Journal of Contemporary Issues in Business and Government Vol. 26, No. 2, 2020
https://cibg.org.au/

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2020.26.02.192

Awareness About Nanoparticle Based Dental Materials

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Abstract: Nanotechnology is the science and technology which brought revolution in the field of medical settings. The extreme small size allows for homogenous deposition leading to a longer future. The nanotech is based on the size of the object, that is less than 10^{-9}. They are either spherical or irregular. Spherical is mostly used because they are extremely homogeneous, henceforth for a longer duration. This provides a working friendly environment. The aim of the study is to create awareness on nano technology in dental restorations. A questionnaire of 15 selective questions were made and circulated among dental students and practitioners. They were asked to fill in. The data was then collected and statistics were done using SPSS. The graphs were drawn and analyzed. The total 100 responses were taken, the data was analysed in SPSS by drawing graphs and piecharts. When comparing the awareness of nanoparticle based dental materials with gender, it was shown that females had a higher level of awareness when compared with males, but (p= 0.858), which was statistically insignificant. Most of the people were aware of nanoparticles and their applications. The reports concluded that the students and the dental practitioners are moderately aware of nanotechnology in dentistry.

Keywords: Dentistry; Nanoparticles; Nanorobots; Bone dysfunction.

INTRODUCTION

Nano dentistry is a branch of science and technology used in diagnosing, treating and preventing oral and dental diseases. They help to achieve anthropometric measurements(1). Nanotechnology is the base for nano dentistry. Even dentures made of nanotechnology has a greater impact(2). The new dental products with nano scale properties are highly used implants and oral hygiene products(3). This is a type which encourages minimally invasive dentistry, hence the caries can be prevented in a greater extent(4). They give a dentist friendly environment and a dentist friendly atmosphere(5). Since the nano tech products are highly expensive the patients will not prefer to have this. But making the patient aware of nano dentistry and the recent developments in it, also plays a crucial role in the era of advanced dentistry(6). This research is to create awareness on nano technology based restorative systems.

Advances in physical properties tackles the issue like polymerisation shrinkage, wear resistance, micro hardness and achieves patient satisfaction(7). The aesthetic appearance is really good when we use nanotechnology restorations. They are specifically selected on colour and they are highly good at homogeneity. They prevent necrosis in the pulp(8). So the aesthetics is really good incase of nano cements. Nanocomposites are excellent forms of tooth correctors. These composites can also be used to seal the dental implant retained prosthesis(8,9). They are used in anterior teeth because they have excellent aesthetics unlike prosthesis.(10). The main use of nanotechnology products is that they have a reduced size, they have a wavelength of visible light, they are highly translucent. These property helps the silicone facial prosthesis to retain magnetically(11). They have high surface area to volume ratio. The molecular interactions are usually high in nano particles which brings us a good bond strength. Mostly all the particles are in the variable dimension(12). The best example can be given as Glass Ionomer Cement, they have an excellent property of chemical bonding, bio compatible and fluoride releasing(13). The shortcomings include aesthetics, prolonged setting reaction, compromised mechanical properties. Addition of cellulose fiber, hydroxyapatite, fluorapatite, nano technologies for reducing short comings(14).

Nano medicine was first introduced by Robert A Fritus, Jr. in 1993. Nanomedicine was an interdisciplinary field, where nano science, nano engineering and technology has a broad scope.. Nano medicine involves all aspects of medicine, and advances in dental implants also included nanocoated implants(14(15) The aim of the

study is to create awareness on nanotechnology among dental students. Hence this could act as a bridge for new inventions.

MATERIALS AND METHODS

Research approach and design: It is a cross sectional survey taken using social media. A questionnaire of 15 questions were made in google forms and they are circulated among the people. They are requested to answer those questions.

