ASSESSMENT OF KNOWLEDGE OF UNDERGRADUATE STUDENTS ABOUT NANOTECHNOLOGY IN DENTISTRY

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ABSTRACT:
Nanotechnology is a science involved within the design, synthesis, characterization and applications of materials and their components at nanoscale dimensions. The present study has been done to assess the knowledge and awareness about nanotechnology in dentistry among undergraduate dental students by distributing 12 questionnaires about nanotechnology among undergraduate dental students. The collected data was supported through SPSS software. The questions were based on knowledge necessary for nanotechnology in dentistry. Out of 100 participants' responses, 59% were aware of nanotechnology and only 67% of participants used nanomaterials within the clinical practice and 72% weren't using it. This study revealed that undergraduate dental students have significant knowledge about nanotechnology.

KEY WORDS: Dentistry; nanodentistry ; nanoparticles ; nanotechnology.

INTRODUCTION:

Nanotechnology is a study about the physical, chemical and biological properties of structures and their components at nanoscale dimensions (Ozak and Ozkan, 2013). Nanotechnology is anticipated to provide advancements in dentistry and innovation in oral health - related diagnostic and therapeutic methods (Kishen, 2015).

Various applications of nanotechnology in dentistry, includes dentition, renaturalization, therapy for dentin hypersensitivity, orthodontics realignment during a single visit (Chen, Henein and Luciani, 2011), (Machusky, 2018). A Range of synthetic nanoparticles such as hydroxyapatite(Menon *et al.*, 2018), bioglass, titanium,zirconium(P *et al.*, 2019), and silver nanoparticles(Karthiga, Rajeshkumar and Annadurai, 2018) are proposed for dental restoration(Rajeshkumar, Kumar, *et al.*, 2018). With the availability of advanced and accurate diagnostic methods, a number of oral diseases can be prevented and treated at early stages (Ogle and Byles, 2014). The disadvantage of nanotechnology(Durán, Guterres and Alves, 2013) in dentistry are the high costs of the products and insufficient knowledge about the toxicity of such formulation (Newberry and Uldrich, 2010; Grumezescu and Oprea, 2017)

As the knowledge about the concept of nanotechnology or nanodentistry in the curriculum is being followed at different education levels(Timp, 1999; Panchbhai, 2019), a need was felt to have a survey on knowledge and awareness or attitude about nanotechnology in dentistry (Mota and Subramani, 2012; Subramani and Ahmed, 2012). The purpose of this study is to ensure comprehensive oral health care if the patient emphasizes the primary prevention of oral diseases (Subramani and Ahmed, 2018; Mirsasaani *et al.*, 2019)

MATERIALS AND METHODS :

A cross sectional study was conducted on self administered online questionnaires was distributed through the link shared to dental students and intern practitioners via social networking websites. 12 questionnaire have taken, certain points covered in questions is divided as 4 - categories,

1. Demographic factors :
- Occupation (dental)
- Year of study
2. Affects : (Pai *et al.*, 2016)
- Uses of nanotechnology
- Safety of nanotechnology
- In relation to academics.
3. Awareness :
- Lack of attention to nanotechnology
4. Changes : (Satyanarayana and Rai, 2011)
- Expected future science of dental materials - change significantly understanding and the introduction of new nanobiomaterials.

The collected data was entered into the computer in an MS excel sheet. Statistical analysis of the data has been performed using the spss software. Descriptive statistical analysis was followed and results are depicted in the form of graphs.

RESULT AND DISCUSSION :

A response of 100 participants were recorded and analysed, 80% of 3rd year students, 20% of 4th year students , 26% of 5th year students and 13% of intern practitioners participated in the study from Saveetha Dental college.

Out of 100 participants,80% - were aware of the concept of nanotechnology.20% were not aware of nanotechnology as shown in figure 1 . Nanotechnology is manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest, widespread description of nanotechnology mentioned the actual technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now mentioned as molecular nanotechnology (kubik T *Website*, no date a et al.,). Nanotechnology has emerged as a promising area of interest in dentistry due to the variety of new treatment options it offers (Rajeshkumar and Naik, 2018; Ponnanikajamideen *et al.*, 2019). The unique properties of nanosized materials (Santhoshkumar, Rajeshkumar and Venkat Kumar, 2017), which are the subject of quantum mechanics (Happy *et al.*, 2019), determine this great interest (Rajeshkumar *et al.*, 2019). The main purpose of using nanotechnologies in dental materials is in achieving better mechanical properties (Happy Agarwal *et al.*, 2018), higher abrasion resistance(Roy *et al.*, 2017) , less shrinkage, and improved optical and aesthetic properties . Till now nanotechnology has been used in the production of a wide range of dental materials, such as light polymerizable composites and their bonding systems, impression materials, ceramics, dental implant coatings, and bioceramics. In addition, titanium nanopores have many advantages over conventional implants since they are more resistant.(Jurczyk, Braegger and Jurczyk, no date; Florczyk, 2007).

