



Awareness About Biohazards of Dental Materials - A Survey

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ABSTRACT

Biohazard is a term that refers to any substance that poses a threat to the health of living tissues. Certain materials employed in dentistry pose a threat to the harmony of biological reactions in humans which may include a sample of micro organism, a virus or toxins that can affect human health. Biohazards also pose a threat to other organisms. Biohazards are usually a side-effect or a byproduct of industrialisation. Dentists usually work with and are exposed to a number of biological and occupational hazards on a daily basis due to the nature of their work. It is vital that the students graduating as dentists are aware of all the risks. This survey was done with the idea of assessing the level of awareness among dental students regarding the biohazard properties of dental materials. A self structured questionnaire consisting of 16 questions was circulated among 200 dental students. Results were tabulated and analysed. The results were varied. Most responses show good knowledge and awareness about biohazards, but the responses to some questions show that more information about dental materials should be provided to the students. It can be concluded that dental students have moderate to good level of knowledge about biohazards of dental materials. This can be improved by delivering information and increasing exposure to the various dental materials available.

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INTRODUCTION

Biohazards are essentially biological substances that can pose a threat to the health of living organisms- mainly humans[1]. This may include a sample of micro organism, a virus or toxins that can affect human health[2]. Biohazards also pose a threat to other organisms. Biohazards are usually a side-effect or a byproduct of industrialisation[3]. In essentiality, anything that comes out of a machine can be a biohazard[3,4][2][3,4]. Dentists usually work with and are exposed to a number of

biological and occupational hazards on a daily basis due to the nature of their work[5].

Some of the common hazards include risk to irritant chemicals[6], inhalation of vapours, dust particles[7], injury from high-speed rotary equipments[8], injury through flammable materials[9], allergens etc[10]. Some common dermatological lesions include redness, irritation or decreased sensitivity, blisters, soreness, desquamation, pain, fissures etc. [11]. There are various biohazards associated with conservative dentistry that are recently coming to light [2][12].

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All clinicians must be aware of the various hazards Dental Materials pose[13]. This present study will be focusing on the following :

Dental amalgam: Various studies correlate and contradict that dental amalgam poses a toxicity issue[14]. Mercury toxicity is caused due to inhalation of liquid mercury vapours by the patient and or or the clinician[15]. Inhalation is fatal[16] [2],[16].

Eugenol: Eugenolic acid is a potent irritant that is known to cause redness and blisters on the skin[4][2] [4].

Monomethyl methacrylate and self cure resins: Inhalation of liquid monomer vapour is found to cause acute respiratory distress syndrome[1]. Formaldehyde is a degradation product of various self cure resins found commonly used in dentistry[5]. Formaldehyde is a potentially lethal cytotoxic chemical irritant . Self-cure resins can facilitate soft tissue irritation in some individuals, resulting in a syndrome called burning mouth syndrome[17].

UV light: Ultraviolet light is known to cause eye sensitivity and Various dermatological reactions in some individuals[18].

Hypersensitivity: Some individuals show hypersensitivity reactions towards various materials like polymethyl Methacrylate, Glass Ionomer cement, zinc oxide eugenol, ceramics etc. [19].

Nickel: Nickel containing alloys have recently been discontinued for prosthetics as new research studies conclude that it can be a potential carcinogen[10].

Previously our team had conducted numerous clinical trials [20–39] and in vitro studies over the past 5 years. Now we are focusing on the epidemiological surveys

The main goal of this study is to assess the knowledge and awareness levels about biohazards of Dental Materials among dental students.

MATERIALS AND METHOD

The study is an online based cross-sectional survey. Data was collected by circulating a Self structured questionnaire consisting of 16 questions. 200 students were selected based on simple random sampling. This is done to minimise bias. The results were tabulated and analysed using Windows version SPSS version 20. Frequency and Chi-Square test was done for the data obtained. Pie charts and bar graphs were used to depict the results.

RESULTS AND DISCUSSION

Analysing the responses, the following results were obtained.80% were aware of biohazard and toxicity associated with dental materials, which is depicted in Fig. 1 .The responses were mixed for specific

toxicity related questions.79% were aware about mercury toxicity which is depicted in Fig. 2, yet only 65% answered correctly when asked who is more prone to mercury toxicity, which is depicted in Fig. 3. 89% were aware about respiratory distress syndrome associated with acrylic monomers, depicted in Fig. 4.

