable you to attend and understand a scientific panel discussion on the topic. | 12.9                  | 33.3          | 29.0        | 20.6      | 4.1                |
| 2.You think you have a sufficient understanding about the application of nanotechnology used in dentistry field.   | 10.8                  | 42.4          | 29.0        | 15.1      | 2.6                |
| 3.There are difficulties in accessing information about what nanotechnology is and its applications in dental sciences due to the novelty of the topic.  | 5.8                   | 11.0          | 30.7        | 36.7      | 15.6               |
| 4.The incorporation of nanoparticles into composite fillings and dental materials in general improves their properties.                                  | 3.1                   | 7.2           | 39.3        | 31.2      | 19.2               |
| 5.You think nanotechnology treatment does not cause long-lasting side effects.   | 4.6                   | 14.1          | 54.4        | 20.4      | 6.5                |
| 6.The applications of nanotechnology have used effectively in dentistry field sciences at the present time.  | 2.4                   | 11.8          | 34.3        | 32.6      | 18.9               |

**Table (4): 3rd axes; assessment of attitude to learn and know more about the nanotechnology:**

| Type of question   | Strongly disagree (%) | Disagree (%) | neutral (%) | agree (%) | Strongly agree (%) |
|--|-----------------------|--------------|-------------|-----------|--------------------|
| 1.Promoting nanotechnology education in medical colleges improves the efficiency of services provided in the future.   | 1.9                   | 3.8          | 20.6        | 40.3      | 33.3               |
| 2.you supports the inclusion of essentials of nanotechnology topics in the curriculum .  | 4.6                   | 5.3          | 21.1        | 41.2      | 27.8               |
| 3.Enhancing the role of the media, research centers and scientific studies to provide and disseminate information about nanotechnology and its effects on society. | 2.9                   | 3.4          | 18.9        | 46.3      | 28.5               |
| 4.You had some knowledge about nanotechnology and now, you are being eager to learn more.  | 4.8                   | 9.1          | 24.0        | 40.0      | 22.1               |
| 5.You will actually use nanotechnology in your clinical work if it is already proven that is greatly improves the work.  | 2.2                   | 3.1          | 19.7        | 36.9      | 38.1               |
| 6.After this survey, you will review your information and search for additional information on a broader and deep understanding of nanotechnology                  | 2.9                   | 5.0          | 23.0        | 44.4      | 24.7               |



**Figure (2): the student attitude about the source of information preferences.**

**Table 5: Relative Importance Index (RII) for the questions:**

| No. | Type of question  | Importance level | RII  |
|-----|---|------------------|------|
| 1   | Do you think that you have enough information about nanotechnology, nanoparticles and nanomedicine to enable you to attend and understand a scientific panel discussion on the topic? | Moderate         | 0.54 |
| 2   | You think you have a sufficient understanding about the application of nanotechnology used in the Dentistry field.  | Moderate         | 0.51 |
| 3   | There are difficulties in accessing information about what nanotechnology is and its applications in dental sciences due to the novelty of the topic.                                 | Moderate-high    | 0.69 |
| 4   | The incorporation of nanoparticles into composite fillings and dental materials in general improves their properties.   | Moderate-high    | 0.71 |
| 5   | You think nanotechnology treatment does not cause long-lasting side effects.  | Moderate-high    | 0.62 |
| 6   | The applications of nanotechnology have a used effectively in dentistry field sciences at the present time.   | Moderate-high    | 0.71 |
| 7   | Promoting nanotechnology education in medical colleges improves the efficiency of services provided in the future.  | high             | 0.81 |
| 8   | you supports the inclusion of essentials of nanotechnology topics in the curriculum .   | Moderate-high    | 0.76 |
| 9   | Enhancing the role of the media, research centers and scientific studies to provide and disseminate information about nanotechnology and its effects on society.                      | Moderate-high    | 0.79 |
| 10  | You had some knowledge about nanotechnology and now, you are being eager to learn more.   | Moderate-high    | 0.73 |
| 11  | You will actually use nanotechnology in your clinical work if it is already proven that is greatly improves the work.   | high             | 0.81 |
| 12  | After this survey, you will review your information and search for additional information on a broader and deep understanding of nanotechnology.                                      | Moderate-high    | 0.77 |

## Discussion

Nanotechnology science field is an emerging technology and undergraduate students should be curious about this future promising technology. Thus students are expected to be aware of basic nanotechnology science. The questionnaire was distributed to (417) student, all five stages were participated, about 58% of students had an idea about nanotechnology, while 42% of students did not had an idea about nanotechnology and this result differ from the result of Asmaa et al <sup>[13]</sup> study who found 69.7% had heard of nanotechnology, whereas 30.3% had never heard of nanotechnology, and

results of Sakr et al.<sup>[14]</sup> in which 69.3% of participants had heard of nanotechnology. This result may be due to the deficiency in the curriculum about this topic in all study stages or may be it mention in curriculum but briefly.

