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Knowledge and Awareness of Mercury Spill Management Among Dental Students

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ABSTRACT

Dental professionals get exposed to mercury as an occupational hazard which is still unaddressed by the public health system in India. Mercury is very toxic to the human nervous system and its exposure leads to adverse health effects when it is exposed for a prolonged time. This study was conducted to assess work practices involving mercury and bring awareness of mercury spill management among dental students. A self-administered questionnaire was prepared to analyze the knowledge and awareness of mercury spill management among dental students and it was circulated through an online platform google forms. The collected data were analysed using SPSS software. The results of the survey showed that about 41% of the respondents were aware of the mercury spill management, 59% of the students performed amalgam restoration, 39% of the respondents were using mercury spill kit to avoid mercury exposure. Most of the students participated in the survey were not aware of the corrosiveness of mercury. The Pearson chi square analysis showed that the majority of the first and second-year students and all the intern students were aware of mercury spill management. The knowledge and awareness among dental students on mercury spill management is moderate. Hence, awareness should be created at the primary level for the students from the initial years of dentistry.

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INTRODUCTION

The amalgam is a commonly used restorative material, it is composed of 50% mercury and 69% Silver. It cannot be disposed of along with other biomedical waste due to mercury contamination. It is usually disposed of through incineration or is autoclaved (Bhardwaj *et al.*, 2017). The advantages of using amalgam restorations are that it has low cost, is a reliable material, and stays for a longer period and works well in load-bearing areas. It has a self-sealing ability and has very low technical sensitivity (Bharti *et al.*, 2010). But the major disadvantage of using amalgam restorations is due to its toxicity, non-conventional waste disposal methods, and non-aesthetic nature (Phillips and Skinner, 1991). The use of copper amalgam is that it is heated before the application. The source of mercury exposure among dental personals is evident and this exposure varies substantially (Singh *et al.*, 2014).

The release of amalgam particles in dental offices is

disposed of along with waste and solid waste and is then later released into the environment (Jokstad and Fan, 2006). Contact amalgam is the type of amalgam that is in contact with the patient like through extracted teeth which contains the restoration, carving scraps, and screens. The non-contact amalgam is the one that is not in contact with the patient like excess and unused set amalgam and amalgam capsules. Both are usually stored separately in different containers with the biohazard symbol as per the ADA (American Dental Association) guidelines (Pennsylvania Dental Association, 2018). Liquid mercury, when spilled in the form of droplets, evaporates and forms vapor which is colorless and odorless. Mercury is very toxic to the human nervous system and its exposure leads to adverse health effects when it is exposed for a prolonged time. It is found to have major effects on growing children and developing fetuses (Wiens and Dods, 2015). A large number of dentists prefer hand mixing and dispensation as it is very cost-saving. Increased chance of handling error, improper mixing ratio, and its toxicity makes it disadvantageous (Vandeven and Mcginnis, 2005).

Previous research on various aspects like cancer biology, which includes breast cancer (Gan *et al.*, 2019), hepatic carcinoma (Jainu *et al.*, 2018), laryngeal cancer (Wang *et al.*, 2019), oral cancer (Rengasamy *et al.*, 2018; Ramya *et al.*, 2018), and thyroid cancer (Ma *et al.*, 2019) etc., metabolic disorders (Ponnulakshmi *et al.*, 2019; Shukri *et al.*, 2016), herbal medicines (Chen *et al.*, 2019; Menon *et al.*, 2016), active constituents (Li *et al.*, 2020; Mohan *et al.*, 2015), nanoparticles (Wu *et al.*, 2019; Ke *et al.*, 2019) and protein characterization (Rengasamy *et al.*, 2016) were conducted by our team. This survey aims to analyze the knowledge and awareness of mercury spill management among dental students.

MATERIALS AND METHODS

The survey was conducted among 199 dental students in Chennai. The various samplings collected by the previous researchers had a similar sample size. In the study conducted by Suhas Kulkarni, the participants were 350 (Kulkarni *et al.*, 2008), in the study done by Sarita Bharadwaj the participants were 175 (Bhardwaj *et al.*, 2017). Meanwhile, the research was done by Srinidhi Surya Raghavendra, the participants were 100 (Raghavendra and Ranadive, 2013) and in the study done by S Pooja, the participants were 132 (Pooja and Delphinepriscilla, 2020). The sampling method used was simple random sampling.

