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Knowledge and awareness of mercury disposal among health care providers

Preethi Shankar, Kavitha S*, Preetha S, Vishnupriya V, Gayathri R

Department of Biochemistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University, Chennai, Tamil Nadu, India

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ABSTRACT

Mercury is considered to be a powerful neurotoxin which leads to mercury poisoning. Mercury can harm us in many ways. Mercury vapour can harm the nervous system in newborn babies and can further lead to cough, tremor and irritability. Being a healthcare provider, it is necessary to know about mercury spill management. To assess the awareness and knowledge of mercury spill management among healthcare providers, an online based survey was created using google forms. The students were asked to answer 10 questions based on mercury spill management and its usefulness. 100 students actively participated in the survey. Correlation analysis was done by chi square test using SPSS software. The results were analysed by Spss software. From the correlation, only 18% of the students in first year, 6% of the students in second year, 2% of the students in third year, 4% of the students in fourth year and 5% of the students in final year were aware of the side effects of mercury with the p value of 0.879 which is statistically insignificant . Similarly, 26% of the first year students, 7% of the second year students, 4% of the third year students, 8% of the fourth year students and 7% of the final year students were aware that hypochlorite solution is used to wipe the mercury spill with p value of 0.323 which is statistically insignificant. On analysing the data it was found that healthcare providers had only little knowledge on mercury spill management. Many healthcare providers were aware of the side effects of mercury and some students were aware of its management. This survey in the current scenario is of utmost importance to reduce exposure of mercury among healthcare providers.

*Corresponding Author

Name: Kavitha S
Phone:
Email: kavithas.sdc@gmail.com

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INTRODUCTION

Mercury is found in a variety of medicinal devices. Mercury is considered as a powerful neurotoxin which leads to mercury poisoning (Clevenger *et al.*, 1997). Mercury vapour can harm our system in newborn babies and can lead to cough,irritability and memory loss, so protection against it is a must (Rennie, 1999). Salts of mercury are corrosive to eyes,nose and GIT (Clarkson and Magos, 2006). Nature of mercury is that it forms small globules on exposure. Mercury is not absorbed readily from skin and it does evaporate at room temperature. Inhalation of mercury vapour is very harmful and can lead to death in severe cases (Langley, 2013).

Mercury spill kit is used to avoid the exposure of mercury spills (Baughman, 2006). Mercury spill management is carried out in implementation mercury disposal practice to help minimise the exposure of workers, patients and environment to toxic

- Question 1 : Are you aware that mercury is used in a variety of medicinal devices?
- Question 2 : Mercury vapour causes
- Question 3 : Mercury is
- Question 4 : Are you aware of the mercury spill management?
- Question 5 : We are supposed to wipe the spill with
- Question 6 : Mercury is found in
- Question 7 : To avoid the exposure to mercury is
- Question 8 : Mercury is corrosive to
- Question 9 : Are you aware of the protocol for mercury spill management?
- Question 10 : Are you trained in mercury spill management?

Figure 1: Questionnaire

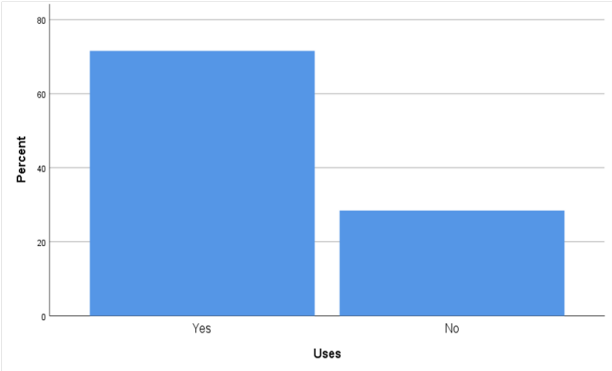

Figure 2: The graph depicts the distribution of awareness of mercury used in a variety ofmedicinal devices