The second axes of the questionnaire, that include questions to evaluate the knowledge concerning the application of nanotechnology in the field of dentistry, and if the students have enough information enabled him to enter discussion about this subject, the largest percentage of student answers were disagree and this result was similar to Pakistan study's result <sup>[15]</sup> 35% had no idea about the applications of NT, the third question: about difficulties in accessing information about nanotechnology, the largest percentage answers' agree (36.7%) and this result agree with the result of Nagib A et al <sup>[16]</sup> who found that the respondents from medical science 32.25% faced difficulties in obtaining information , this mean the students search about the subject and this subject not included in the curriculum or the information was little. The last three questions, which are directed about material and its applications, the side effects, and uses the largest percentage of student answers were neutral, and this result were disagree with result of H. Albraidi and M. Al-Haddab study <sup>[17]</sup> who found that about 32.7% think that there is a long-term side effects of nanotechnology and about 27.2% answer that nanotechnology was effectively used in the field of medicine. These last three questions were more specific so we notice that the positive response decreased as the questionnaire move towards more specific question

that need a greater level of familiarity with the topic, and this mean that the students can not draw a definitive conclusion because their level of awareness was not enough.

In the third axes of the questionnaire, all the six question put to evaluate the attitude of the students to learn and know more about the nanotechnology, the first and second questions given to see if the student want to introduce the nanotechnology in the education system (curriculum), and the largest percentage were agree and strongly agree (agreement) (81.5%) and (61.1%) respectively, and this result was agree with the study of Nagib A et al <sup>[16]</sup> who found that the about 60% of the participants which consider the majority were strongly supported the introducing of nanotechnology studies idea to the undergraduate curriculum, and also agree with the study of Asmaa et al <sup>[13]</sup> who found that the majority of the students (88.4%) supported the idea of addition of lectures about nanotechnology in the curriculum of academia . This result means that the undergraduate student are eager to know and learn more about this modern technology and its benefits in dentistry field , and this explanation was supported by study of Chow L and Chia Sung <sup>[18]</sup> which state that nanotechnology programs have even been designed for the high school level and should implemented in all stages of education, also the RII for introduce the nanotechnology in the curriculum was high that mean the students liked this paragraph .

The third, fourth and sixth questions given to see if the student wish to search information about the nanotechnology and largest percentage were agree (46.3%, 40.0%, 44.4%) and strongly agree (28.5%, 22.1%, 24.7%) respectively. The fifth question about the use of nanotechnology in clinic, the largest percentage of students (about 75%) believe that the use of nanotechnology in clinical work will improve performance and this result agree to the result of Abiodun-Solanke I study<sup>[19]</sup> who found that 91.6% of students believed that the quality of treatment in dentistry will improved by use of nanotechnology, and this will affects the daily life of human and its important applications expected to alter health care in important



ways, also agree with Auplat [20] study who found that life standards of the community members' will improve by nanotechnology as assured by good proportion of the participants. The RII for this question shows the highest importance paragraph the students liked and this means that the undergraduate students want to improve their selves and be in line with evolution of nanotechnology which is a developing part of fundamentally every industry and it has a reflective effect on people lives of in the 21st century.

Finally, about the source of reliable and scientific information that the student prefer to search about nanotechnology, largest percentage were for fifth and forth stages prefer browsing to scientific sites specialized in nanotechnology, , this result may be because the final stage have no time to take courses because this questionnaire made at the ending of the courses so they go to take information from another reliable site such as browsing to scientific sites, while the first three stages prefer the college as lectures in the curriculum or as seminars and conferences .

### Conclusion

Based on the results of this study, the dental students of University of Babylon have inadequate knowledge about nanotechnology and its applications in field of Dentistry. Furthermore, nanotechnology is not effectively used in the dentistry field as they believed. We think that the incorporation of nanotechnology in the dentistry curriculum of colleges in Iraq was mandatory to increase the awareness, knowledge and attitude. Authors of higher education, centers of research, university bodies should stand-in teamwork among themselves and work in the short period to plan and create nanotechnology courses. This research data represented the first step in preparing the input for the development of nanotechnology within the country.