The type of questions was close-ended. The data collection software used was through surveys online using google forms, it was analyzed and cleaned up to excel sheets and was represented graphically using bar charts. The statistical software used was SPSS and chi-square test analysis was performed through percentage analysis and the p-value was obtained.

RESULTS AND DISCUSSION

The survey was conducted among dental college students from first-years to interns. Majority of the participants, 36.36% were from the second year followed by 27.27% of them from the first year, 25.76% from the third year, 9.60% from fourth year and 1.01% from intern (Figure 1). Majority of the participants were from the second year (36.36%) where blue denotes first year, green for second year, beige for third year, violet for fourth year and yellow for intern. The number of male participants, 56.06% was slightly greater than female participants (Figure 2). Majority of the participants were males (56.06%) where male denotes male and green denotes female. 59.60% of the participants perform amalgam restoration frequently and 40.40% of the participants do not (Figure 3). Majority of the participants perform amalgam restoration (59.60%) where blue denotes yes and green for no, 38.89% of the participants said that the vapor from mercury causes irritation, 28.28% of them for memory loss, 15.15% for coughing, and 17.68% for all of the above (Figure 4). 52.53% of the participants agreed that mercury is absorbed by the skin and 47.47% of the participants disagreed (Figure 5). 44.95% of the participants agreed that mercury evaporates at room temperature and 55.05% of the participants disagree (Figure 6). The direct exposure of mercury is avoided using mercury spill kit by 39.90% of the participants, 37.88% of them use safe disposal, 14.66% by PPE, and 7.58% by other means (Figure 7). 41.92% of the participants were aware of mercury spill management and 58.08% were not aware (Figure 8). 52.53% of the participants wipe off mercury using hypochlorite solution, 18.69% use phenyl, 21.21% by other means, and 7.58% by water (Figure 9). 49.49% of the students sometimes use mortar and pestle for trituration, 24.24% of the participants never used and 26.26% of them always used (Figure 10). 14.14% of the participants agree that mercury is corrosive to the skin, 19.70% to the teeth, 47.98% of the participants said none and 18.18% agreed to both skin and teeth (Figure 11). Disposal of amalgam contaminated gloves and cotton, 76.77% of the participants use biomedical waste and 23.23% of them use regular dustbin

(Figure 12).