The physicochemical properties of nanoparticles shows how they interact with cells. Understanding these properties increase the development of safer nanoparticles. Recent studies have found that some nanoparticles are more toxic than others. Theoretically, particle sizes are likely to contribute to cytotoxicity. Smaller nanoparticles have a larger specific surface area (SSA) and the available surface area interacts with cellular components such as nucleic acids, proteins, fatty acids, and carbohydrates. In

the current study , a questionnaire was asked about the toxicity of nanoparticles among dental students (figure 2), 63.33% responded that they agree that nanoparticles are more toxic than larger particles of the same materials whereas 36.67% disagree with the above statement and in relation with size of nanoparticles (figure 3) 38.33% were aware about the size of nanoparticles that are 1-100 nm whereas 21.67% responded to 2500-10000 nm and 40.00% responded to 1-1000 nm. The smaller size also likely makes it possible to enter the cell, causing cellular damage. For instance, the size of anatase TiO2 was shown to correlate with reactive oxygen species (ROS) production when comparing the amount of ROS production per surface area within a certain size range. Particles below 10 or above 30 nm produced similar levels of ROS per area. However, there was a dramatic increase in ROS production per unit area in particles of size varying from 10 to 30 nm. This information provides insight regarding the complex relationship between nanoparticle properties and nanotoxicity.

Nanotechnology, a technology that deals with objects of nanometer size and the particles are called nanoparticles (NPs). Silver is the frequently used NPs, used in different forms, followed by carbon and titanium oxides (TiO2). The nanoparticle improves the quality of the products by adding many functional groups to it. Therefore nano products are widely used in various industrial sectors, medicine and in the field of dentistry also. One questionnaire conducted among undergraduate students with response to assess the knowledge on uses of nanotechnology in dentistry (Figure 4); Only 20.00% were gave opinion on diagnose disease , 21.67% responded for improve dental materials and 58.33% were responded for nanotechnology in dentistry is used to prevent and cure disease (Rajeshkumar, Agarwal, *et al.*, 2018)

The dental implants are made of biocompatible materials like hydroxyapatite and titanium embedded into the alveolar bone along with an artificial tooth (Anitha and Ashwini, 2017; Ashwini, Ezhilarasan and Anitha, 2017). This implant, mainly, supports the periodontium and forms the structure of the original tissue. Without titanium coating, it may cause dental ankylosis when alveolar bone directly contacts the dental implant (Lakshmi *et al.*, 2015; Sharma *et al.*, 2019) Nanoporous anodic alumina (NAA), porous silicon (pSi) and Titania nanotubes (TNTs) are used for development of drug-releasing implants by anodizing silicon, titanium and aluminum electrochemically (Ezhilarasan, Lakshmi, Vijayaragavan, *et al.*, 2017; Perumalsamy *et al.*, 2018). Nano pores of TNTs, NAA and pSi are developed electrochemically to change the length and shape, the diameter of the pore to develop implants which can release drugs (Ezhilarasan, Lakshmi, Nagaich, *et al.*, 2017; Mehta *et al.*, 2019). Drug-releasing action can be studied by accurately making the nanoporous structure which is based on therapeutic requirements such as drug loading, dosages of the drug, the rate of drug release, etc (Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018).

In recent study S. Priyadarsini et al stated that Nanotechnology is used in the dental field as nano dentistry (Gheena *Website*, no date b et al). While choosing the nanoparticle for the use in the field of nano dentistry its chemical, physical, along with the biological aspect of nanostructures are taken into account (Menon *et al.*, 2018). Often various atoms or molecules are added to form the functional structure. Nanostructures are used in innovations or diagnosis of dentistry. Some nanoparticles are used to treat oral diseases, prostheses and for teeth implantation. In relation with the current study by assessing the knowledge on use of restorative dental nanoparticles causes (figure 5), 33.33% were responded that restorative dental nanoparticles can cause allergy, 53.33% - were responded that it is dangerous for human health and 13.33% were responded that it can cause dangerous for environment among 100 participants of undergraduate dental students. This study shows that 20% of the participants among undergraduate dental students were not aware of the knowledge on nanotechnology in dentistry.

