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### RESEARCH ARTICLE

## TO ASSESS THE KNOWLEDGE AND AWARENESS REGARDING GENERAL CONCEPT OF NANOTECHNOLOGY AMONG MEDICAL AND PARAMEDICAL STUDENTS OF MEDICAL COLLEGE

Dr. Manjusha Hivre<sup>1</sup>, Dr. Shirang Holkar<sup>1</sup> and Dr. Deepali Vaishnav<sup>2</sup>

1. Assistant Professor, Department of Biochemistry, MGM Medical College Aurangabad.
2. Professor, Department of Biochemistry, MGM Medical College Aurangabad.

#### Manuscript Info

##### Manuscript History

Received: 20 April 2021  
Final Accepted: 18 May 2021  
Published: June 2021

##### Key words:-

Nanoparticle, Nanomedicine,  
Biomarkers, Nanoprobes, Knowledge,  
Students

#### Abstract

**Introduction:** Nanotechnology is a rapidly growing field to improve a number of medical products and processes. The merging of nanotechnology with molecular imaging provides a versatile platform for the novel design of nanoprobe that will have tremendous potential to enhance the sensitivity, specificity and signalling capabilities of various biomarkers in human diseases.

**Aim:** This study was conducted to assess the knowledge and awareness about general concept of nanotechnology among Undergraduate and postgraduate students.

**Material And Methods:** A cross sectional questionnaire based study was carried out among postgraduate and undergraduate medical and allied students of the medical college for a period of six months regarding knowledge and awareness about general concept of nanotechnology.

**Results:** This study included 300 participants. Data from this study revealed a high level of awareness and knowledge of the nanotechnology among the undergraduate and postgraduate students.

**Conclusion:** Our results showed excellent knowledge about general concept of nanotechnology among the medical and para medical students.

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#### Introduction:-

Nanotechnology is an exciting novel area in science, with many promising applications in medical field such as diseases diagnosis, drug delivery, imaging etc. Nanotechnology can be defined as the integration between technology and biological systems not previously attainable.<sup>1,2</sup> It should be appreciated that nanotechnology is not in itself a single emerging scientific discipline, but rather, a meeting of different time-honoured sciences, such as, chemistry, physics, materials science and biology, to bring together the required collective proficiency needed to develop these novel technologies.<sup>3</sup> By manipulating drugs and other materials at the nanometer scale, the elemental properties and bioactivity of the materials can be altered. These tools can permit a control over the different characteristics of drugs or agents. Nanotechnology has been applied to improve a number of medical products and processes such as drugs, medical imaging, antimicrobial materials, medical devices, burn and wound dressings, and protective coatings for eyeglasses.<sup>4</sup> Nanotechnology has improved drug targeting and bioavailability, diagnostic imaging, biomarker detection sensitivity, and drug-delivery efficiency.<sup>5</sup>

**Corresponding Author:-Dr.Deepali Vaishnav**

Address:-Professor, Department of Biochemistry, MGM Medical College Aurangabad.

Hence knowledge and awareness amongst medical and non-medical undergraduates and postgraduate students was evaluated about general concept of nanotechnology for health and diseases.

### Material and Method:-

A cross sectional questionnaire based study was carried out among 300 students of MGM Medical College in Department of Biochemistry Aurangabad for a period of six months. Ethical clearance was obtained from the Institutional Ethics Committee. Inclusion criteria included subjects who were willing to participate in the study and then a written consent was obtained from them. A sample size of 300 including MBBS students, Allied health science students, Physiotherapy students, Nursing students, Pharmacy students and postgraduate/superspeciality students; and questionnaire was designed in such a way that the procedure should not take more than 10 minutes per participant.

The questionnaire was prepared in English language based on a search of review of the literature regarding nanotechnology. A structured questionnaire with a set of 15 questions was designed to evaluate the knowledge and awareness among participants regarding general concept of nanotechnology. The questionnaire was pre tested amongst 10 teaching faculty members to confirm its validity and reliability and to avoid uncertainty. Following the pretest, some modifications in the order of questions and terminologies were made in the final questionnaire. A five point Likert scale was used for scoring.