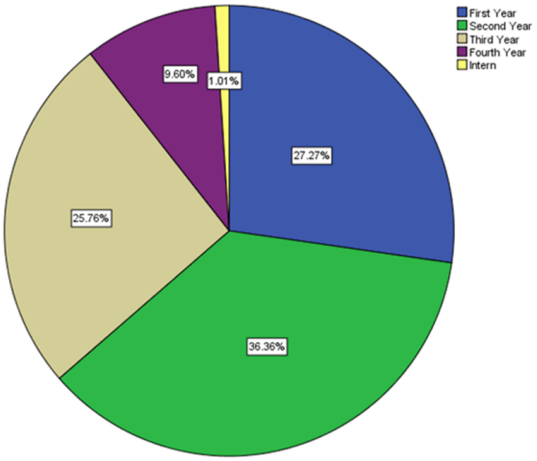

Figure 1: This pie chart represents the year of study of the participants

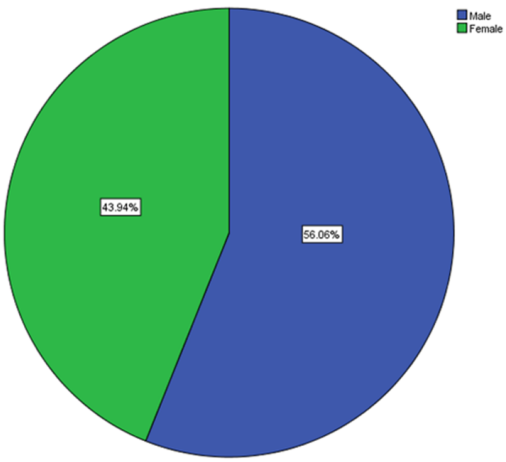

Figure 2: This pie chart represents the gender of the participants

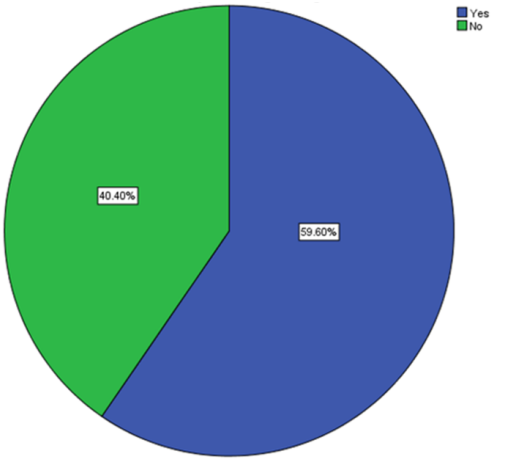

Figure 3: This pie chart represents the practice of doing amalgam restoration

The Chi- square test was done comparing the year of study of the student and the awareness on mer-

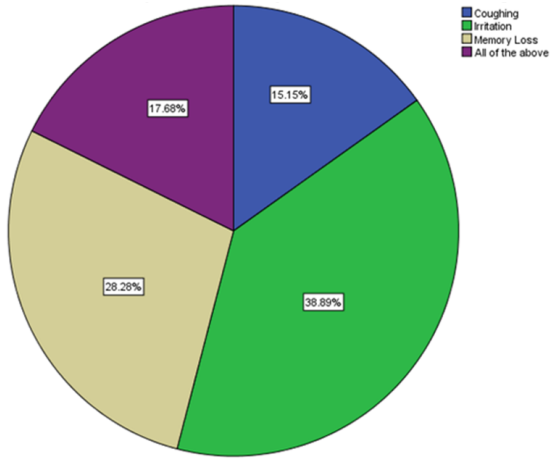

Figure 4: This pie chart represents the knowledge of the participants about the effects caused due to mercury vapour

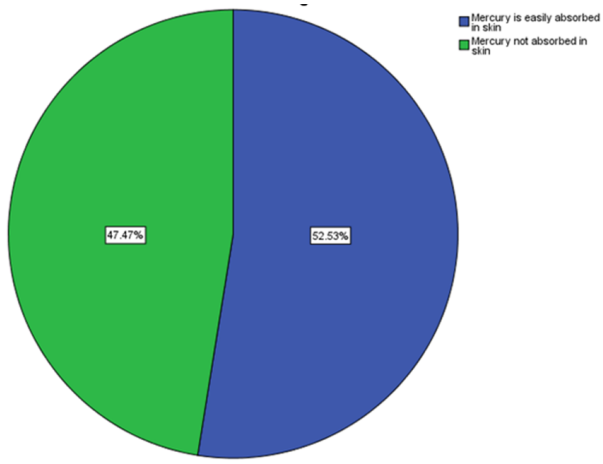

Figure 5: This pie chart represents the knowledge of the participants about the absorption of mercury in the skin

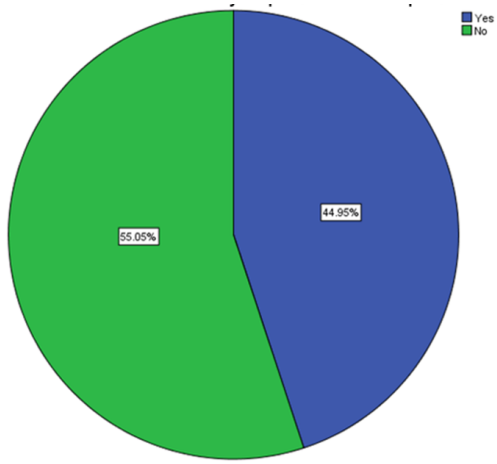

Figure 6: This pie chart represents the knowledge of the participants about the evaporation of mercury at room temperature

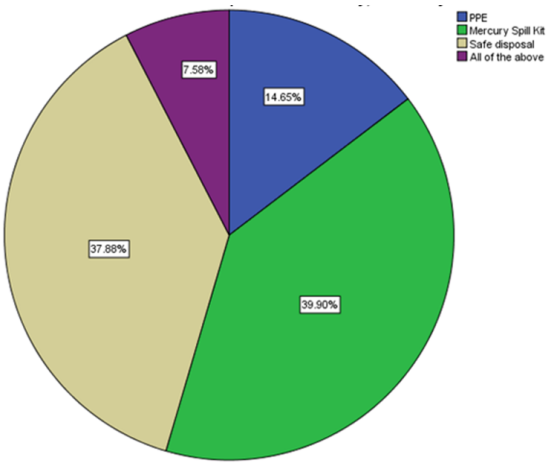

Figure 7: This pie chart represents the knowledge of the participants about the measures used to avoid mercury exposure