Population, Sample, Sampling: The sample size of 100 members, that too dental students and dental practitioners from selected colleges were asked to answer. The data was collected and tabulated on excel sheet and SPSS software was used to analyse the data. The method of representations was by graphs and pie chart. Chi square test and pearson correlation analysis were used, with p value less than 0.05 to be statistically significant.

RESULTS AND DISCUSSION

There were 14 questions in the survey and the data collected using social media were analysed. Statistics were made in SPSS. The analysed data shows that the students and the dental practitioners are moderately aware of nanotechnology in dentistry. They prefer to use nano tech products.

74% of the people are aware of nano technology whereas 26% of the people were unaware (fig 1,15).The size of the nano particle is 10^{-9}which is known by 35.71% of the people whereas 64.29% of the people were unaware of it(16) (fig 2,16).The synthesis of nanoparticles is a crucial method which takes a longer time for the synthesis(17). This can be done by either plasma etching or chemical vapour decomposition(18). Plasma etching is a process of nano particle synthesis by plasma processing. This plasma source is known as etch species, which either be charged (ions) or neutrals (atoms and radicals). The other process is chemical vapour decomposition, the synthesis of nanoparticles is a condensation process that is heating and cooling of the substance(18,19). This changes them to nano form. All the people are aware of the synthesis of nanoparticles but only 64% of the people are aware of both the mechanisms the remaining 36% of the people are aware of either of the methods (fig 3).

74% of the people are aware of nano robots 26% of the people are unaware of it (fig 4). Nano robots and nano devices used for the purposes of maintaining and protecting human bodies against pathogens(20). Nano robots are implemented by using several components such as sensors, activators, controls, power, communication and by interfacing cross-special scales between organic and inorganic systems(20,21) .There are many functions of nano robots, out of which two were given in the question the uses of the nano robot are drug delivery, diagnosis and testing, surgery, gene therapy, cancer detection and treatment, diabetes, etc. 63.64% of the people are aware of the uses of nano robots, whereas 36.36% of the people are not completely aware of the uses of nano robots (fig 5).The nanorobots are the emerging nanotechnologies in dentistry. The most important function of the nanorobots are in the orthodontic treatment(22). They help in molar upright technique. The tipped molar is a frequent situation among orthodontic patients. Molar uprighting into its correct position leads to normalization of the molars(23).

74% of the people are aware of nano robots's molar upright technique usage, 26% of the people are unaware of it (fig 6).75% of the people are aware of nano composites and remaining 25% of the people are unaware of it (fig 7). Nano solutions seek to identify and elaborate the characteristics of engineered nanomaterials that determine their biological hazard(24). 51% of the people are aware of nano solutions and another 49% of the people are unaware of it (fig 8).The main use of nano solutions is to bring homogeneity(25). 76% of the people are aware of it and 24% of the people are unaware of the uses of nano solutions (fig 9).Vinyl polysiloxanes are the impression materials made by nano technologies. Mostly, people don't prefer this because of its cost(26). 63% of the people are aware of Vinyl polysiloxanes whereas the remaining 37% of the people are unaware of it (fig 10). The important function of the nanocomposites includes high strength weight ratio of the carbon fibre or glass fibre reinforced composites, shear strength, high service temperature capabilities(27).

63% of the people are aware of the functions of nanocomposites, remaining 37% of the people are aware but not all the uses of the composites(27,28) (fig 11). Nano zirconia is the main component of the bio implants(29). They are highly bio compatible and highly aesthetic. 39.39% of the people are aware of nano zirconia, 60.61% of the people are unaware of it (fig 12). The surface modifications of the dental implants can be done by nano diamonds. These nano diamonds give friction and they provide retention(30). 69% of the people are aware of nano silica and 31% of the people are unaware of it (fig 13). The light nanoGIC uses includes filing, looting and orthodontic brackets(31). The future of light nanoGIC is superb polish and excellent aesthetics(32). 75% of the people are aware of the uses of light nanoGIC whereas 25% of the people are not fully aware of the uses of light nanoGIC (fig 14). When comparing the awareness of nanoparticle based dental materials with gender, it was shown that females had a higher level of awareness when compared with males, but ($p= 0.858$), which was statistically insignificant. (Table 1 and Figure 15). When comparing the knowledge about the nanoparticle sized

materials with gender, it was shown that females had a higher level of knowledge when compared with males.(p= 0.718), which was statistically insignificant. (Table 2 and Figure 16).