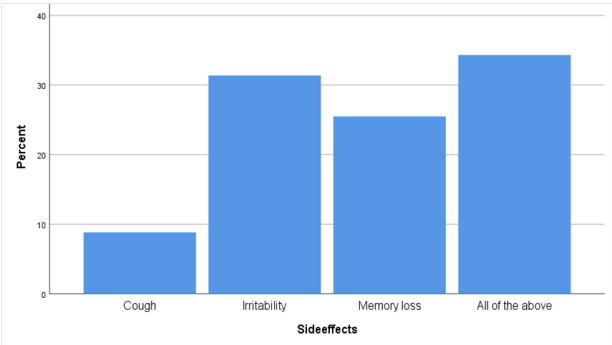

Figure 3: The bar graphs depicting the distribution of side effects of mercury

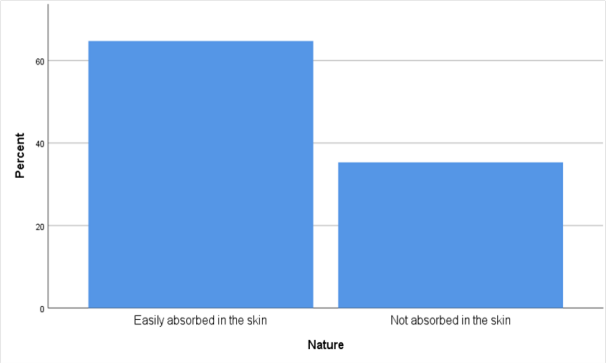

Figure 4: The bar graphs depicting the distribution of absorption of mercury in skin

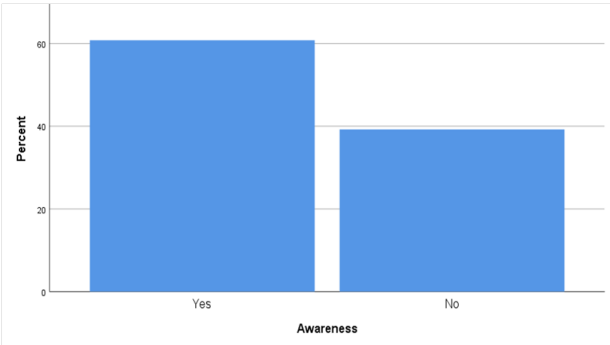

Figure 5: The bar graphs depicting the distribution of awareness of mercury spill management

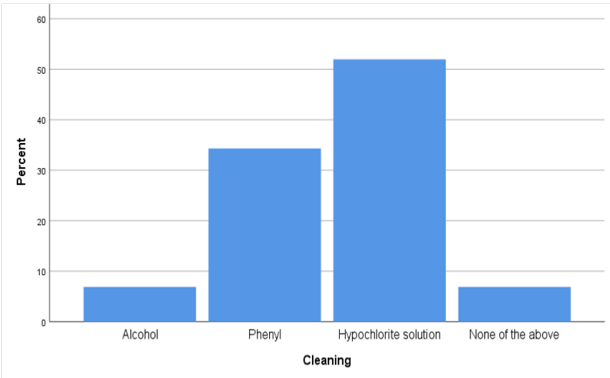

Figure 6: The graph depicts the distribution of awareness on cleaning of the mercury spill

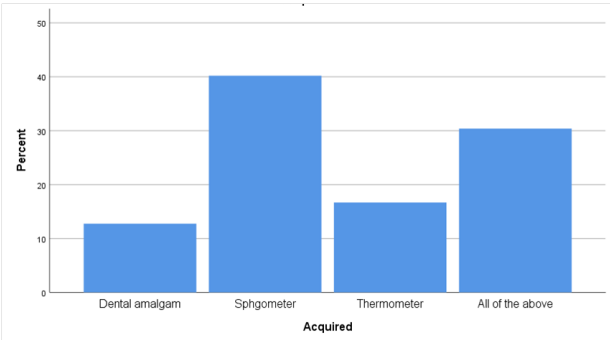

Figure 7: The graph depicting the distribution of materials in which the mercury is mainly used in

mercury (Azziz-Baumgartner, 2007). Mercury spill kits are essential for mercury spill and breakages. It is mandatory for each medical personnel to have two or three kits and should be replaced once after use (Goldman and Shannon, 2001). Management of mercury includes constructing safe mercury storage facilities, adopting preventive measures, safe handling procedures, mercury spill cleanup kits and also use of proper PPE during spill cleanup

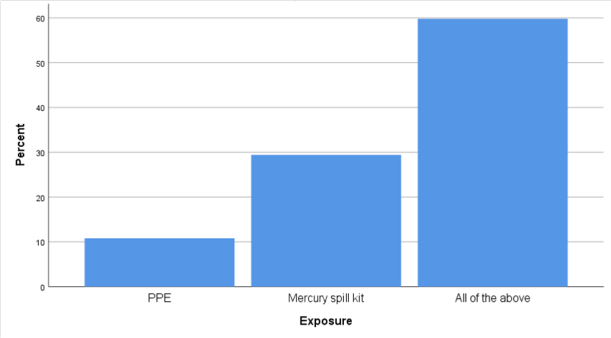

Figure 8: The bar graph depicting the distribution of the knowledge on exposure of mercuryspill prevention