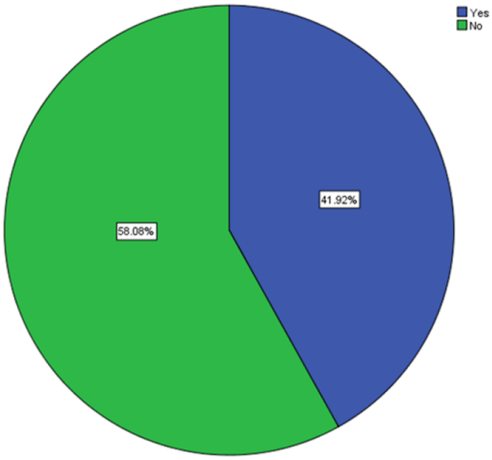

Figure 8: This pie chart represents the knowledge of the participants about the awareness of mercury spill management

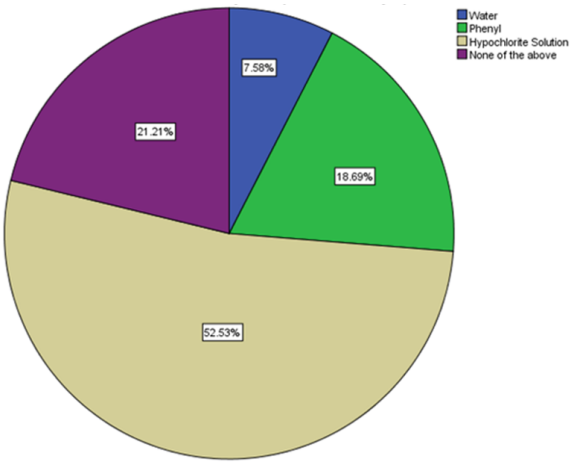

Figure 9: This pie chart represents the knowledge of the participants about cleaning the mercury spill

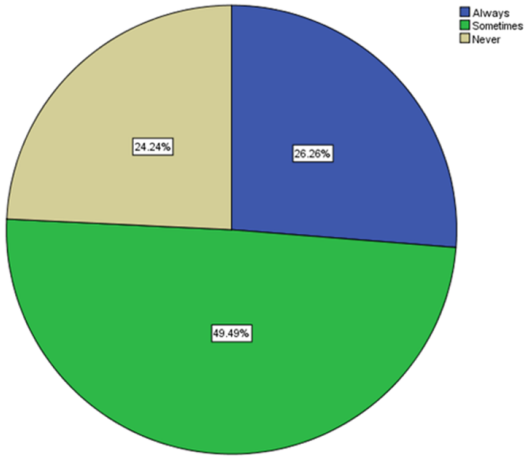

Figure 10: This pie chart represents the knowledge of the participants about the use of mortar and pestle for trituration

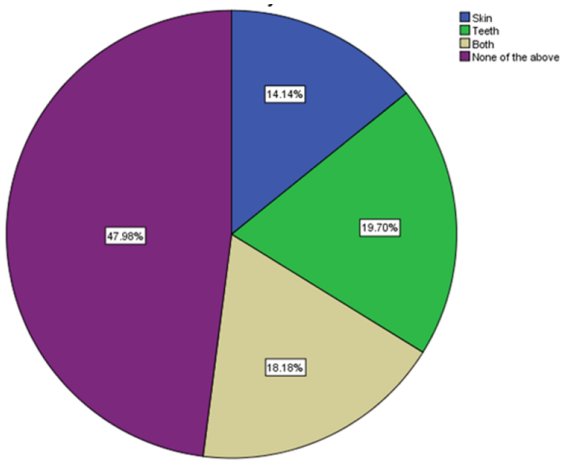

Figure 11: This pie chart represents the knowledge of the participants about the corrosiveness of mercury