59% were practising the UV light and eugenol exposure protocols properly, depicted in Fig. 8 and 9. 74% give correct responses to questions related to denture stomatitis which is depicted in Fig. 5; Fig. 6 shows that 77% were aware about formaldehyde as an acrylic byproduct. 64% aware about GIC sensitivity which is depicted in Fig. 10. 77% Agree on harmful effects of dental materials. Only 5% were aware about the carcinogenic property of nickel, depicted in Fig. 12. 94% agree on allergic responses to dental materials, which is depicted in Fig. 11. 92% agree that knowledge about biohazards are essential for a clinician.

The responses were cross tabulated and correlated using the Chi-Square test in SPSS windows version 20. There was significant correlation between Educational Qualification and the responses which are depicted in Fig 13-18.

Modern technological advancements have become a necessity in the dental field. While newer researchers develop newer materials with better properties it is hard to find the line separating “innovation” and “burden”[40].While newer materials are developed, some research studies also prove to us why the older materials don’t work anymore[41]. One of the main scope in dental materials researchers studying the adverse affects each material shows. Hence, it is vital that the clinicians and the students are in touch with it[42]. One study conducted by Schendle at al in 2008 concurs that was the actions of dental materials are obtained through a study of prevalence and incidence. This is not proof for a material’s basic property and it can be a supportive evidence[43].

The results obtained by this study shows that 82% of dental students agreed that Dental Materials have adverse effects. This is in correlation with the present study (Fig. 1) Biocompatibility is a major concern in dentistry. This is because the material will be in constant contact with saliva, oral mucosa, tongue, cheek, lips et cetera. Any sensitivity issues caused will be manifesting in a more painful manner[44]. In a recent study conducted by Al Aslami et al in 2018 concluded that dental amalgam is one of the more controversial materials to work with, owing to its toxicity and biocompatibility issues. It also concluded that only 33% of its participants had awareness about biohazard of Dental Materials but 86% were aware about mercury toxicity. This Is in correlation with the present study[45] (Fig. 2).

A study conducted by Arvind et al in 2017 agrees that occupational hazards in dentistry are quite severe. 88% of its participants agreed that mercury toxicity is one of the lethal hazards that can affect both the patient and the clinician. This contradicts our study in which only 65% of the population answered correctly[46] (Fig. 3). This shows us that more knowledge about toxicity should be incorporated into dental students. Dental polymers are a very versatile group of materials that is used for various things.

Monomethyl methacrylate (MMA) monomer results in toxic reactions and allergic responses.

Estrogenicity is one of the most studied adverse effects of thermoplastic resins. Bis-GMA, found in acrylic resins, are known to mimic the hormone Estrogen. This phenomenon is called Estrogenicity, and is known to cause severe clinical manifestations like Severe long bone calcification, prematuration of breast cells in young females etc. [47]

One of the more serious adverse effects of MMA is acute respiratory distress syndrome. It is a very potential hazard according to Jyothi Tadakamadla et al In 2012. 57% of the participants responded that they were aware about acrylic monomer related syndrome[18]. This correlates with the present study where 89% responded that they were aware about acute respiratory distress syndrome associated with acrylic monomers[48] (Fig. 4).

Denture stomatitis is an inflammatory condition that arises due to denture wearing where the soft tissues get irritated due to various reasons. A study conducted by Shivakumar et al 2012, showed 75% participants having prior knowledge about denture stomatitis. This correlates with the present study[49] (Fig. 5). Formaldehyde is the degradation product of several monomers used in dentistry. According to Churgin et al in 1981, it can cause gingival irritation and reddening[50] (Fig. 6). Burning mouth syndrome is a diffused or localised burning sensation in the mouth due to self cure resins[51]. According to Ananda et al in 2011, Burning mouth syndrome is a soft tissue irritation caused due to self cure resin based dentures. It is due to some of the degradation products [52] (Fig. 7).

Durgha et al In 2014 described the proper protection protocol to be used when dealing with dental materials. In his study, 87% of the participants knew the proper protocol for handling irritant materials [53] (Fig. 8 and Fig. 9). A research conducted by Raja et al In 2014 shows that hypersensitivity for GIC and ceramics are uncommon in the Indian population. Ceramics allergies are considered to be rare in Indians[54] (Fig. 10 and Fig. 11). Research conducted by Padmaja et al in 2013, concludes that nickel is a

carcinogen and that nickel-based alloys have become less favoured in clinical practices[55]. The current study population was unaware about Nickel's carcinogenic properties.