### Likert scale:

Strongly Disagree (1), Disagree (2), Neutral(3), Agree(4), Strongly Agree(5).

The questionnaire consisted of 10 statements that suggested the degree of agreement or disagreement with each statement using a 5-point Likert scale<sup>6</sup>. Participants were instructed to choose only one answer for each statement. Score of (10 to 50) was given for all the questions. The portion of the questionnaire related to knowledge and awareness assessment is shown in Table. 1.

**Table 1:-** Questionnaire for assessment of Knowledge and awareness of general concept of nanotechnology.

QUESTION
1.I have heard the term Nanotechnology
2. According to (ISO) nanomaterials are Spherical , Fibrous Extremely thin layers structures
3.Is nanotechnology new to us?-Yes
4.Nanomaterials do exist in nature
5. Nanomaterials are used as auxiliaries and additives in foods.
6.Nanotechnology is used in medicine
7.Nanotechnology is used in industry
8.Nanotechnology is used in agricultural and natural sciences
9.Nanotechnology can be useful in reducing air pollution
10.Nanomaterials can cause damage to health

Other 5 questions consisted of yes or no responses (Table 5). The responses thus obtained were then compiled, processed and analysed to arrive at the opinion on various answers.

After collection, the Descriptive analysis of the Data was performed to get the frequency of responses using SPSS version 20. Independent sample t-test was used to assess the difference between undergraduate and postgraduate scores for knowledge and awareness. Chi Square test was used to assess the significance of the responses and a p value <0.05 was considered statistically significant.

### Result:-

The following observations were made by the data analysed for demographic variables. Majority of the participants were in the age group 21-30 years (51.7%). 98.7% of the participants were less than 40 years which comprises of the younger generation. The male-to-female ratio of the students participated was approximately 1:1, with 158 males and 142 females. Descriptive statistics of the participants are shown in Table 2.

**Table 2:-** Socio-demographic variables of participants.

Sr No.	Demographic Variable	Category	Number (%)
1	Age (years)	≤20	105 (35)
		21-30	155 (51.7)
		31-40	36 (12)
		41-50	4 (1.3)
2	Gender	Male	158 (52.7)
		Female	142 (47.3)

According to the individual question analysis, participants showed great knowledge related to almost all questions where >50% participants strongly agreed to the question, while second and sixth question had the highest rate of strongly agreed percentage in medical field (71% and 68% respectively) showing correct knowledge regarding nanotechnology. Majority of the participants strongly disagreed that they can cause damage to health (69%). 73% and 61% of the participants agreed with the question stating that they can be used in industry and agriculture also. The number and percentage of students representing each question of knowledge level are presented in Table 3.

**Table 3:-** Knowledge and awareness of general concept of nanotechnology among the participants in percentage (according to likert scale) (n=300).

**Likertscale:** Strongly Disagree (SD), Disagree(D), Neutral(N), Agree(A), Strongly Agree(SA).

SrNo	Knowledge and awareness question	SD n(%)	D n(%)	N n(%)	A n(%)	SA n(%)	p-value
1	I have heard the term Nanotechnology	30 (10)	39 (13)	12 (4)	48 (16)	171 (57)	<0.01
2	According to (ISO) nanomaterials are Spherical, Fibrous Extremely thin layers structures	9 (3)	24 (8)	0	54 (18)	213 (71)	0.002
3	Is nanotechnology new to us?-yes	159 (53)	78 (26)	15 (5)	39 (13)	9 (3)	0.003
4	Nanomaterials do exist in nature	21 (7)	63 (21)	15 (5)	84 (28)	117 (39)	<0.01
5	Nanomaterials are used as auxiliaries and additives in foods.	66 (22)	3 (1)	0	54 (18)	177 (59)	<0.01
6	Nanotechnology is used in medicine	3 (1)	27 (9)	30 (10)	36 (12)	204 (68)	0.00
7	Nanotechnology is used in industry	6 (2)	15 (5)	18 (6)	42 (14)	219 (73)	0.001
8	Nanotechnology is used in agricultural and natural sciences	6 (2)	63 (21)	18 (6)	30 (10)	183 (61)	0.001
9	Nanotechnology can be useful in reducing air pollution	6 (2)	9 (3)	12 (4)	204 (68)	69 (23)	0.03
10	Nanomaterials can cause damage to health	207 (69)	27 (9)	0	30 (10)	36 (12)	0.000

