Knowledge and Applicational arsenic poisoning among dental students- A Survey

ABSTRACT

Arsenic pollution of groundwater has far-reaching implications, including consumption through the food chain, which manifests as social problems, health dangers, and socioeconomic breakdown, as well as sprawling with mobility and groundwater mining. Food crops grown with arsenic-affected water are marketed to other locations, including uncontaminated areas where residents may be exposed to arsenic via the contaminated food. This could result in the emergence of a new threat.

KEYWORDS

Arsenic; poisoning; groundwater; cancer.

INTRODUCTION

Arsenic is one of the most hazardous metals that may be found in nature. The main source of human arsenic toxicity is natural geological contamination of drinking water, rather than mining, smelting, or agricultural sources (pesticides or fertilisers) (1) . Drinking water in many industrialised and developing countries is contaminated by arsenic (2,3). Bangladesh , West Bengal and India, are the two worst-affected countries on the planet.

Groundwater arsenic concentrations exceeding the World Health Organization's maximum allowed level of 50 g/l are present in 42 districts in southern Bangladesh and nine nearby districts

in West Bengal, exposing 79.9 million and 42.7 million people, respectively (4)The cause of arsenic in each of these locations is geological, damaging aquifers that supply water to nearly one million tube wells (5,6). The concentration of arsenic in some tube wells in West Bengal is as high as 3400 g/l (7).

Arsenic is a human carcinogen that has been linked to a number of negative health effects. (8)Raindrop pigmentation, hyperpigmentation, hyperkeratosis, squamous cell carcinoma, basal cell carcinoma, and Bowen's disease are all skin disorders caused by chronic arsenic exposure. (9) . Toxic metals have a significant impact on dental health. Melanocytes in the oral mucosa's basal cell layer are comparable to those found in the skin (10) After oral cavity lesions, oral cancer is the sixth most prevalent cancer worldwide, and it continues to be a significant health problem (11).

Arsenic pollution of groundwater has far-reaching implications, including consumption through the food chain, which manifests as social problems, health dangers, and socioeconomic breakdown, as well as sprawling with mobility and groundwater mining. Food crops grown with arsenic-affected water are marketed to other locations, including uncontaminated areas where residents may be exposed to arsenic via the contaminated food. This could result in the emergence of a new threat.

A number of counteractive actions, initiatives, and research projects have been launched and put into operation, primarily in West Bengal, to tackle the arsenic threat.

This survey based study is one such initiative to determine the level of knowledge and awareness of dental students about arsenic poisoning.

MATERIALS AND METHOD

Study Setting

The Institutional Ethics Committee gave its clearance to the study [SDC/SIHEC/2020/DIASDATA/0619-0320]. One reviewer, one assessor, and one guide were involved in the research.

Study Design

All students in years I, II, III, and IV BDS, as well as interns and post-graduates, were invited to participate in the study.

Sampling Technique

A non-probability consecutive sampling strategy was used in the investigation. All replies were evaluated and incorporated to reduce sample bias.

Data Collection and Tabulation

The poll was performed using Google Forms, an online platform. All data were included to reduce sampling bias. The data was taken from Google Forms and imported into Excel, where it was tabulated. The data was tallied and analysed.

RESULT AND DISCUSSION

The survey involved 244 students, and the data were gathered and examined. 25% were 1st year students, 25% were 2nd year students, 25% were 3rd year students and 25% were 4th year students [Figure 1]. [Figure 2] represents if the undergraduate students have any knowledge about arsenic poisoning. [Figure 3] represents when/how they were aware about arsenic poisoning . [Figure 4] represents the knowledge of undergraduate students about the Cause/Source of Arsenic Poisoning. [Figure 5] represents the knowledge of undergraduate students about early symptoms of arsenic poisoning . [Figure 6] represents the knowledge of undergraduate students about the more visible symptoms of arsenic poisoning. [Figure 7] represents the knowledge of undergraduate students about diseases caused because of arsenic poisoning. [Figure 8] represents the knowledge of undergraduate students about how long it takes to develop visible symptoms. [Figure 9] represents the knowledge of undergraduate students about How long it takes to develop cancer. [Figure 10] represents the knowledge of undergraduate students about how arsenic can be removed from the water. [Figure 11] represents the knowledge of undergraduate students about the use of arsenic in dentistry. [Figure 12] represents the knowledge of undergraduate students about the common oral symptoms due to arsenic leakage into the oral cavity.