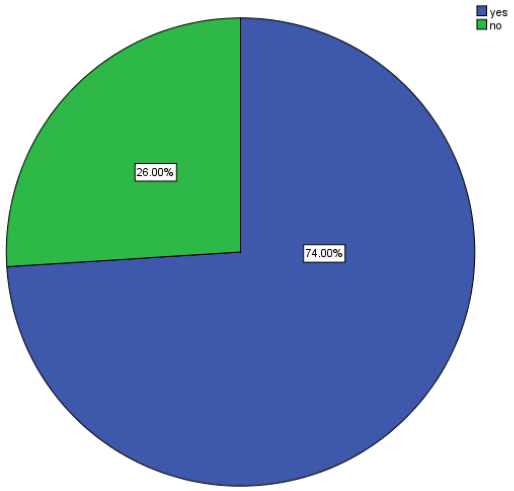

Fig.1: Pie chart showing response to the question," Are you aware of nanotechnology?". Where the blue represents yes (74%) and green represents no (26%)

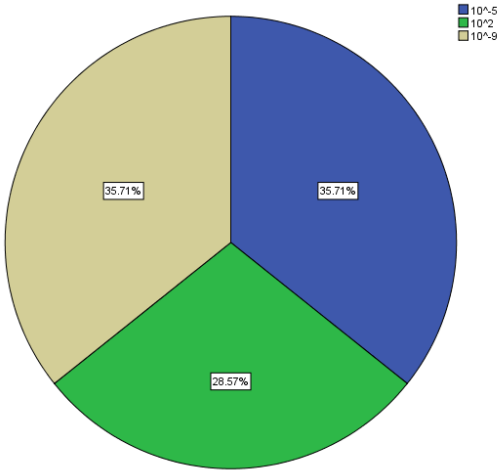

Fig.2: Pie chart showing response to the question,"What is the size of nanoparticle ?", where blue represents 10^{-5}(35.71%), green represents 10^{2}(28.57%) and grey represents 10^{-9}(35.71%)

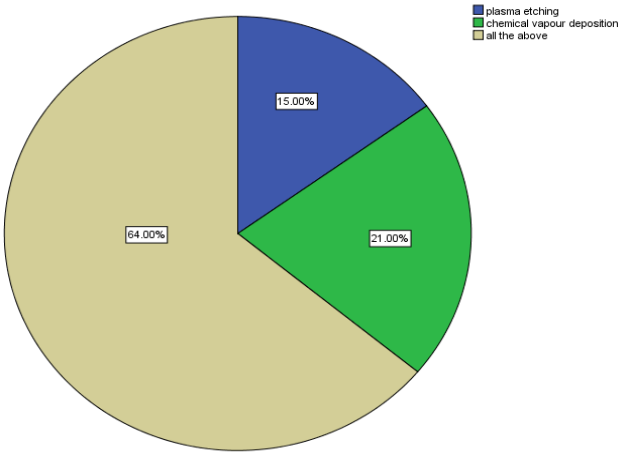

Fig.3: Pie chart showing response to the question,"Name a method for the synthesis of nanoparticles.", blue represents plasma etching (15%), green represents chemical vapour deposition (21%) and grey represents all the above (64%)