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### References

1. Capon A, Gillespie J, Rolfe M, Smith W. Perceptions of risk from nanotechnologies and trust in stakeholders: a cross sectional study of public, academic, government and business attitudes. *BMC Public Health*. 2015 Dec 1;15(1):424.
2. Kanaparthi R, Kanaparthi A. The changing face of dentistry: nanotechnology. *International journal of nanomedicine*. 2011;6:2799.
3. Li L, Pan H, Tao J, Xu X, Mao C, Gu X, Tang R. Repair of enamel by using hydroxyapatite nanoparticles as the building blocks. *Journal of Materials Chemistry*. 2008;18(34):4079-84.
4. Binns C. *Introduction to nanoscience and nanotechnology*. John Wiley & Sons; 2010 Oct 19.
5. Sree L, Balasubramanian B, Deepa D. Nanotechnology in dentistry — A review. *Int J Dent Sci Res* 2013;1:40-4.
6. Acosta-Torres LS, Mendieta I, Nuñez-Anita RE, Cajero-Juárez M, Castaño VM. Cytocompatible antifungal acrylic resin containing silver nanoparticles for dentures. *International Journal of Nanomedicine*. 2012;7:4777; <http://dx.doi.org/10.2147/IJN.S32391>.
7. Monteiro DR, Gorup LF, Takamiya AS, de Camargo ER, Filho AC, Barbosa DB. Silver distribution and release from an antimicrobial denture base resin containing silver colloidal nanoparticles. *Journal of Prosthodontics: Implant, Esthetic and Reconstructive Dentistry*. 2012 Jan;21(1):7-15; <http://dx.doi.org/10.1111/j.1532-849X.2011.00772.x>
8. Li Z, Sun J, Lan J, Qi Q. Effect of a denture base acrylic resin containing silver nanoparticles on *Candida albicans* adhesion and biofilm formation. *Gerodontology*. 2016 Jun;33(2):209-16; <http://dx.doi.org/10.1111/ger.12142>.
9. Jithin , Amalorpavam V., T. Sreelal, Giri Chandramohan, Aparna Mohan, Allen Jim Hines. New era in prosthodontics nanotechnology.JPID

- The journal of Prosthetic and Implant Dentistry 2019 ; Volume 3 Issue 1,15-19.
10. Sasalawad SS, Sathyajith NN, Shashibhushan KK, Poornima P, Hugar SM, Roshan NM. “Nanodentistry”-The Next Big Thing Is Small. International Journal of Contemporary Dental & Medical Reviews. 2014;2;1-6.
  11. Robert A, Freitas JR. Nanodentistry. Cover Story. J Am Dent Assoc. 2010;131:1559-65.
  12. Nunnally JC. The assessment of reliability. Psychometric theory. 1994;3, p.284-292.
  13. Faden A, AlFouzan N, AlRabeeah M, AlHarbi K, AlAmeel A. Knowledge and Attitude of Dental Students Regarding Nanotechnology in Dentistry. International Journal Dental and Medical Sciences Research (IJMSR) ISSN: 2393-073X Volume 3, Issue 12 .2019; PP 09-13.
  14. Sakr OM, EA A. Assessment of the Knowledge and Attitude of Dental Students and Intern Practitioners about the Nanotechnology in Dentistry at KSA. AIM, 2018; 5(10): 87-94.
  15. Ahmed T, Imdad S, Yaldram K, Raza SM. Awareness and attitude about nanotechnology in Pakistan. Journal of Nano Education. 2015 Jun 1;7(1):44-51.
  16. Elmarzugi NA, Keleb EI, Mohamed AT, Benyones HM, Bendala NM, Mehemed AI, Eid AM. Awareness of Libyan students and academic staff members of nanotechnology. Journal of Applied Pharmaceutical Science. 2014 Jun 1;4(6):11.
  17. Albraid H, Al-Haddab M. Nanomedicine awareness among medical students in Saudi Arabia. Nanopages. 2018 Dec;13(1):19-27.
  18. Lu CC, Sung CC. Effect of nanotechnology instructions on senior high school students. InAsia-Pacific Forum on Science Learning & Teaching 2011 Dec 1 (Vol. 12, No. 2);p1-18.
  19. Abiodun-Solanke IM, Ajayi DM, Arigbede AO. Nanotechnology and its application in dentistry. Annals of medical and health sciences research. 2014;4(3):171-7.
  20. Auplat CA. The Challenges of Nanotechnology Policy Making PART 1. Discussing Mandatory Frameworks. Global Policy. 2012 Nov;3(4):492-500.