The cross tabulations and correlation tests were done between Educational Qualifications and various responses of the survey. The p value of the Chi-Square test between Educational Qualification and the responses to "Do you think Dental materials can cause adverse effects in humans and other organisms?" was found to be 0.02 which is statistically significant (Fig. 13). The p value of the Chi-Square test between Educational Qualification and the responses to "What do you do when your bare hands are exposed to Eugenol?" was found to be 0.00 which is statistically significant (Fig. 14). The p value of the Chi-Square test between Educational Qualification and the responses to "Do you wear protective equipment to prevent UV exposure?" was found to be 0.00 which is statistically significant (Fig. 15). The p value of the Chi-Square test between Educational Qualification and the responses to "What is denture stomatitis?" was found to be 0.05 which is statistically significant (Fig. 16). The p value of the Chi-Square test between Educational Qualification and the responses to "Which of the following is a carcinogen?" was found to be 0.099 which is statistically significant (Fig. 17). The p value of the Chi-Square test between Educational Qualification and the responses to "Do you agree that a clinician must keep in mind the biohazards of the materials and proceed with treatment accordingly?" was found to be 0.00 which is statistically significant (Fig. 18). This tells us that there is a significant level of correlation that can be understood between the participants' education and their knowledge. Some of the limitations of this study include a smaller sample size and the participants unwillingness to answer honestly and truthfully.

FUTURE SCOPE

The study can be expanded by extensive research about biohazards of dental materials. Improve knowledge about bio hazards related to dental materials. Research to improve properties of dental materials.

CONCLUSION

Within the limits of the study, knowledge and awareness about biohazards of Dental Materials was evaluated. It was found that the dental students and the clinicians had a moderate to good level of knowledge about biohazard and toxicities related to dental materials. This can be improved by delivering information and increasing exposure to various dental materials available.

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AUTHOR CONTRIBUTIONS

Samyuktha P S¹ contributed to the survey formulation, data collection, data analysis and interpretation. Samyuktha P S¹ and Dr. Jayalakshmi S² contributed to manuscript preparation.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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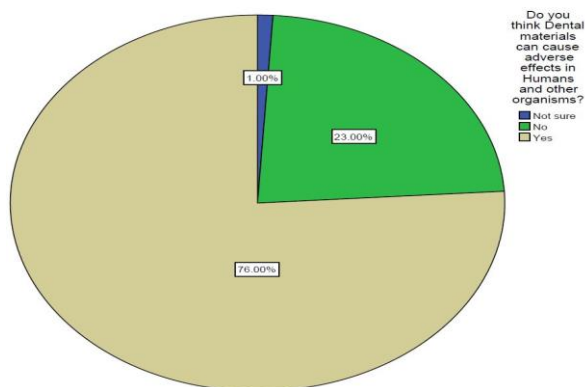


Fig. 1: Pie chart depicting response to the question “Do you think dental materials can cause adverse effects in both animals and humans?”. 78% responded positively (Yellow), 23% responded negatively (Green) while 1% were not sure about it (Blue).

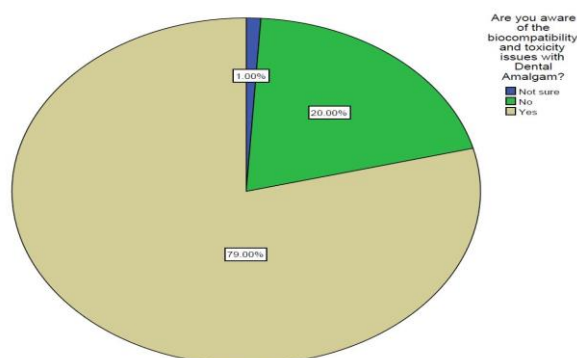


Fig 2: Pie chart depicting the responses to the question “Are you aware of the Biocompatibility and toxicity issues associated with Dental Amalgam?”. 79% responded positively (Yellow), 20% responded negatively (Green) while 1% were not sure about it (Blue).