For the question if the undergraduate students have any knowledge about arsenic poisoning 84.8% of the study population said yes whereas about 15.2% of the study population said no.

For the question: how long have they had an idea about arsenic poisoning? 41% of the study population said they have had an idea for more than 1 year whereas 59% of the study population said they had an idea for less than one year. For the question What is the source of arsenic poisoning 56.4% of the study population said it was due to drinking of arsenic contaminated tubewell water, 20.7% of the study population said it was due to use of arsenic containing products, 14.9% of the study population said it was due to release of contaminants from factories into the atmosphere and 7.9% of the study population said it was none of the other option. Arsenic (As) is released into the soil and groundwater as a result of the weathering of rocks and minerals, which is followed by leaching and runoff. Anthropogenic sources can also release it into soil and groundwater (12). For the question what are the early symptoms of arsenic poisoning, 65.1% of the study population said it was darkening of skin on palms, 15.1% of the population said it was due to skin rash, 10.1% of the study population said it was itching, and about 9.7% of the study population it was loss of appetite. The skin, lungs, liver, and blood systems are the most common chronic symptoms. Prof. K. C. Saha of the School of Tropical Medicine, Calcutta, discovered this in West Bengal and Bangladesh patients of Khulna in December 1984 (13)(14,15).The cutaneous alterations are distinct but not unique. An initial erythematous flush progresses to melanosis, hyperkeratosis, and desquamation over time. The skin pigmentation is spotty (16) and has been described as "raindrops on a sandy road" in lyrical terms. The hyperkeratosis is often punctate and affects the distal extremities. There is also a generalised desquamation of the palms and soles. For the question What are the more visible symptoms of arsenic ?72.1% of the study population said it was cardiovascular disorder, 15.4% of the study population it was weight loss, 6.3% of the study population said it was itching and 6.3% of the study population said it was a coma. Several epidemiological studies have suggested

that chronic inhalation of arsenic trioxide increases the risk of death from cardiovascular disease in humans(17–19). Inhaling inorganic arsenic over an extended period of time can harm blood vessels and the heart. In children who drank water containing about 0.6 mg/l arsenic, (20)documented multiple incidences of myocardial infarction and arterial thickening. For the question, what are the diseases caused because of arsenic?60.4% of the study population said it caused bladder cancer, 19.2% of the study population said it caused stomach cancer, 12.5% of the study population said it caused stroke and about 7.9% of the study population said it caused arthritis. Presently, epidemiological investigations of communities exposed to high levels of inorganic As have found substantial links and dose–response connections between As in drinking water and bladder cancer, as well as probable links with kidney cancer (21). These studies usually focus on locations of high exposure, with As levels in drinking water ranging from 150 to over 1000 ug/L. The extent to which health impacts may develop at lower levels of exposure (150 g/L) is unknown, with many studies failing to show the harm that may be expected based on findings from high levels of exposure (22). For the question: How long does it take to develop visible symptoms due to arsenic poisoning ?, 71.7% of the study population said it would be visible in 2-10 years, 11.8% of the study population said it would be visible in 15-18 years, 10.5% of the study population said it would be visible in 15-30 years, 5.9% of the study population said it would be visible in 1-2 years. The onset is gradual, with symptoms like abdominal pain, diarrhoea, and a sore throat.(23). For the question how long it takes to develop cancer post exposure to chronic arsenic poisoning, 74.4% of the study population said it will take about 5-20 years, 11.5% of the population said it will take about 6-8 years , 9.4% of the study population said it will take about 30-50 years and 4.7% of the study population said it will take about 2-4 years. Arsenic-related Bowen's disease can appear 10 years after exposure to arsenic,