The cross-lagged association between year of study and awareness on nanotechnology, the majority of third years (30.00%) were aware of nanotechnology as shown in figure 6 . In comparison with responses for use of nanoparticles in clinical practices, (figure 7) , majority of third year (25.00%) undergraduate students responded that they use nanomaterials in clinical practices. In comparison with uses and applications of nanotechnology in dentistry (figure 8), the majority of third year (20.00%) undergraduates responded that it is used to prevent and cure diseases. In comparison with the number of responses towards the use of nanotechnology in periodontal diseases (figure 9), the majority of third year (30.00%) responded that they use nanomaterials for management of periodontal diseases. Although on comparison of all responses with year of study, found to be non significant as analysed by chi square test.

CONCLUSION :

The study reveals that the undergraduate dental students demonstrated limited knowledge on the concept of nanotechnology. The main purpose of this study is to ensure comprehensive oral healthcare of the patient and emphasizes the primary prevention of oral diseases. It can be expected in future that the specialization in dentistry ranging, diagnosis and treatment of oral cancers, development of colloid. A suspension containing millions of active analysis micron size dental robots result in anesthesia in patients may develop or change significantly with better understanding and the introduction of new nano-biomaterials.

AUTHOR CONTRIBUTIONS :

All authors in the manuscript have equally contributed in drafting, editing and conceptualisation, proof reading and approval of manuscript.

CONFLICT OF INTEREST :

The author declares no conflict of interest.

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Figures

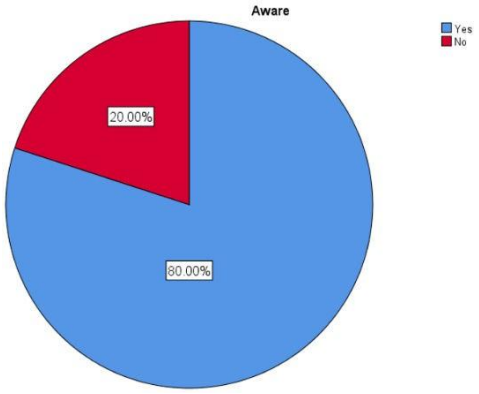

Figure 1: Pie chart representing awareness of nanotechnology. 80% are aware and 20% are not aware.

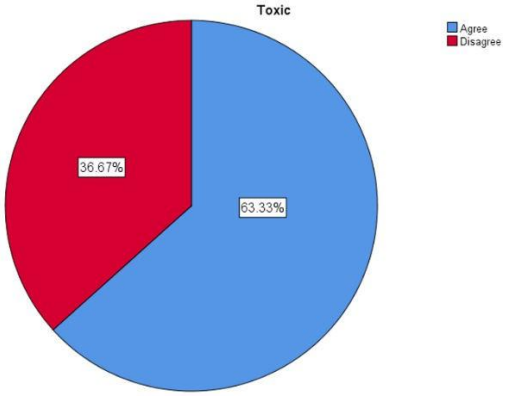

Figure 2 : Pie charts representing nanoparticles are more toxic than larger particles of the same material. 63.33% agree whereas 36.67% disagree.

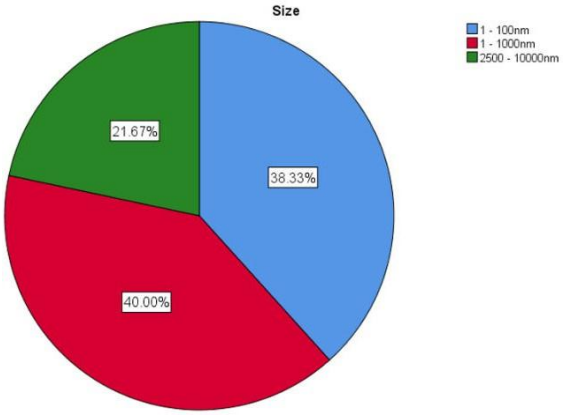

Figure 3 : Pie chart representing size of nanoparticles. 38.33% responded to 1-100 nm, 21.67% responded to 2500-10000 nm and 40.00% responded that it is 1-1000 nm.