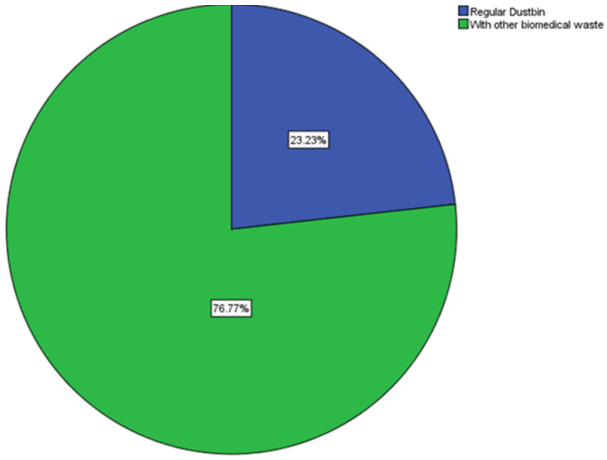

Figure 12: This pie chart represents the knowledge of the participants about the disposal of amalgam contaminated gloves and cotton

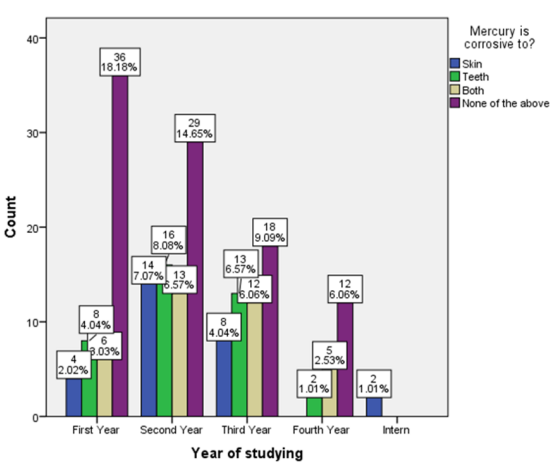

Figure 13: This bar graph represents the association between the year of study and the knowledge about the corrosiveness

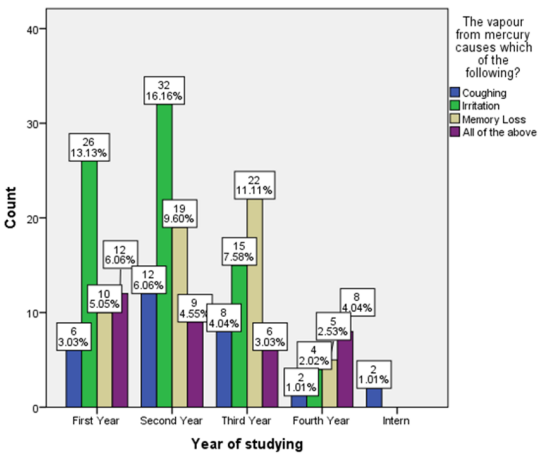

Figure 14: Bar chart showing the association between the year of study and knowledge about the effects caused due to the exposure of mercury vapors

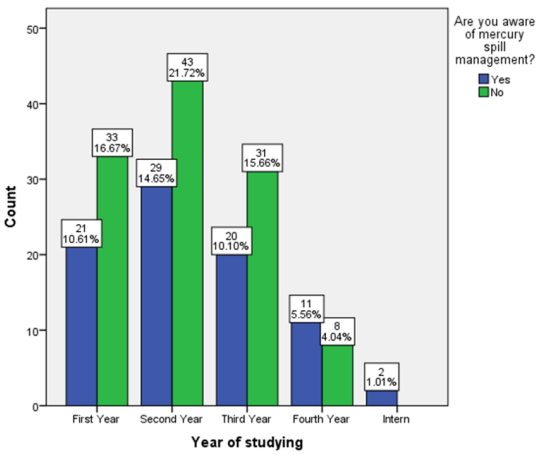

Figure 15: Bar chart showing the association between the year of study and the awareness on mercury spill management

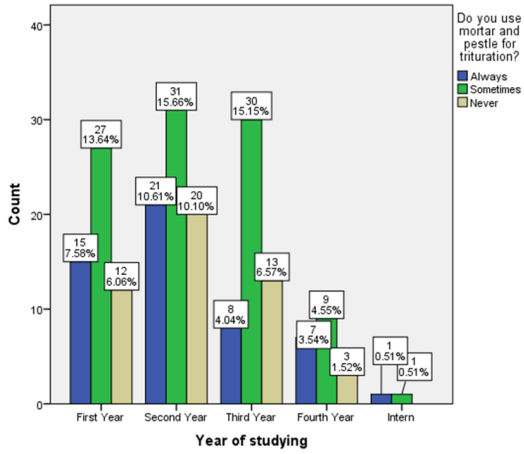

Figure 16: Bar chart showing the association between the year of study and the knowledge of the uses of mortar and pestle for trituration