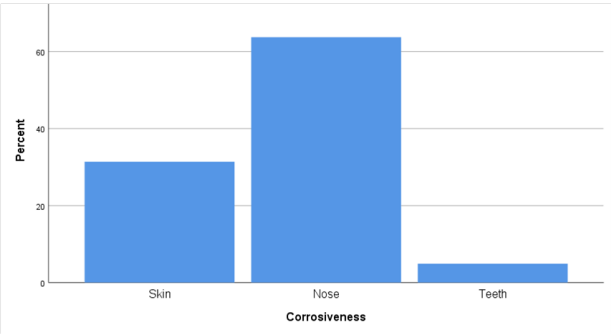

Figure 9: The bar graph depicts the distribution of knowledge on the corrosiveness of mercury

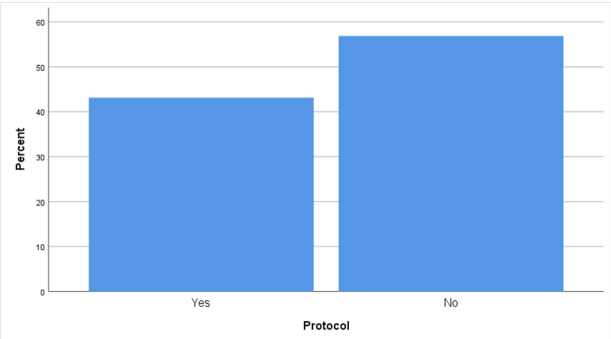

Figure 10: The bar graph depicts the distribution of awareness on protocol of mercury spill management

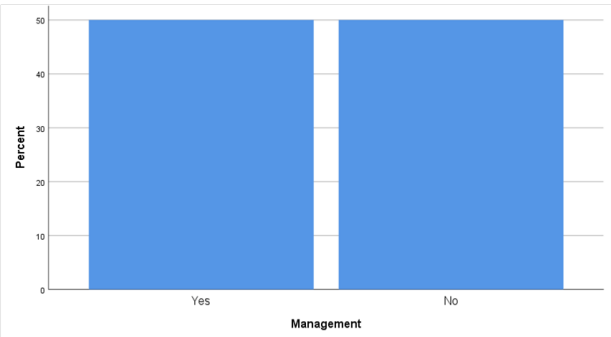

Figure 11: The graph depicts the distribution of training in mercury spill management

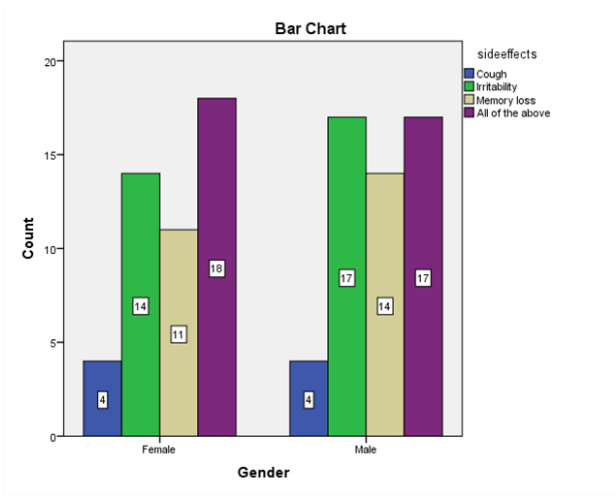

Figure 12: The bar graph represents the association between gender and awareness on side effects of mercury spill

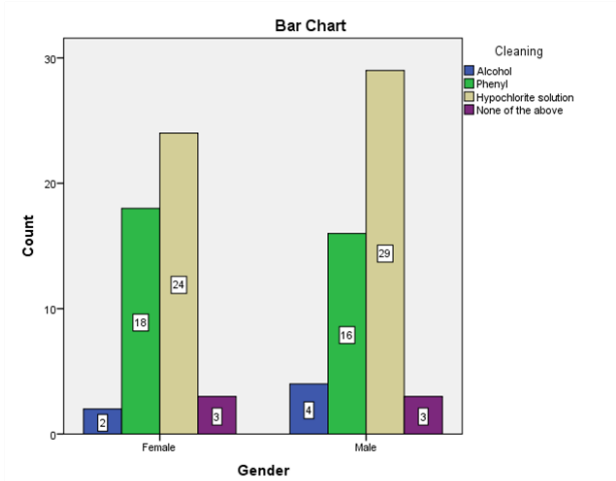

Figure 13: The graph represents the association between gender with the knowledge on cleaning mercury spill