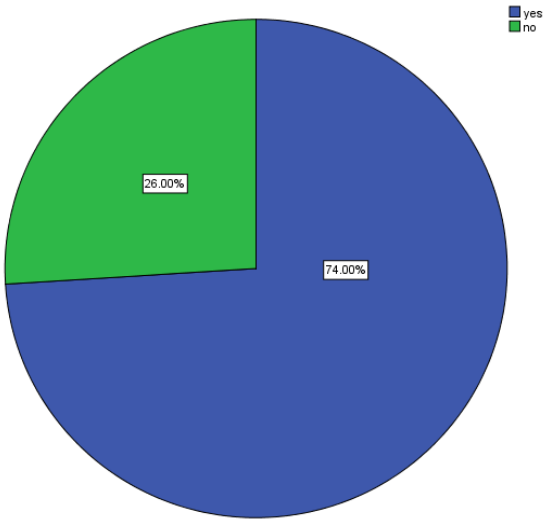

Fig.4: Pie chart showing response to the question," Are you aware of nanorobots ?", where blue represents yes (74%) and green represents no (26%).

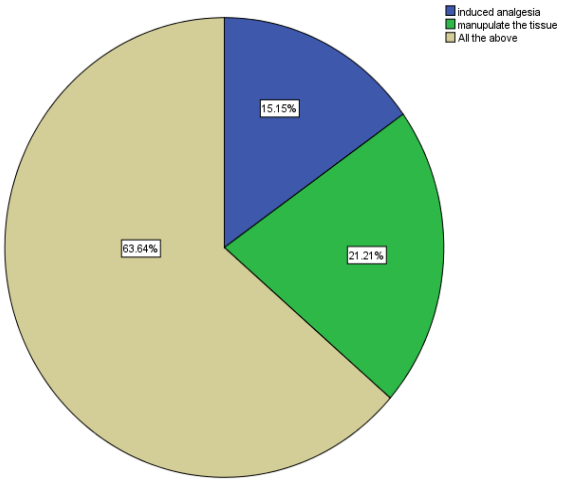

Fig.5: Pie chart showing response to the question,"Name a function of a nanorobot.", where blue represents induced analgesia(15.15%), green represents manipulate the tissue(21.21%) and grey represents all the above (63.64%).

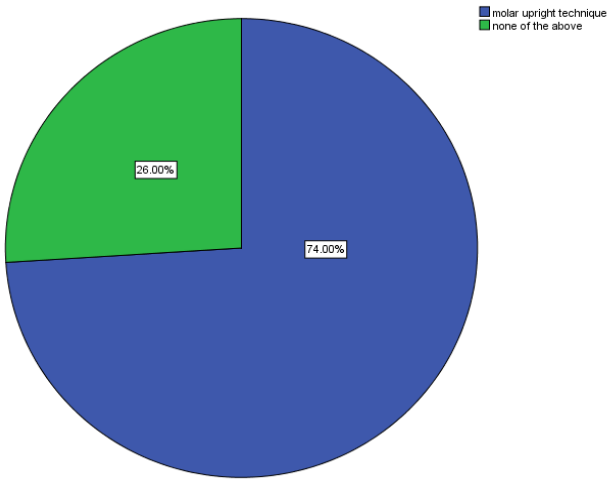

Fig.6: Pie chart showing response to the question," The most important orthodontic treatment done by nanorobot is. " where blue represents molar upright technique (74%) and green represents none of the above (26%).

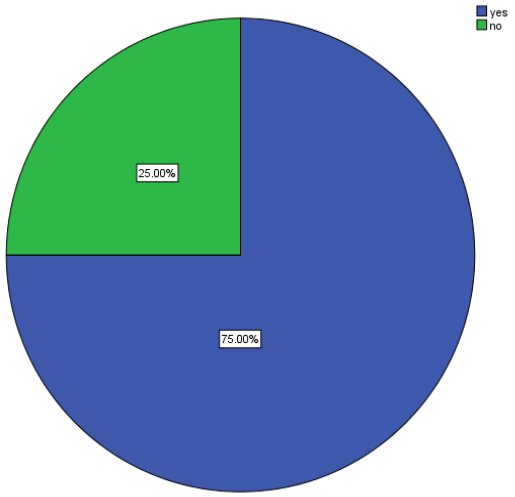

Fig.7: Pie chart showing response to the question,"Do you prefer using nanocomposites?", where blue represents yes (75%) and green represents no (25%).