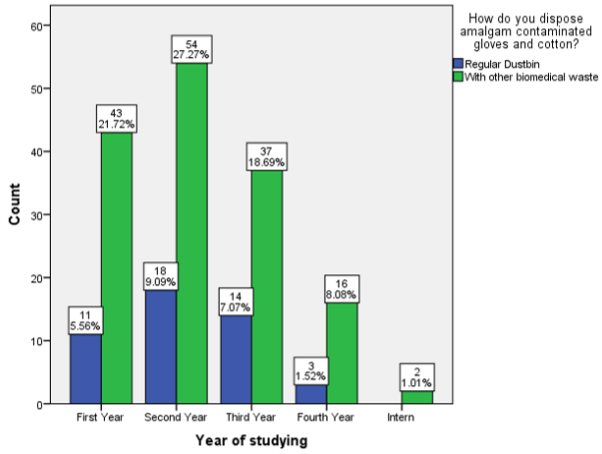

Figure 17: Bar chart showing the association between the year of study and the knowledge about the disposal of amalgam contaminated gloves and cotton

cury spill management. There was a significant correlation between the year of study and the knowledge about the corrosiveness of mercury. 28 participants said it is corrosive to skin, 39 of them to teeth, 36 participants chose both and 95 of them for all of the above. The intern students were the most aware about the corrosiveness of mercury followed by first and second year students (the P value is 0.002 (<0.05) which is statistically significant) (Figure 13). There was a significant correlation between the year of study and knowledge about the effects caused due to the exposure of mercury vapors. 30 participants said it caused coughing, 77 of them said irritation 56 of them said memory loss and 35 for all of the above. The first and second year students were the most aware about the effects caused due to the exposure of mercury vapors. (The P value was 0.002 (<0.05) which is statistically significant) (Fig-

ure 14). There was a correlation between the year of study and the awareness on mercury spill management. 115 participants knew about mercury spill management and 83 participants did not know. All the intern students and majority of the fourth year students were aware about mercury spill management (the P value is 0.267 (>0.05) which is statistically insignificant) (Figure 15). There is a correlation between the year of study and the knowledge of the uses of mortar and pestle for trituration. 52 participants chose always, 98 participants chose sometimes and 48 of the participants never used. Almost all the intern students use mortar and pestle for trituration followed by first, second, third and fourth year students. (The P value was 0.564 (>0.05) which is statistically insignificant) (Figure 16). There is a correlation between the year of study and the disposal of amalgam contaminated gloves and cotton. 152 participants dispose of amalgam contaminated gloves and cotton with other biomedical waste and 46 of them using regular dustbin. All the intern students and majority of the students from the other years are highly aware about the disposal of amalgam contaminated waste. (The P value was found to 0.721 (>0.05) which is statistically insignificant) (Figure 17).

In the present study, 42.2% of the participants were aware of mercury spill management and 57.8% were not aware. Similarly, in the study conducted by Sarita Bharadwaj, 63% of the participants were aware (Bhardwaj *et al.*, 2017). 59.3% of the participants performed amalgam restorations and 40.7% do not. Similarly, in the study done by Tarun Karla, it was found that less number of dentists performed amalgam restorations for aesthetic reasons 14. In the work done by Sunil K Jurel, 23% of them do not prefer doing amalgam restorations due to appearance, cost and durability, and the procedures involved (Singh *et al.*, 2014). The disposal of amalgam contaminated gloves and cotton through biomedical waste was 76.9% and 23.7% for a regular bin, but in the study conducted by Suchi Tripathi, 78% used regular bin for disposal as the participants were not much aware of color-coding laws (Singh *et al.*, 2014). 54.8% of the participants agreed for evaporation of mercury at room temperature and 45.2% did not agree. Similarly, in the study by Bharti R, 73.9% of the participants agreed (Bharti *et al.*, 2010) as mercury is a toxic, colorless, and odorless gas. Mercury spill is wiped off by water by 8% of the participants, 52.3% by hypochlorite solution, 18.6% by phenyl, and 21.1% by other methods. Similarly, in the study done by Rheema Kumari states that chemicals were used and wiped off with a damp cloth (Singh *et al.*, 2014).