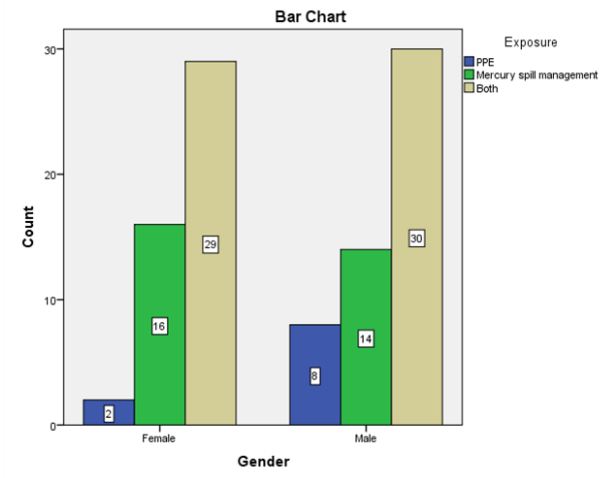

Figure 14: The bar graph represents the association between gender and awareness on the measures to avoid exposure to mercury spill

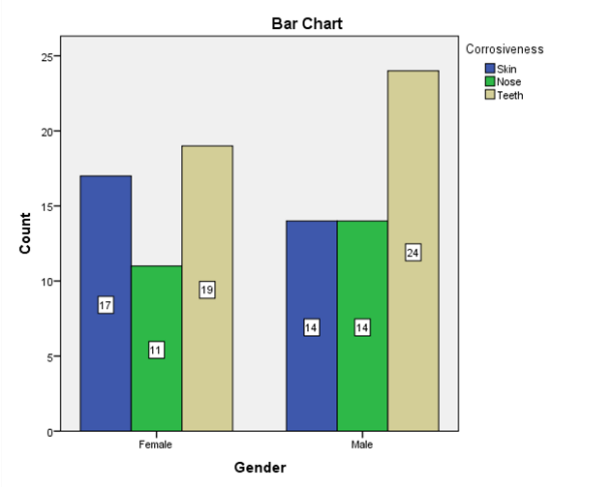

Figure 15: The bar graph denotes the association between gender and the awareness on the corrosiveness of mercury

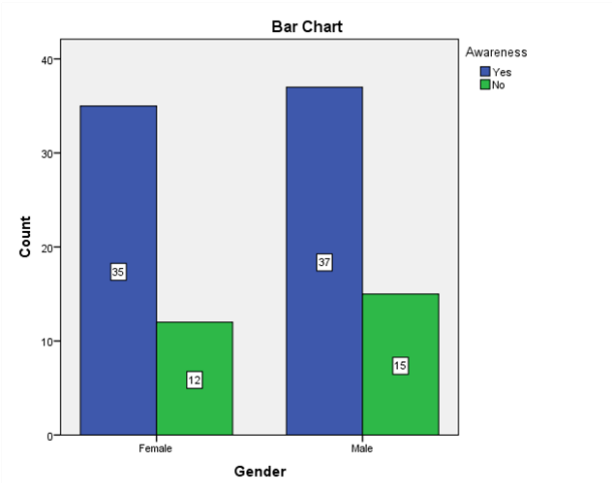

Figure 16: The bar graph represents the association between gender with the awareness on mercury spill management among healthcare providers

cleanup (Spiegel and Veiga, 2010). There are four major steps in mercury spill management which are evacuating the area immediately, putting on face masks, changing clothes which have spilled on them and removing jewellery (Ishigaki and Yanase, 2016).