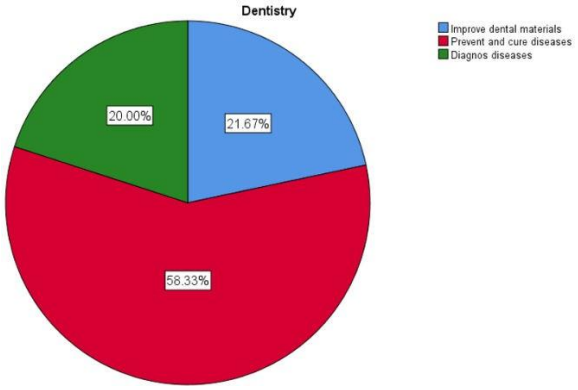

Figure 4 : Pie chart represents the uses and applications of nanotechnology in dentistry. 20.00% to diagnose diseases , 21.67% to improve dental materials, 58.33% to prevent and cure diseases.

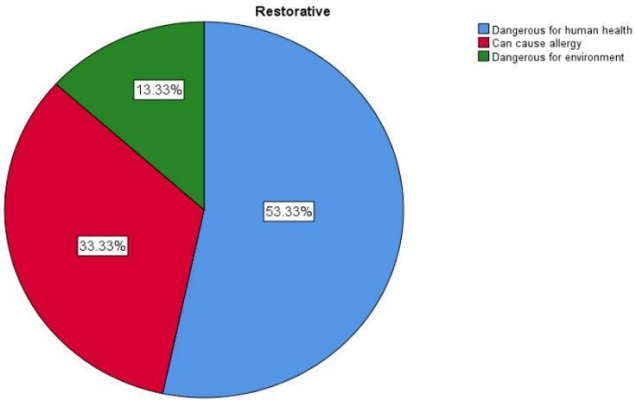

Figure 5 : Pie chart represents the causes of restorative dental nanoparticles. 33.33% can cause allergy , 53.33% dangerous for human health and 13.33% are dangerous for the environment.

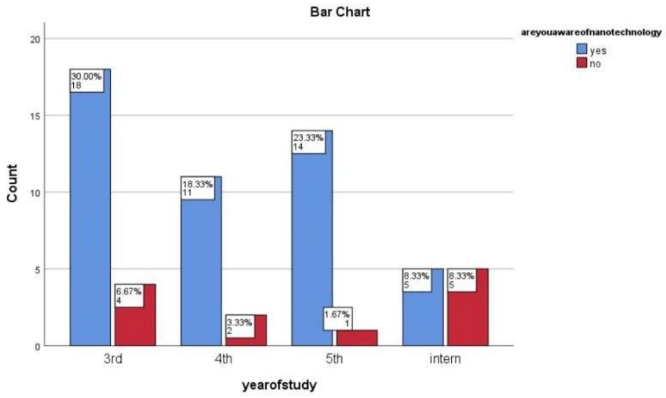

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Figure 6: The graph depicts the association between years of study and awareness on nanotechnology. X axis represents year of study , Y axis represents number of responses. Blue colour denotes aware, red colour denotes not aware. The majority of third years (30.00%) were aware of nanotechnology. There is no significant difference between years of study to awareness on nanotechnology. Chi square test was carried out for the association between parameters. chi square test ; p value = 0.057 (p >0.05). Hence there is no significance.