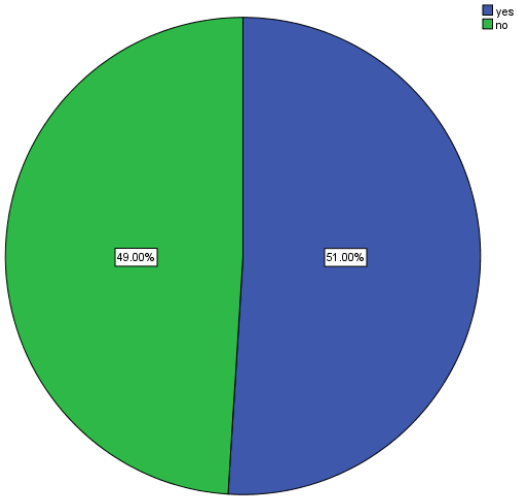

Fig.8: Pie chart showing response to the question," Are you aware of nanosolution ?", where blue represents yes (51%) and green represents no (49%)

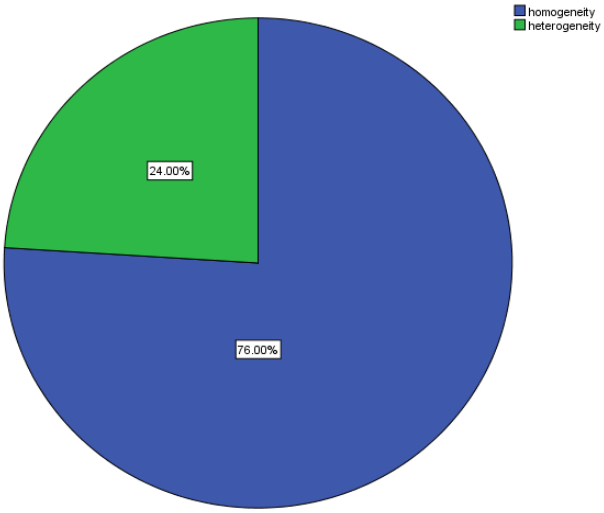

Fig.9: Pie chart showing response to the question,"Nanosolution can be added for", where blue represents homogeneity (76%) and green represents heterogeneity (24%).

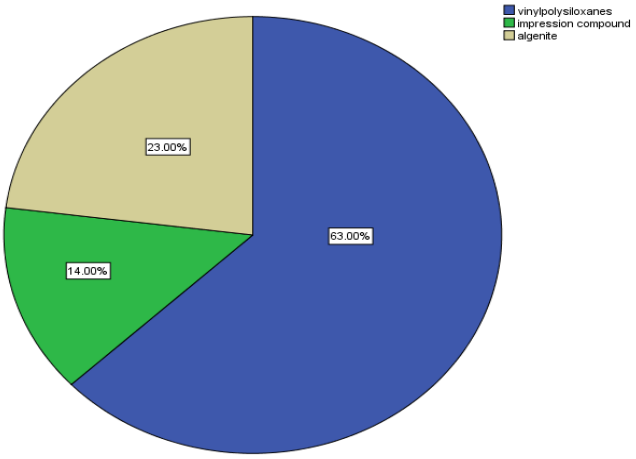

Fig.10: Pie chart showing response to the question,"Name a impression material made of nanotechnology.", where blue represents vinylpoly siloxanes (63%), green represents impression compound (14%) and grey represents alginate (23%).