Dental professionals are exposed to mercury on a daily basis. Dental amalgam, thermometer and sphygmomanometer used by medicinal staff contain mercury in them (Babu *et al.*, 2011). Mercury spill management includes use of personal protective equipment, covering the papilloma with newspaper or blotting paper, wiping the spill with hypochlorite solution and spills should be placed in biohazards bag and safe disposal (Ceaser, 2003). Educating healthcare providers about the protocol for mercury devices, mercury spill management and its disposal

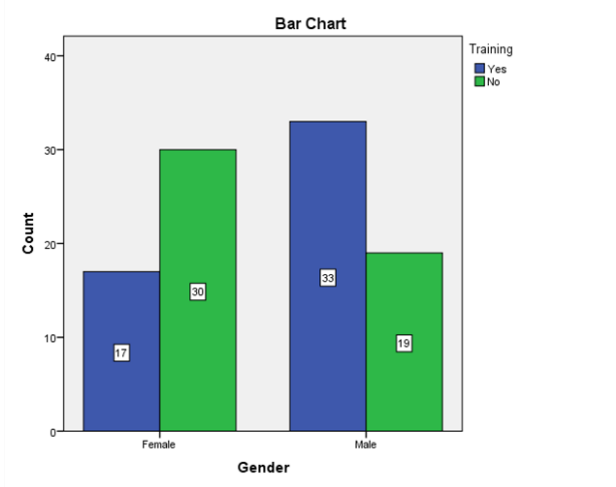

Figure 17: The bar graph represents the association between gender with the knowledge in training of mercury spill management among health care providers

is necessary.

Numerous researches have been conducted by our team in various fields. Studies have been conducted in cancer biology, which includes breast cancer (Gan *et al.*, 2019), hepatic carcinoma (Jainu *et al.*, 2018), laryngeal cancer (Wang, 2019), oral cancer (Rengasamy *et al.*, 2018; Ramya *et al.*, 2018), and thyroid cancer (Ma, 2019) etc. Studies are also focussed on metabolic disorders (Ponnulakshmi *et al.*, 2019; Shukri, 2016), herbal medicines (Chen, 2019; Menon *et al.*, 2016), active constituents (Li, 2020; Mohan *et al.*, 2015), nanoparticles (Wu, 2019; Ke, 2019) and protein characterization (Rengasamy, 2016). The aim of the research was to assess and improve the knowledge about mercury spill management among healthcare providers to overcome the hazards to mercury spill.

MATERIALS AND METHODS

The study was conducted among healthcare providers in Chennai. The sample size was 100. The survey was conducted through an online basis and the questions asked were close ended questions. Questions included in the survey were based on mercury spill management and its hazards. A questionnaire composed of 10 questions (Figure 1) was prepared and circulated using an online platform google forms. The responses were collected and analysed. Correlation analysis was done by chi square test using SPSS software. Method of representation of data was done using bar graphs. Statistical software used was Spss. Statistical test used was the chi square test.

RESULTS AND DISCUSSION

The response of the survey was collected and tabulated in the form of bar graphs. When inquired about the awareness of the mercury spill management among healthcare providers, 98% of the participants responded. Correlation analysis was done by chi square test using SPSS software. It was disappointing to find that healthcare providers had mere knowledge about the mercury spill management.

The response of the survey was collected and the table later in the form of a bar graph. It was disappointing to know the healthcare providers had very little knowledge about mercury spill management and its uses. The questions were many focused on mercury spill management, its uses and hazards of mercury spills. In the present study, 71.6% of the students were aware that mercury is used in a variety of medicine and devices while 28.4% of the healthcare providers were not aware of it [Figure 2]. The x axis represents the uses of mercury and y axis represents the number of responses. 71.6% were aware and 28.4% was not aware.

In the current study 8.8% of the healthcare providers believed that mercury vapours causes cough, while 31.4% believe that it causes irritability, 25.5 % of the students believed that mercury vapour causes memory loss, while 34.3 % believes all three cough, irritability and memory loss [Figure 3]. The X axis represents side effects of mercury and Y axis represents the number of responses. 8.8% cough, 31.4% irritability, 25.5% memory loss and34.3% believe all of the above.

64.7% of the students believe that mercury is easily absorbed in the skin, while the other 35.3% believe that mercury does not get absorbed in the skin [Figure 4]. The axis represents the nature of mercury and Y axis represents the number of responses. 64.7% of them believe it absorbs in the skin and 35.3% opposes it. 60.8% of the healthcare providers were aware of mercury spill management while 39.2% were not of mercury spills management [Figure 5]. The X axis represents the awareness and Y axis represents the number of responses. 60.8% of them were aware and 39.2% of them were not aware.

7% of the students believed that we are supposed to wipe the mercury spill with alcohol, while 34.3% of the students believe the phenyl was used to write the mercury spill and 52% were aware hypochlorite solution is used to wipe the mercury spill 7 % of students believed neither alcohol, phenols or hypochlorite solution is used [Figure 6]. The X axis represents the cleaning of mercury spill and Y axis represents number of respiratory.7% believes with alcohol, 34.3% believes phenyl, 52%believes hypochlorite solution and 7% believes none of the above.