but other types of skin cancer can take 20 or 30 years to manifest (24). For the question How can arsenic be removed from the water ?, 26.4% of the study population said it can be removed by arsenic treatment plant, 8.7% of the study population said it can be removed by filters, 5.6% of the study population said it can be removed by the use of tablets, 59.3% of the study population said it can be removed by all of the up mentioned methods. So far, arsenic removal experiments have yielded positive results. The removal of arsenic from drinking water was discovered to be possible by running the water through wood-charcoal at a controlled flow rate, treating the water with calcium oxide, using the sedimentation process, and repeatedly removing the top surface layer having high levels of arsenic. These approaches could be used to remove arsenic from drinking water in a cost-effective and straightforward manner (25). For the question respondents knowledge about the use of arsenic in dentistry is mainly for?65.7% of the study population said it is for the use as a root canal treatment component. 8.7% of the study population said it is used as a component of implant, 12% of the study population said it is used as a component of anesthetic, whereas 13.6% of the study population said it was none of the above options. For the Dental pastes containing arsenic trioxide, an arsenic-based chemical, have been used to eliminate injured nerves in the dental pulp (the inside of the tooth). Analyses of data from laboratory and population research show that the arsenic contained in these dental goods may represent a danger of genotoxic effects, which could increase the risk of cancer, according to an assessment of the benefits and risks of these dental products. Furthermore, arsenic is suspected to have spilled into the areas around the teeth in a small number of cases, causing sections of the tissue, including bone, to die (26). For the question what are the common oral symptoms due to arsenic leakage into oral cavity, 9% of the study population said it caused necrosis of oral tissue, and osteomyelitis, and 7.8% of the study population said it caused oroantral fistula, 74.2% of the

study population that all the above mentioned symptoms are oral symptoms of arsenic poisoning (8).

Figure 1: This pie chart depicts the demographics of the research participants, with blue denoting 1st year students , red denoting 2nd year students, yellow denoting 3rd year students and green depicting final year students . 25% of the study population fall into the 1st year category, 25% of the study population fall into the 2nd year category, 25% fall into the 3rd year category and 25% fall into the 4th year category.

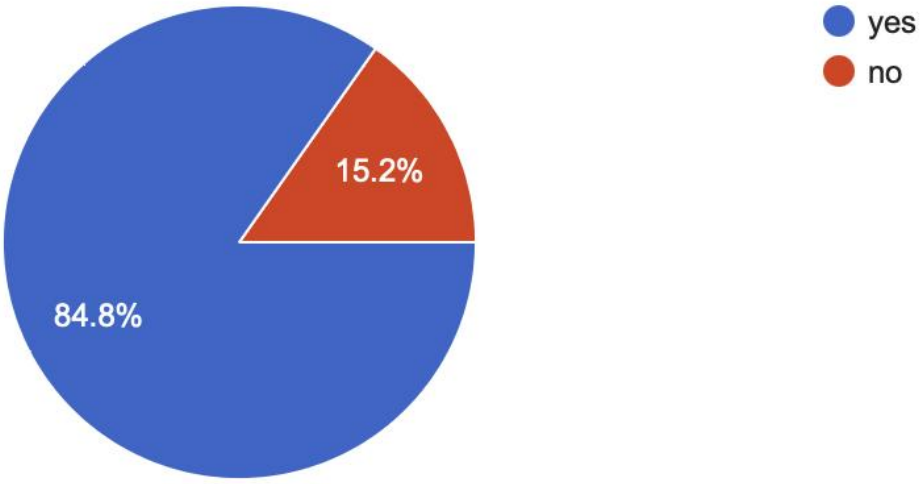

Figure 2: This pie chart depicts Respondent Knowledge about Arsenic Poisoning, it asks the question, if they were aware or unaware of poisoning problem, blue denotes yes whereas red denotes number of 84.8% of the study population said yes whereas about 15.2% of the study population said no.