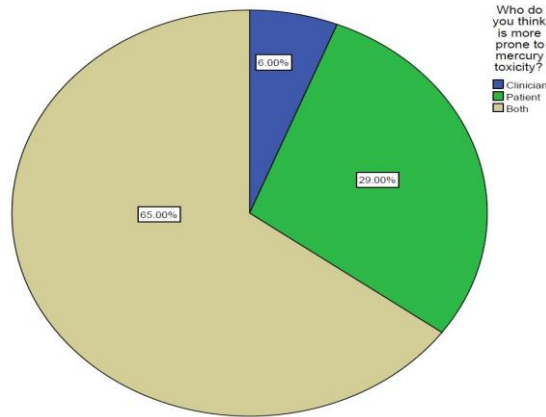


Fig. 3: Pie chart depicting the responses to “Who do you think is more prone to mercury toxicity?”. 29% responded “patient” (Green), 6% responded “clinician” (Blue) and 65% responded that both the patient and clinician are prone to mercury toxicity (Yellow).

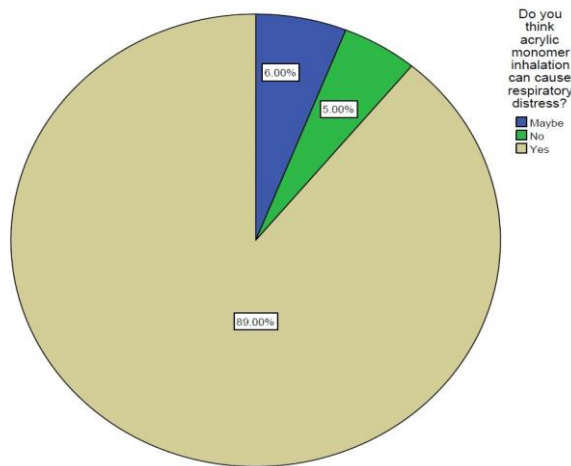


Fig 4: Pie chart depicting the responses to “Were you aware that acrylic monomer inhalation can cause Acute Respiratory Distress Syndrome?”. 89% responded positively (Yellow), 5% responded negatively (Green) while 6% were not sure about it (Blue).

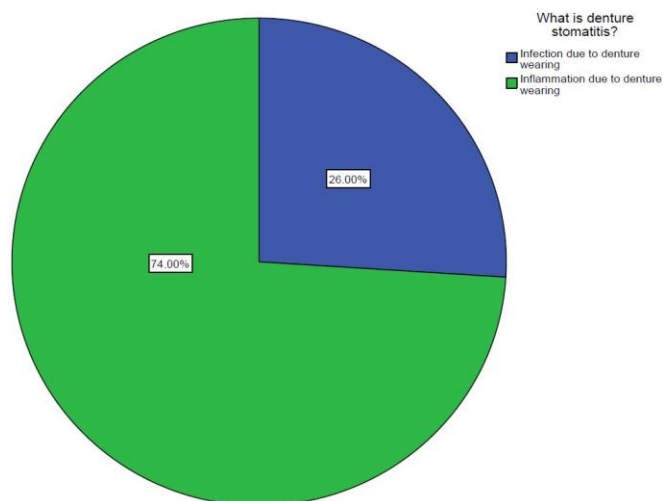


Fig. 5: Pie chart depicting the response to “What is denture stomatitis?” 26% reported an incorrect response- infection due to denture wearing (Blue) and 74% responded correctly- inflammation due to denture wearing (Green).

Awareness About Biohazards of Dental Materials

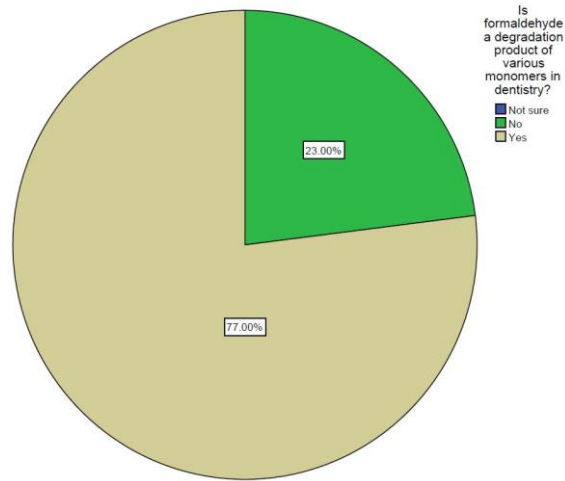


Fig. 6: Pie chart depicting the responses to “Formaldehyde is a degradation product of several acrylic monomers used in dentistry. Were you aware of this?”. 23% were not aware (Green) ; 77% were aware (Yellow).