12.7% of the students believed that mercury seen only in dental amalgam while 40.2% believed that mercury is seen in sphygmomanometer, 16.7% believe in thermometer and only 30.4% of the study where are there that mercury is found in dental amalgam, sphygmomanometer and thermometer [Figure 7]. The X axis represents the materials in which mercury is found and Y axis represents the number of responses.12.7% believed dental amalgam, 40.2% believes sphygmometer, 16.7% thermometer and 30.4%believes all of the above.

In the current study for the prevention of exposure to mercury spill, 10.8% believes PPE, 29.4 % believes mercury spill management and 59.8% believes both [Figure 8]. The X axis denotes the materials by which materials by which exposure of mercury can be prevented and Y axis denotes the number of response.10.8% believes PPE, 29.4 % believes mercury spill management and 59.8%believes both.

For the corrosiveness of mercury, 31.4% believe skin, 63.7% nose and 4.9% believes teeth [Figure 9]. The X axis represents the part affected due to the corrosive nature of mercury and Y axis represents the number of responses.31.4% believe skin, 63.7% nose and 4.9% believes teeth.

For the awareness of the protocol for mercury spill management, 43.1% of the students were aware and 56.9% were not aware [Figure 10]. The X axis represents the awareness and Y axis represents the number of responses. 43.1% saids yes and 56.9% says no.

For the training in mercury spill management, 50% of the dental students have been trained and 50% has not been trained [Figure 11]. The X axis represents the training awareness while Y axis represents the number of responses. 50% of the dental students have been trained and 50% have not been trained.

Chi square test was done in comparison with the gender of the respondents. The graph showed only 18% of the females and 17% of the males were aware of the side effects of mercury Figure 12 shows that The X axis represents gender while Y axis represents the number of responses. Blue colour denotes cough, green colour denotes irritability, beige colour denotes memory loss and purple colour denotes all of the above. Majority of the females (18 participants) were aware that cough, irritability and memory loss are the side effects of mercury spill. How-

ever the difference in awareness among males and females is not statistically significant.

(Pearson chi square value= 0.935, p value 0.427 (> 0.05) is statistically not significant. The association shows that 29% of the males and 24% of the females were aware that hypochlorite solution is used to wipe the mercury spill Figure 13 shows that X axis represents gender and Y axis represents the number of responses. Blue colour denotes the alcohol, green colour denotes phenyl, beige colour denotes hypochlorite solution and purple colour denotes none of the above. Majority of the males (29 participants) were aware that sodium hypochlorite is used for cleaning mercury spill. However the difference in knowledge between the male and female is not statistically significant. Pearson chi square test value is 0.800, p value is 1.006 (>0.05) which is statistically not significant. The association showed that 29% of the females and 30% of the males were aware that the exposure to mercury can be reduced by using PPE and mercury spill management Figure 14 shows that The X axis represents the gender and Y axis represents the number of responses. Blue denotes PPE, green denotes mercury spill management and beige denotes both. Majority of the males (30 participants) were aware about the measure to avoid exposure to mercury spill. However the difference in knowledge between the male and female is not statistically significant. Pearson chi square test 0.173, p value is 3.507 (>0.05) which is statistically not significant. The association graph shows that only 17% of the females and 14% were aware that mercury is corrosive to skin Figure 15 shows that The X axis represents the gender and Y axis represents the number of responses. Blue denotes the skin, green denotes the nose, beige denotes teeth. Majority of the males (24 participants) responded that mercury is more toxic to teeth. .However the difference is not statistically significant. Pearson chi square value is 0.612, p value is 0.982 (>0.05) which is statistically not significant. The correlation shows that 37% of the male and 35% of the females were aware of the mercury spill management Figure 16 shows that The X axis represents the gender and Y axis represents the number of responses. Blue denotes the yes and green denotes no. Majority of males (37 participants) were aware about mercury spill management.However the difference in awareness between the male and female is not statistically significant. Pearson chi square test 0.172, p value is 0.137 (>.05) which is statistically not significant. Association graph depicts that only 30% of the females and 33% of the males were trained in mercury spill management Figure 17 shows that The X axis represents the gender and Y axis represents the number of responses. Blue denotes the yes and green denotes no. However the difference in awareness between the male and female is not statistically significant. Pearson chi square test 0.007, p value is 0.189 (>.05) which is statistically not significant.