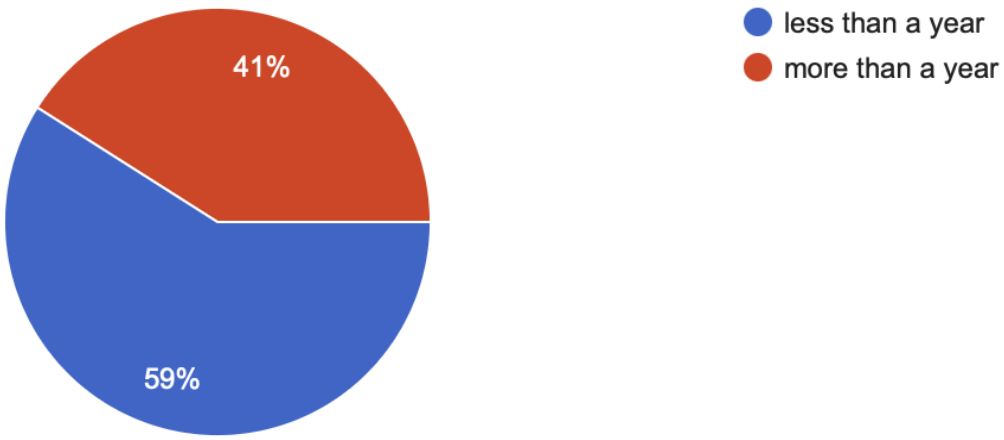

Figure 3: This pie chart depicts the respondents duration of the knowledge about arsenic poisoning, blue denotes respondents who have had knowledge for about less than a year and red denotes respondents who have had knowledge for more than a year. 59% of the respondents have had knowledge for less than a year whereas 41% of the respondents have had knowledge for more than a year

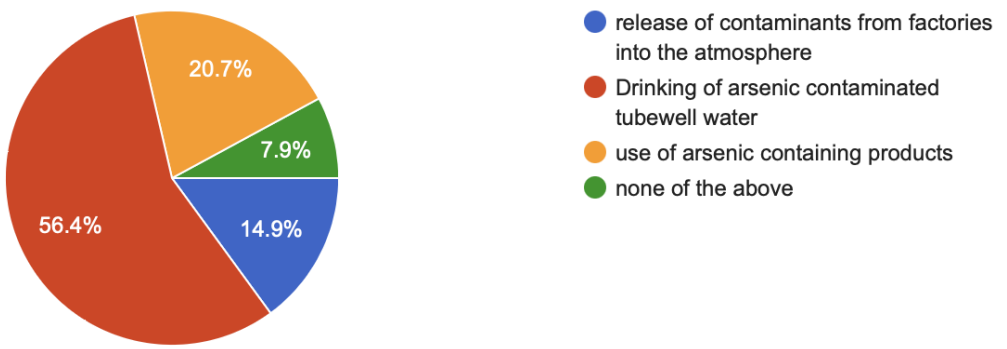

Figure 4: This pie chart depicts respondents Knowledge about the Cause/Source of Arsenic Poisoning , blue denotes the source is from release of contaminants from factories into the atmosphere, red denotes the source is from Drinking of arsenic contaminated tubewell water, yellow denotes the source is from use of arsenic containing products and green denotes none of the above mentioned options. 56.4% of the respondents said it was caused due to Drinking of arsenic contaminated tubewell water, 20.7% of the respondents said it was caused due to use of arsenic containing products, 14.9% of the respondents said it was caused due to release of contaminants from factories into the atmosphere and 7.9% of the respondents said it was none of the above options.

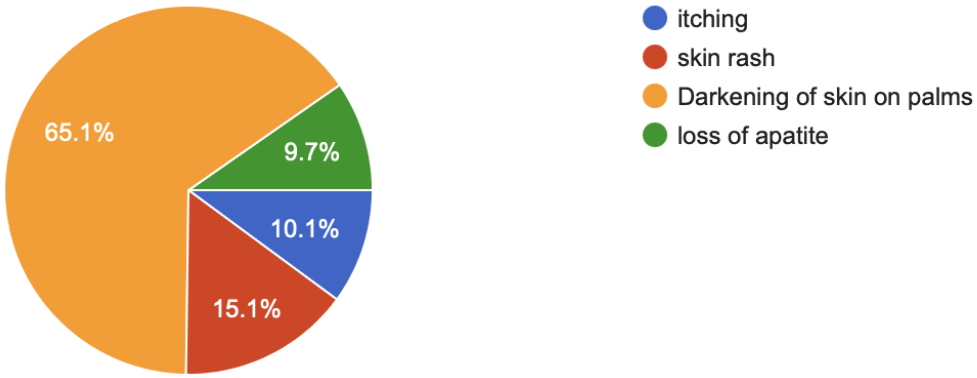

Figure 5: This pie chart respondents knowledge about early Symptoms of Arsenic Poisoning, blue denotes itching, red denotes skin rash, yellow denotes darkening of skin on palms and green denotes loss of appetite, 65.1% of the respondents said darkening of skin is the early symptoms of arsenic poisoning, 15.1% of the respondents said skin rash is the early symptoms, 10.1% of the respondents said itching is a early symptom and 9.7% of the respondents said loss of appetite is an early symptoms.