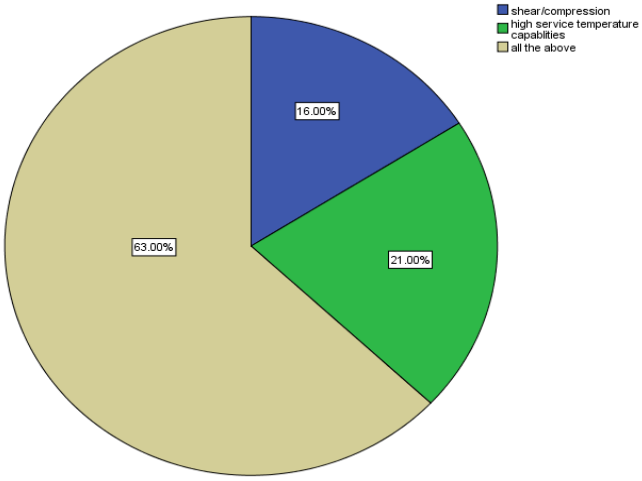

Fig.11: Pie chart showing response to the question,"What is the most important function of nanocomposite?", where blue represents shear/compression(16%), green represents high service temperature capabilities(21%) and grey represents all the above (63%).

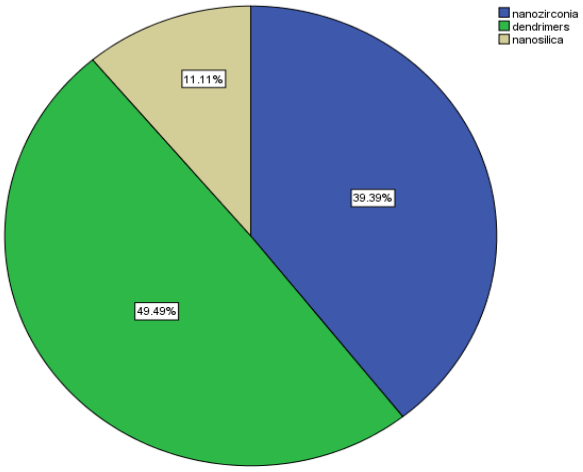

Fig.12: Pie chart showing response to the question," Nanotechnology used in ceramic bioimplants.", where blue represents nano zirconia (39.39%), green represents dendrimers (49.49%) and grey represents nanosilica (11.11%).

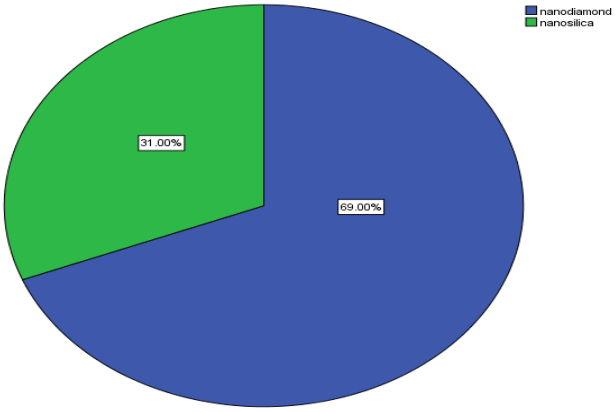

Fig.13: Pie chart showing response to the question,"Nanotechnology used in the surface modification of dental implants.", where blue represents nanodiamonds(69%) and green represents nanosilica(31%).

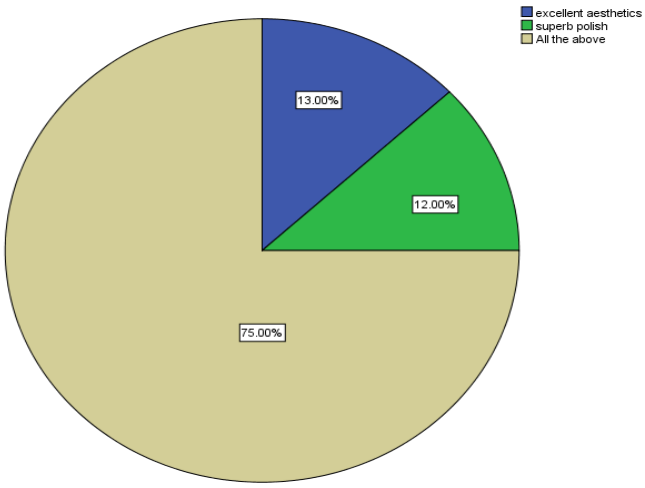

Fig.14: Pie chart showing response to the question," What is the use of nanolight in GIC?"where blue represents excellent esthetics (13%), green represents superb polish (12%) and grey represents all the above(75%).