Mercury is the neurotoxin which is used in medicine and devices. Medicinal personals, especially dentists deal with mercury regularly (Boening, 2000). Mercury as such is not absorbed in the skin but inhalation of its vapour is harmful (Andreescu, 2017). Use of PPE, safe disposal using hypochlorite solutions are some of the precautions for mercury spill management. Mercury is a very toxic substance, people can be exposed to it in many ways (Baughman, 2006). There are many side-effects of mercury, in serious condition it can lead to death also. Mercury causes skin rashes, eye irritation and lung damage (Melville, 1936). Mercury spill in water leads to mercury laced fish and meat. Foetus and children are more susceptible towards mercury spill (Zahir, 2005). Among dentists, greatest potential hazard results from contamination of hands after working with fresh amalgam and mercury metal. Unawareness of dentists about mercury could be hazardous (Buchwald, 1972). Amalgam has shown to be the most versatile and durable of all restorative materials used in dental treatments. Each practitioner should realise the potential hazards associated with mercury and should practise good mercury hygiene measures (Perim and Goldberg, 1984). Mercury containing a thermometer and sphygmomanometer is preferred for medicinal use. Educating health personnel and public about correct handling of mercury and its management is necessary (Halder, 2015; Wang, 2019). Mercury spill has a significant impact on public health and economic value. Safe handling of mercury is of utmost importance and securely storing mercury is also necessary (Zeitz *et al.*, 2002).

CONCLUSION

From the study it is evident that the healthcare providers had very little knowledge on mercury spill management, despite the fact that they deal with mercury every day. The chi square analysis showed that males were more aware about the corrosiveness of mercury and the management of mercury spill. Hence it is of utmost importance to enhance the awareness on spill management among the healthcare providers. This study will establish a future scope by creating awareness among the general population to reduce the risk of mercury spills.

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Conflict Of Interest

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

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REFERENCES

Andreescu, C. F. 2017. Neurotoxic effects of mercury exposure for dental workers - A literature review. *Dental, Oral and Craniofacial Research*, 3(4).

Azziz-Baumgartner, E. 2007. Exposure assessment of a mercury spill in a Nevada school-2004. *Clinical Toxicology*, pages 391–395.

Babu, S. G., Shetty, S. R., Bhat, S., Sushma, M. K. 2011. Biomedical dental waste management and awareness of waste management policy among private dental practitioners in Mangalore city. *Tanzania Dental Journal*, 16(2):1–5.

Baughman, T. A. 2006. Elemental Mercury Spills. *Environmental Health Perspectives*, 114(2):147–152.

Boening, D. W. 2000. Ecological effects, transport, and fate of mercury: a general review. *Chemosphere*, 40(12):1335–1351.

Buchwald, H. 1972. Exposure of Dental Workers to Mercury. *American Industrial Hygiene Association Journal*, 33(7):492–502.

Ceaser, M. A. 2003. Mercury spill control & cleanup. *Occupational health & safety*, 72(7):94–96.

Chen, F. 2019. 6-shogaol, a active constiuents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (HaCaT cells). *Journal of photochemistry and photobiology. B, Biology*, 197:111518–111518.

Clarkson, T. W., Magos, L. 2006. The Toxicology of Mercury and Its Chemical Compounds. *Critical Reviews in Toxicology*, 36(8):609–662.

Clevenger, W. L., Smith, B. W., Winefordner, J. D. 1997. Trace Determination of Mercury: A Review. *Critical Reviews in Analytical Chemistry*, 27(1):1–26.

Gan, H., Zhang, Y., Zhou, Q. 2019. Zingerone induced caspase-dependent apoptosis in MCF-7 cells and prevents 7,12-dimethylbenz(a)anthracene-induced mammary carcinogenesis in experimental rats. *Journal of Biochemical and Molecular Toxicology*, 33(10).

Goldman, L. R., Shannon, M. W. 2001. Technical Report: Mercury in the Environment: Implications for Pediatricians. *PEDIATRICS*, 108(1):197–205.

Halder, N. 2015. Awareness assessment of harmful effects of mercury in a health care set-up in India: A survey-based study. *Toxicology and industrial health*, (12):1144–1151.

Ishigaki, T., Yanase, R. 2016. Environmentally-sound Final Disposal of Mercury Waste. *Material Cycles and Waste Management Research*, 27(6):404–411.