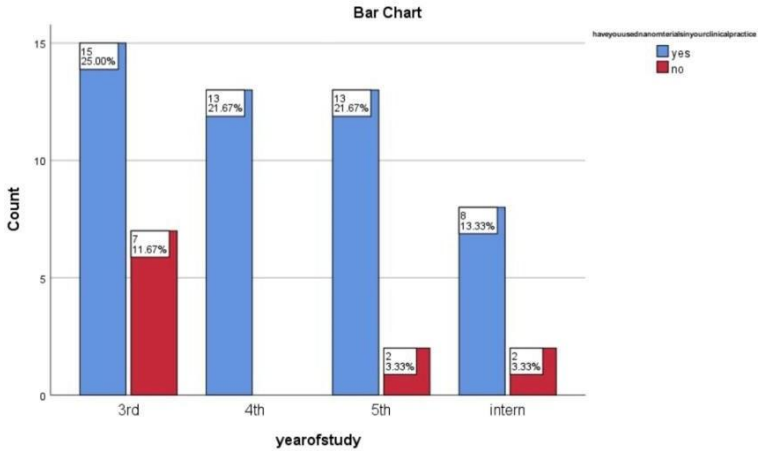

Figure 7: The graph depicts the association between year of study and number responses for uses of nanoparticles in clinical practices . X axis represents year of study , Y axis represents the number of responses. Blue colour denotes used whereas red colour denotes not used. Majority of third year (25.00%) undergraduate students responded that they use nanomaterials in clinical practices. There is no significant difference between years of study to knowledge on uses of nanoparticles in clinical practice. The chi square test was carried out to find the association between the variables. Chi square test ; p value = 0.057 (P>0.05). Hence there is no significance.

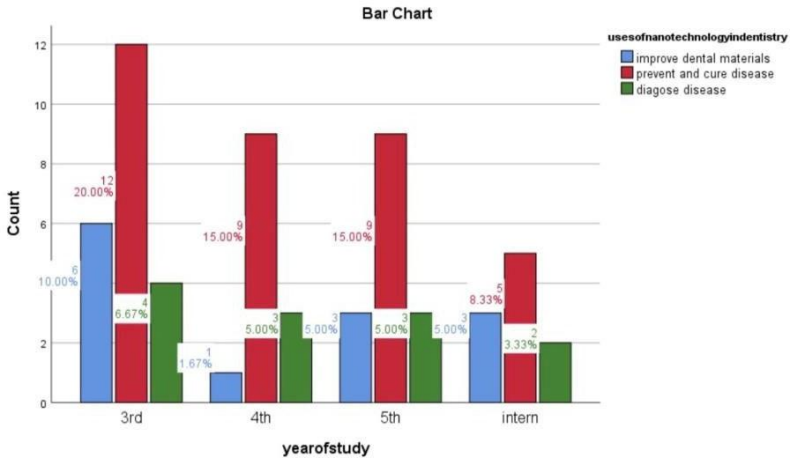

Figure 8 : The graph depicts the association between year of study and number of responses to uses of nanotechnology in dentistry . X axis represents year of study , Y axis represents the number of responses. Blue color denotes to improve dental materials, red color denotes to prevent and cure diseases and green color denotes to diagnose diseases . Majority of third year (20.00%) undergraduate students responded that nanotechnology is used to prevent and cure diseases. There is no significant difference between years of study and knowledge on uses of nanotechnology in dentistry. The chi square test was carried out to find the association between the variables.chi square ; p value = 0.882 (p value > 0.05) . Hence there is no significance.

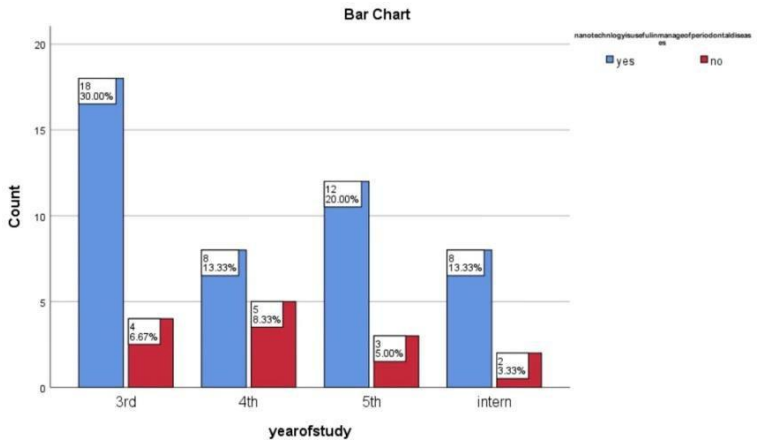

Figure 9 : The graph depicts the association between the year of study and number of responses towards the use of nanotechnology in periodontal diseases. X axis represents year of study , Y axis represents the number of responses. Majority of third year (30.00%) responded that they use nanomaterials for management of periodontal diseases. There is no significant difference between years of study to knowledge on use of nanotechnology in periodontal disease. The chi square test was carried out to find the association between the variables. chi square test ; p value = 0.882 (p value > 0.05) . Hence there is no significance.