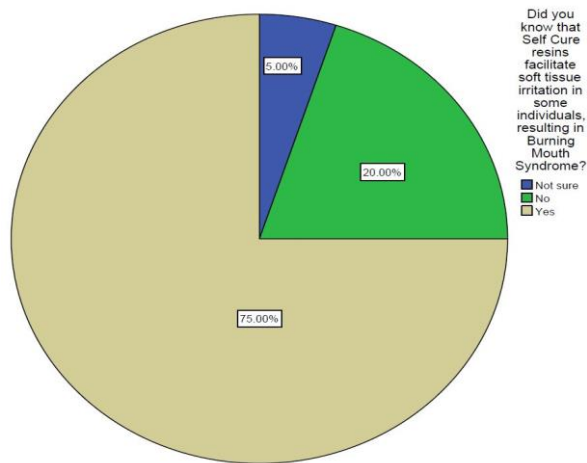


Fig. 7: Pie chart depicting the responses to “Did you know that Self Cure resins facilitate soft tissue irritation in some individuals, resulting in Burning Mouth Syndrome?” 75% responded positively (Yellow), 20% responded negatively (Green) while 5% were not sure about it (Blue).

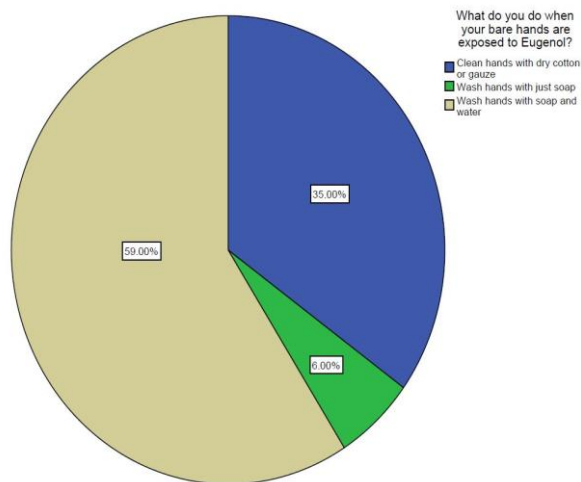


Fig. 8: Pie chart depicting the responses to “What do you do when your bare hands are exposed to Eugenol?”. 59% responded that they wash their hands with soap and water (Yellow); 6% responded that they wash their hands with just water (Green) and 35% responded that they clean their hands using cotton or gauze (Blue).

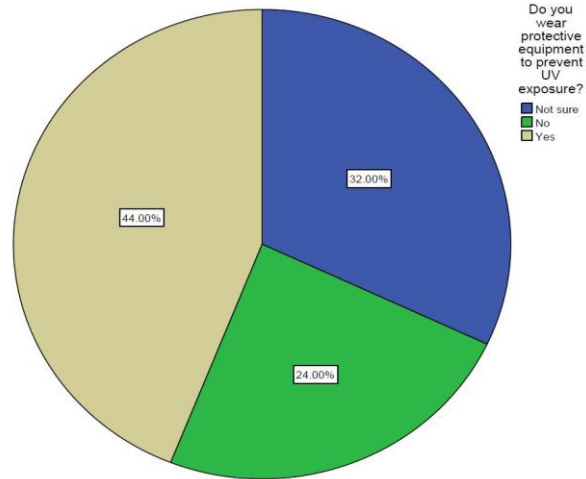


Fig. 9: Pie chart depicting the response to “Do you wear protective equipment to prevent UV exposure?”. 44% responded positively (Yellow), 24% responded negatively (Green) while 32% were not sure about it (Blue).

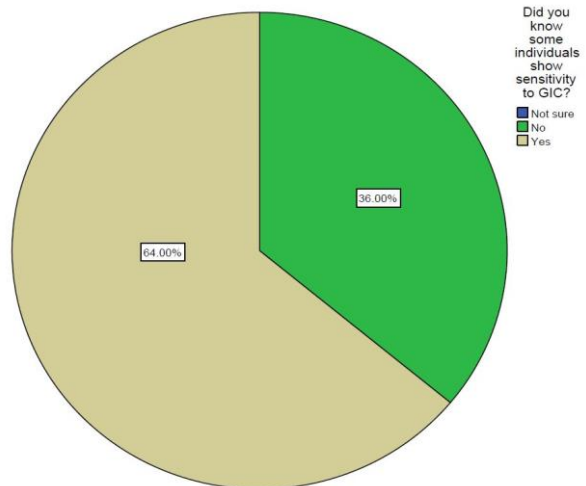


Fig. 10: Pie chart depicting the responses to “Did you know that some individuals show sensitivity to GIC?”. 64% responded positively (Yellow), 36% responded negatively (Green).