Jainu, M., Priya, V., Mohan, S. 2018. Biochemical evidence for the antitumor potential of Garcinia mangostana Linn. On diethylnitrosamine-induced hepatic carcinoma. *Pharmacognosy Magazine*, 14(54):186–186.

Ke, Y. 2019. Photosynthesized gold nanoparticles from Catharanthus roseus induces caspase-mediated apoptosis in cervical cancer cells (HeLa). *Nanomedicine, and Biotechnology*, pages 1938–1946.

Langley, R. 2013. Notes from the field: elemental mercury spill in school bus and residence - North Carolina. *Morbidity and mortality weekly report*, 63(6):131–131.

Li, Z. 2020. Apoptotic induction and anti-metastatic activity of eugenol encapsulated chitosan nanopolymer on rat glioma C6 cells via alleviating the MMP signaling pathway. *Journal of photochemistry and photobiology. B, Biology*, 203:111773–111773.

Ma, Y. 2019. Sesame Inhibits Cell Proliferation and Induces Apoptosis through Inhibition of STAT-3 Translocation in Thyroid Cancer Cell Lines (FTC-133). *Biotechnology and Bioprocess Engineering*, pages 646–652.

Melville, H. W. 1936. The mercury photosensitised polymerisation of acetylene. *Transactions of the Faraday Society*, 32:258b–258b.

Menon, A., Priya, V. V., Gayathri, R. 2016. Preliminary Phytochemical Analysis And Cytotoxicity Potential Of Pineapple Extract On Oral Cancer Cell Lines. *Asian Journal of Pharmaceutical and Clinical Research*, 9(8):140–143.

Mohan, S. K., Veeraraghavan, V. P., Jainu, M. 2015. Effect of pioglitazone, quercetin and hydroxy citric acid on extracellular matrix components in experimentally induced non-alcoholic steatohepatitis. *Iranian journal of basic medical sciences*, 18(8):832–836.

Perim, S. I., Goldberg, A. F. 1984. Mercury in hospital dentistry. *Special Care in Dentistry*, 4(2):54–55.

Ponnulakshmi, R., Shyamaladevi, B., Vijayalakshmi, P., Selvaraj, J. 2019. In silicoandin vivoanalysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. *Toxicology Mechanisms and Methods*, 29(4):276–290.

Ramya, G., Priya, V. V., Gayathri, R. 2018. Cytotoxicity Of Strawberry Extract On Oral Cancer Cell Line. *Asian Journal of Pharmaceutical and Clinical Research*, 11(9):353–355.

Rengasamy, G. 2016. Characterization, Partial Purification of Alkaline Protease from Intestinal Waste of Scomberomorus Guttatus and Production of Laundry Detergent with Alkaline Protease Additive. *Indian Journal of Pharmaceutical Education and Research*, 50(2):59–67.

Rengasamy, G., Venkataraman, A., Veeraraghavan, V. P. 2018. Cytotoxic and apoptotic potential of Myristica fragrans Houtt. (mace) extract on human oral epidermal carcinoma KB cell lines. *Brazilian Journal of Pharmaceutical Sciences*, 54(3):1–7.

Rennie, A. C. 1999. Lesson of the week: Mercury poisoning after spillage at home from a sphygmomanometer on loan from hospital. *BMJ*, pages 366–367.

Shukri, N. M. M. 2016. Awareness in childhood obesity. *Research Journal of Pharmacy and Technology*, pages 1658–1658.

Spiegel, S. J., Veiga, M. M. 2010. International guidelines on mercury management in small-scale gold mining. *Journal of Cleaner Production*, 18(4):375–385.

Wang, Y. 2019. Synthesis of Zinc oxide nanoparticles from Marsdenia tenacissima inhibits the cell proliferation and induces apoptosis in laryngeal cancer cells (Hep-2). *Journal of photochemistry and photobiology. B, Biology*, 201:111624–111624.

Wu, F. 2019. Biologically synthesized green gold nanoparticles from induce growth-inhibitory effect on melanoma cells (B16). *Artificial cells, nanomedicine, and biotechnology*, 47(1):3297–3305.

Zahir, F. 2005. Low dose mercury toxicity and human health. *Environmental toxicology and pharmacology*, 20(2):351–360.

Zeitz, P., Orr, M. F., Kaye, W. E. 2002. Public health consequences of mercury spills: Hazardous Substances Emergency Events Surveillance system, 1993-1998. *Environmental Health Perspectives*, pages 129–132.