Calculating the correct response for the questionnaire, a score of around 29 was considered as having excellent knowledge regarding the study. No significant difference (p 0.322) was observed among postgraduates level of knowledge with compared to undergraduates as shown in Table 4.

**Table 4:-** Comparison of mean score of undergraduate and postgraduate students.

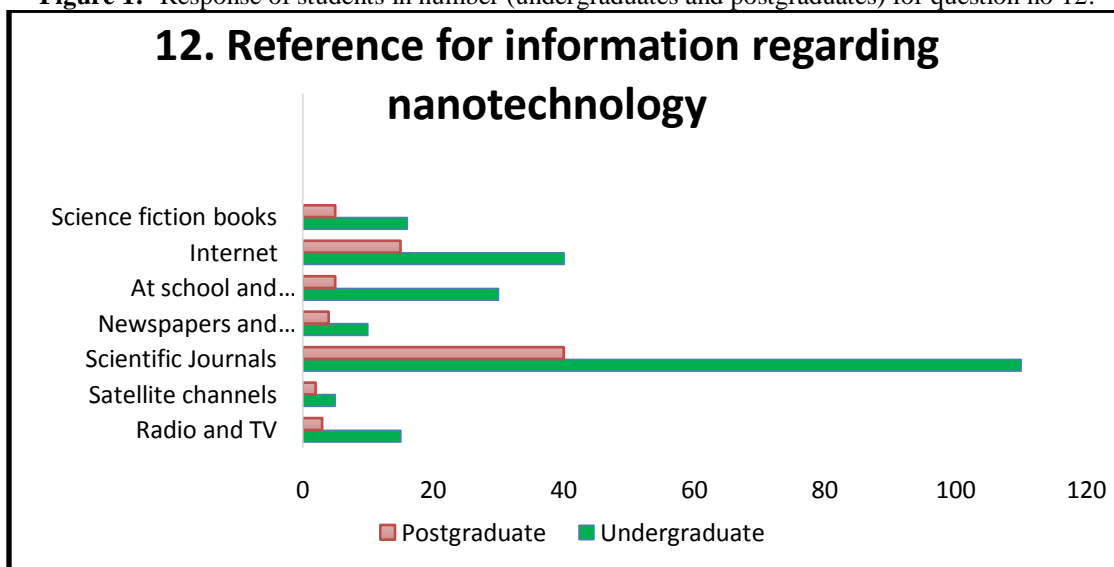
Participants (n)	Undergraduate (226)	Postgraduate (74)	P value
Mean ± SD	28.11± 3.48	28.39± 3.27	0.322

Majority of the participants considered nanotechnology as a boon to mankind comprising of 97% students; while 87% of students believed that nanotechnology products are available. Interestingly, high percentage of participants (80%) have heard about NNI (National Nanotechnology Initiative). The percentage is given in table 5.

**Table 5:-** Response of students in percentage for question no 11 to 15.

Question	Yes (%)	No (%)
11.Nanotechnology is a boon to mankind.	97	3
12. From which of the below references have you learned about nanotechnology? <ul style="list-style-type: none"> <li>• public programs of radio and T.V</li> <li>• satellite channels</li> <li>• scientific journals</li> <li>• newspapers and public magazine</li> <li>• at school and university</li> <li>• internet</li> <li>• science fiction books</li> </ul>	6.6 2.2 48.7 4.5 13.2 17.7 7.1	- - - - - - -
13.Are nanotechnology products available today?	87	13
14. Do you know that Nano-bioengineering of enzymes is aiming to enable conversion of cellulose into fuel.	39	61
15. Have you heard about NNI (National Nanotechnology Initiative)?	80	20

Figure 1 represents the major source of information regarding nanotechnology. Majority of students received information from scientific journals followed by internet.