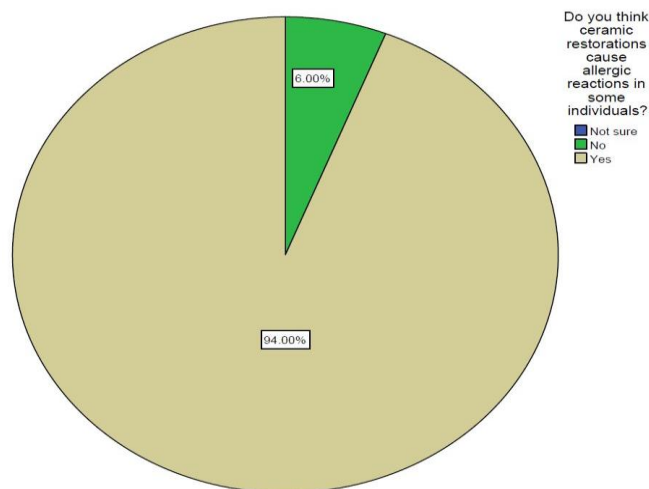


Fig. 11: Pie chart depicting the responses to “Do you think ceramic restorations can cause allergies in some individuals?”. 94% responded positively (Yellow), 6% responded negatively (Green).

Awareness About Biohazards of Dental Materials

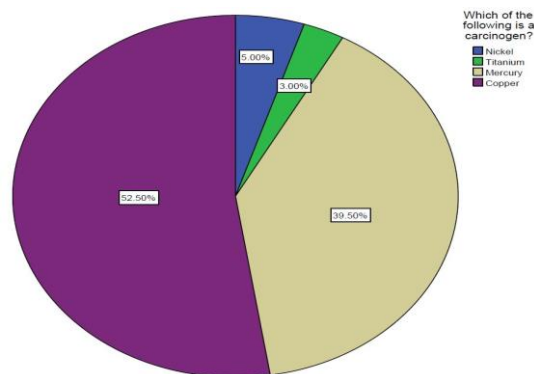


Fig. 12: Pie charts depicting the responses to “Which of the following is a carcinogen?”. Only 5% answered correctly- Nickel (Blue). 95% responded incorrectly.

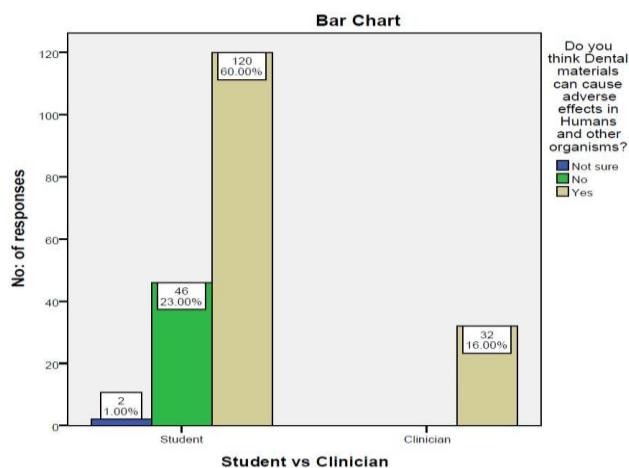


Fig. 13: Bar chart representing the association between qualification and biohazard awareness. X axis represents dental students and clinicians and Y axis represents number of responses. 60% of the total participants were students who responded positively, while all the Clinicians responded positively. Chi-Square test was done and the association was found to be statistically significant. Pearson’s Chi square value was 12.030, df was 2 and p value was found to be 0.02, which is statistically significant. This indicates that there is significantly increased awareness among the students when compared to the clinicians.