In our present study, 49.7% of them sometimes use mortar and pestle for trituration, 24.7% never use and 26.1% of the participants always use mortar and pestle. Similarly, in the study done by Kaushal Agarwal, 82% of them prefer hand mixing procedure (Singh *et al.*, 2014). It was found that amalgamators are more efficient and accurate in mixing ratios. The research done by Kovid Sharma said that the nurses and the healthcare professionals were aware of mercury disposal and trained in waste management (Kovid, 2008). Hence most of the previous articles support the current study on mercury spill management among dental students. The limitation of this study was less sample population size and further study can be conducted among a large scale to give a more accurate result measuring the awareness.

Figure 4 shows the majority of the participants agreed that the vapour from mercury causes irritation (38.89%) where blue denotes coughing, green for irritation, beige for memory loss and violet for all of the above. Figure 5 shows the majority of the participants agreed that mercury is easily absorbed by the skin (52.53%) where blue denotes that mercury is easily absorbed in skin and green denotes that mercury is not absorbed in skin. Figure 6 shows the majority of the participants said that mercury does not evaporate at room temperature (55.05%) where blue denotes yes and green denotes no. Figure 7 shows the majority of the participants use mercury spill kit to avoid mercury exposure (39.90%) where blue denotes PPE, green for mercury spill kit, beige for safe disposal and violet for all of the above. Figure 8, Majority of the participants were not aware of mercury spill management (58.08%) where blue denotes yes and green for no. Figure 9 shows the majority of the participants use hypochlorite solution to clean the mercury spill (52.53%) where blue denotes water, green for phenyl, beige for hypochlorite solution and violet for none of the above. Figure 10 shows the majority of the participants sometimes use mortar and pestle for trituration (49.49%) where blue denotes always, green for sometimes and beige for never. Figure 11 shows the majority of the participants said that mercury is not corrosive to the body (47.98%) where blue denotes skin, green for teeth, beige for both and violet for none of the above.

Figure 12 shows the pie chart represents that the majority of the participants dispose of amalgam contaminated gloves and cotton with other biomedical waste (76.77%) where blue denotes regular dustbin and green denotes with other biomedical waste.

Figure 13 shows the X axis represents the stu-

dent's year of study and Y axis represents the number of responses where blue denotes skin, green for skin, beige for both and violet for none of the above. Majority of the participants from the first year agreed that skin is corrosive to mercury (18.18%). There is a significant association between year of study and awareness on mercury management. Pearson's Chi square value- 31.068, p value- 0.002 (<0.05) hence significant.

Figure 14 shows the X axis represents the student's year of study and Y axis represents the number of responses where blue denotes coughing, green for irritation, beige for memory loss and violet for all of the above. Majority of the participants from the second year agreed that mercury vapour causes irritation (16.16%). There is a significant association between year of study and awareness on mercury management. Pearson's Chi square value- 31.725, p value- 0.002 (<0.05) hence significant.

Figure 15 shows the X axis represents the student's year of study and Y axis represents the number of responses where blue denotes yes and green denotes no. Majority of the intern students were aware of mercury spill management (1.01%). There is no significant association between year of study and awareness on mercury management. Pearson's Chi square value- 5.199, p value- 0.267 (>0.05) hence not significant.

Figure 16 shows the X axis represents the student's year of study and Y axis represents the number of responses where blue denotes always, green for sometimes and beige for never. Majority of the second year students agreed that they sometimes use mortar and pestle for trituration (15.66%). There is no significant association between year of study and awareness on mercury management. Pearson's Chi square value- 6.749, p value- 0.564 (>0.05) hence not significant.

Figure 17 shows the X axis represents the student's year of study and Y axis represents the number of responses where blue denotes regular dustbin and green denotes with other biomedical waste. Majority of the intern students dispose of other biomedical waste (1.01%). There is no significant association between year of study and awareness on mercury management. Pearson's Chi square value- 2.078, p value- 0.721 (>0.05) hence not significant.

CONCLUSION

In the present study, knowledge, and awareness of mercury spill management among dental students in Chennai is moderately high. The Intern students were highly aware of mercury spill management followed by the first and the second-year students. For further argumentation, awareness should be created at the primary level in the initial years of dentistry.

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Conflict of interest

The authors declare that they have no conflict of interest for this study.

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