**Figure 1:-** Response of students in number (undergraduates and postgraduates) for question no 12.

### Discussion:-

The long-term purpose of nanomedicine study is to exemplify the quantitative molecular-scale components known as nanomachinery. Precise control and manoeuvring of nanomachinery in cells can lead to superior understanding of the cellular mechanisms in living cells, and to the improvement of advanced technologies, for the early diagnosis and treatment of a variety of diseases.<sup>7</sup> The significance of this research lies in the development of a platform technology that will influence nanoscale imaging approaches designed to probe molecular mechanisms in living cells.<sup>8</sup> The current study investigated the knowledge and awareness regarding general concept of nanotechnology among undergraduate and postgraduate students of medical and paramedical fraternity.

In our study it was found that Postgraduates and undergraduates showed almost same level of awareness and knowledge with no significant difference. Medical students as well as para clinical and non-medical stream had a good knowledge regarding nanotechnology still need to update the knowledge. Majority of the participants considered nanotechnology as a boon to mankind comprising of 97% students; while 87% of students believed that nanotechnology products are available for use. According to a recent study, female participants have a positive attitude towards nanotechnology than male participants. Interestingly, high percentage of participants (80%) have

heard about NNI (National Nanotechnology Initiative). Mostly the findings are supported by Faiz M. M. T. Marikar et al; 2014.<sup>9</sup> Nano-bioengineering of enzymes is aiming to enable conversion of cellulose into fuel was known by less participants (37%). Over the years definitely knowledge has increased. This seems to be fairly good percentage and also draws attention to the fact that youths are concerned with knowledge regarding nanotechnology.

Banet and Ayuso; 2003<sup>10</sup> commented, "From an academic point of view, we consider it is important to provide students with a basic conceptual framework for understanding the location, transmission and expression of hereditary information and the basic mechanisms involved in the evolution of living beings. Such knowledge would also help students to understand the biological significance of certain phenomena such as cell division, the reproduction, which will leads to understand nanomedicine therapeutic application based on nanoparticle in a similar manner to cell division." These applications include fluorescent biological labels, drug and gene delivery, bio-detection of pathogens, detection of protein, probing of DNA structure, tissue engineering, tumor detection, separation and purification of biological molecules and cells, MRI contrast enhancement and pharmacokinetic studies.

Molecular imaging has emerged as a powerful tool to visualize molecular events of an underlying disease, sometimes prior to its downstream manifestation. The merging of nanotechnology with molecular imaging provides a versatile platform for the novel design of nanoprobes that will have tremendous potential to enhance the sensitivity, specificity and signalling capabilities of various biomarkers in human diseases.<sup>11</sup> Despite the benefits that nanomedicine has to offer, much research is still required to evaluate the safety and toxicity associated with many Nanoparticles. Data from this study revealed a high level of awareness and knowledge regarding nanotechnology concept. It is high time that the message needs to be passed for the benefit of population that they are aware of such emerging technology which can benefit the human in health and diseases as well as other fields also. A concerted effort of creating awareness can take this message forward.

### **Conclusion:-**

Many experts agree that nanomedicine will create a paradigm shift that revolutionizes health care within the next 10 years. The results of the present study concluded that majority of the medical students were aware of nanotechnology concept in health. The genesis of nanotechnology can be traced to the promise of revolutionary advances across the field of medicine and genetics.

### **Limitation:**

The sample size was smaller for this study, hence a study with larger sample size is needed for the assessing the awareness and knowledge among the students, not only medical but also students and faculties of other profession.

### **Funding**

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### **Conflicts of interest**

The authors declare no conflict of interest.

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