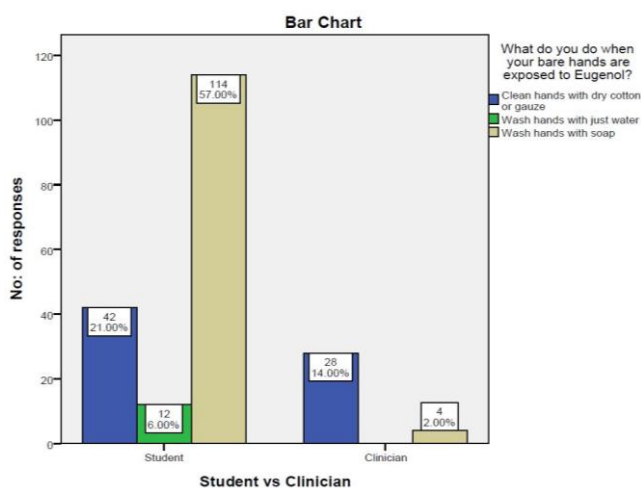


Fig. 14: Bar chart representing association between qualification and protocols during eugenol exposure. X axis represents qualification and Y axis represents number of responses. 57% of the students wash their hands with soap when exposed to eugenol, while most of the clinicians clean their hands using cotton or gauze. Chi-Square test was done and the association was found to be statistically significant. Pearson’s Chi square value was 46.247, df was 2 and $p=0.00$ ($p<0.05$), which is statistically significant. This indicates that students who participated in the survey are more aware of the protocols than clinicians.

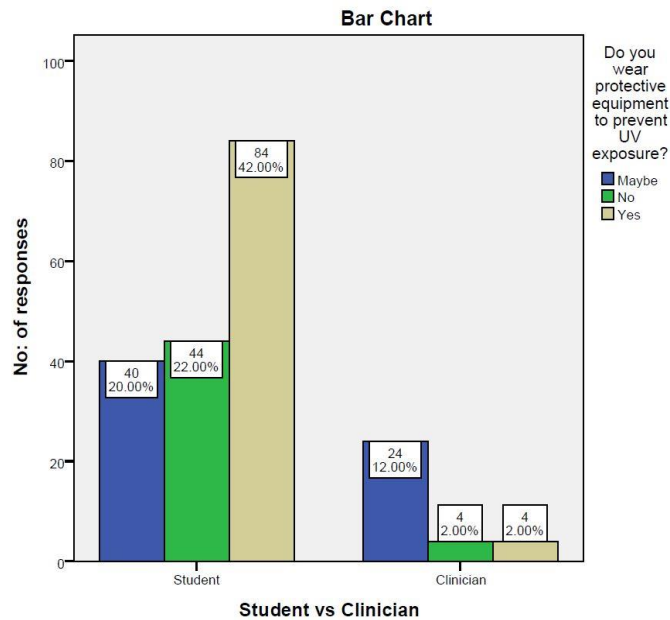


Fig. 15: Bar chart representing association between qualification and protocols during UV exposure. X axis represents qualification and Y axis represents number of responses. More number of students wear protective equipment to prevent UV exposure when compared to clinicians. Chi-Square test was done and the association was found to be statistically significant. Pearson’s Chi square value was 32.702, df was 2 and $p=0.00$ ($p<0.05$), which is statistically significant. This indicates that there is more awareness among students regarding the occupational hazards related to UV exposure.

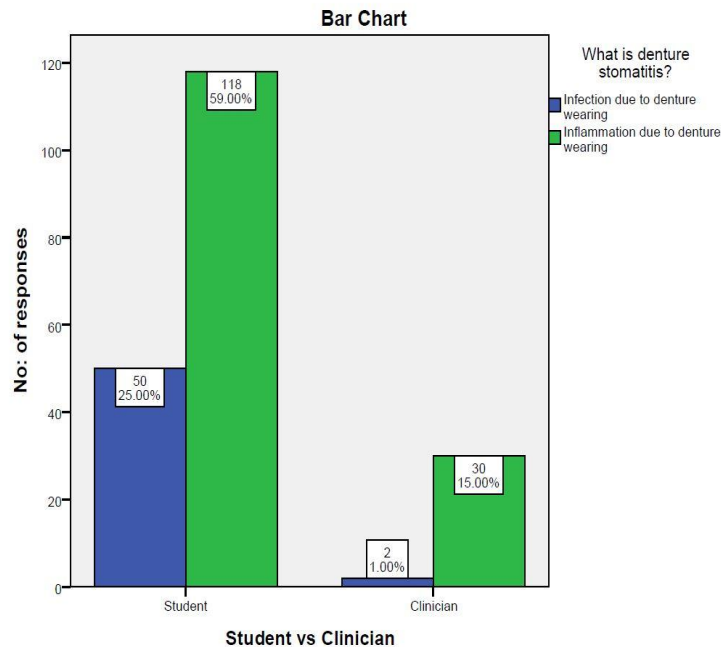


Fig. 16: Bar chart representing association between qualification and awareness about denture stomatitis. X axis represents qualification and Y axis represents number of responses. Most of the clinicians correctly, while 25% of the students answered incorrectly. Chi-Square test was done and the association was found to be statistically significant. Pearson’s Chi square value was 7.723, df was 1 and $p= 0.05$ ($p<0.05$), which is statistically significant. This indicates that there is better awareness among clinicians when compared to students about denture stomatitis .