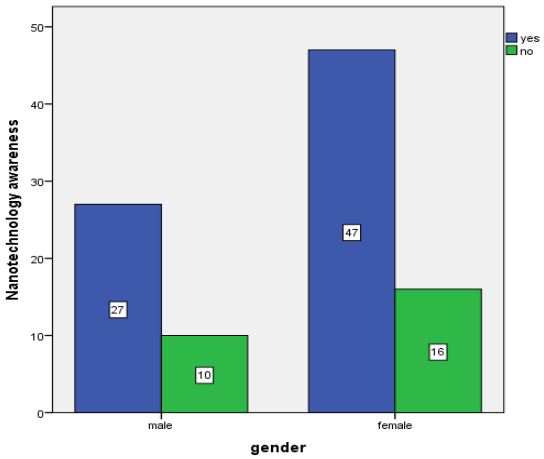

Fig.15: Bar graph depicting comparison of gender and awareness of nanoparticle based dental materials. X axis represents the gender and the Y axis represents the nanotechnology awareness. Blue represents yes and green represents no. Female dental students and practitioners are more aware about nanoparticle based dental materials than male dental students and practitioners. However, this is not statistically significant (Pearson Chi-Square Value: 0.032; p value=0.858)

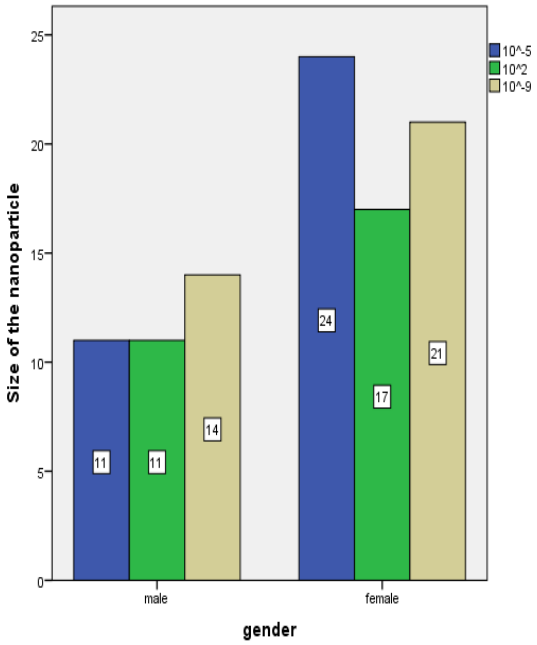

Fig.16: Bar graph depicting the association between gender and knowledge of nanoparticle size. X axis represents the gender and the Y axis represents the awareness on the size of nanoparticle. Where blue represents 10^{-5}, green represents 10^{2} and grey represents 10^{-9} Female dental students and practitioners have more knowledge of nanoparticle size than male dental students and practitioners. However, this is not statistically significant (Pearson Chi-Square Value: 0.663; p value: 0.718)

CONCLUSION

Nanodentistry will make possible the maintenance of comprehensive oral health by employing nanobiomaterials, including tissue engineering and, ultimately, dental nanorobots. In present study, 74% of the study population were aware of nanotechnology based dental materials. Female dental students and practitioners had a higher level of awareness and knowledge about the nanoparticle sized dental materials when compared with males. The study population prefer to use nanotechnology based dental biomaterials. Development of novel modified nanomaterials is definitely going to help to solve the various dental problems. In future, nanotechnology is going to be an essential part of the clinical dental practice.

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