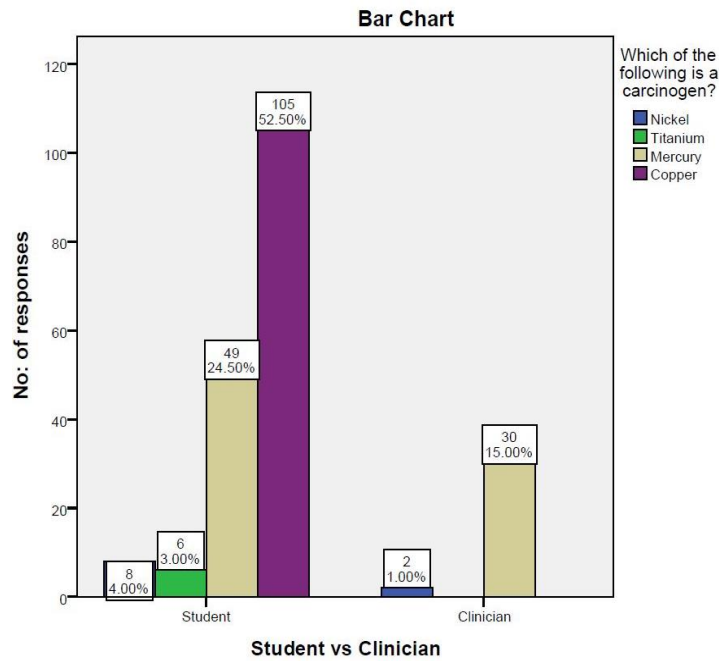


Fig. 17: Bar chart representing association between qualification and awareness about carcinogenicity of nickel. X axis represents qualification and Y axis represents number of responses. Chi-Square test was done and the association was not found to be statistically significant. Pearson’s Chi square value was 4.633, df was 2 and $p=0.099(P>0.05)$, which is not statistically significant. This indicates that there is no correlation between education and knowledge about newer research developments.

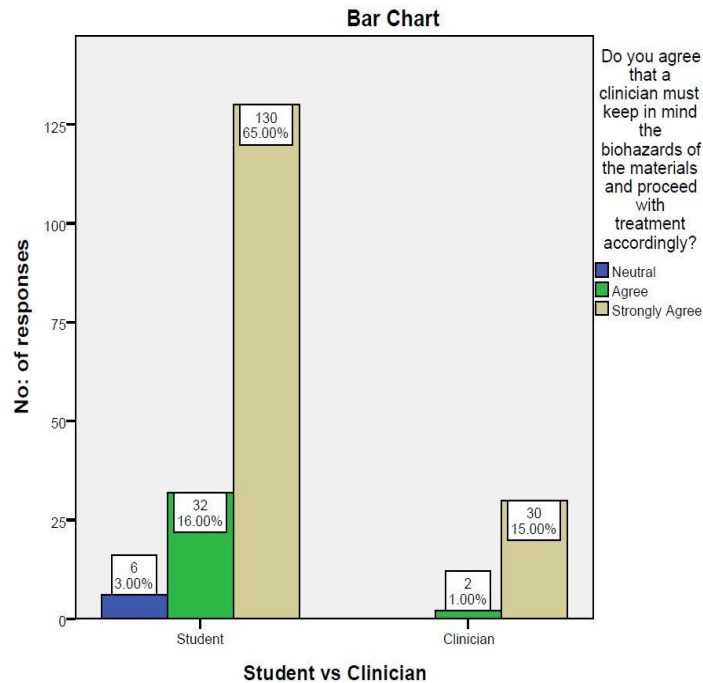


Fig. 18: Bar chart representing association between Qualification and the responses to “Do you agree that a clinician must keep in mind the biohazards of the materials and proceed with treatment accordingly?”. X axis represents Qualification and Y axis represents the number of responses. Most of the students responded positively. Chi-Square test was done and the association was found to be statistically significant. Pearson’s Chi square value was 49.646, df was 3 and p value was found to be 0.00, which is statistically significant. This indicates that the students are more aware of the importance of knowledge related to biohazards when compared with clinicians.