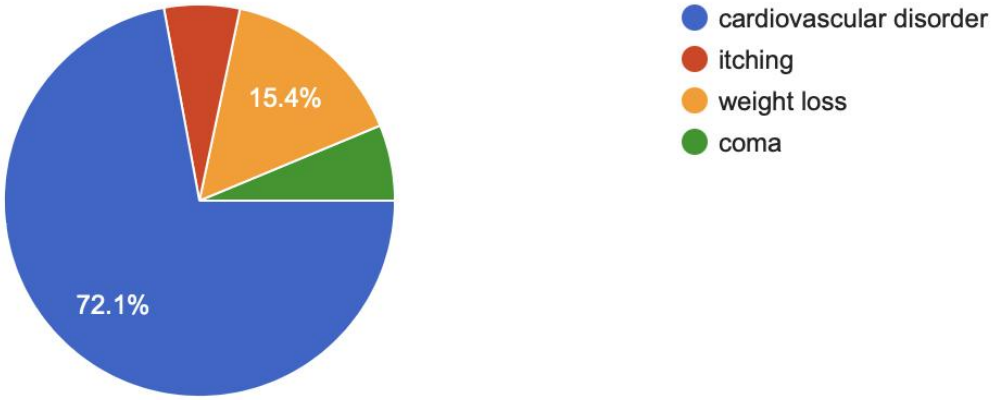

Figure 6: This pie chart depicts respondents' knowledge about the more visible symptoms of arsenic poisoning, blue denotes cardiovascular disorder, red denotes itching, yellow denotes weight loss and green denotes coma. 72.1% of the respondents said cardiovascular disorder is the more visible symptom of arsenic poisoning, 15.4% of the respondents said weight loss is the more visible symptom, 6.3% of the respondents said itching is a more visible symptom and 6.3% of the respondents said coma is a more visible symptom.

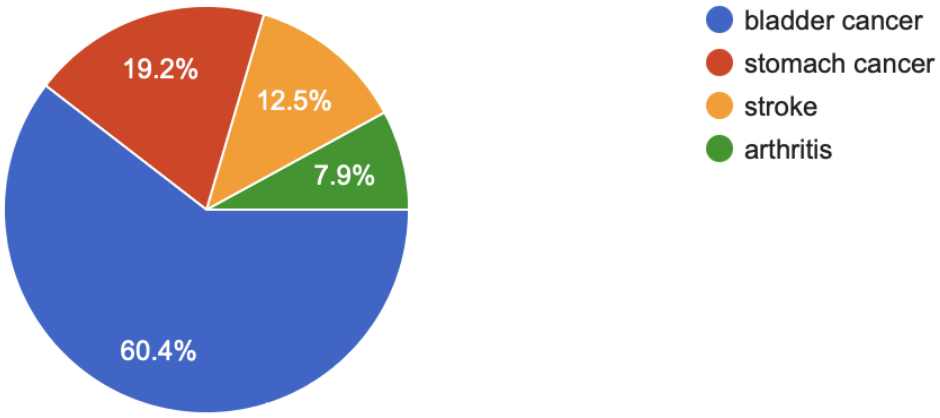

Figure 7: This pie chart depicts Respondents Knowledge about Arsenic-Related Diseases, blue denotes bladder cancer, red denotes stomach cancer, yellow denotes stroke and green denotes arthritis. 60.4% of the respondents said bladder cancer is an arsenic related disease. 19.2% said stomach cancer is an arsenic related disease, 12.5% said stroke is an arsenic related disease and 7.9 said arthritis is an arsenic related disease.

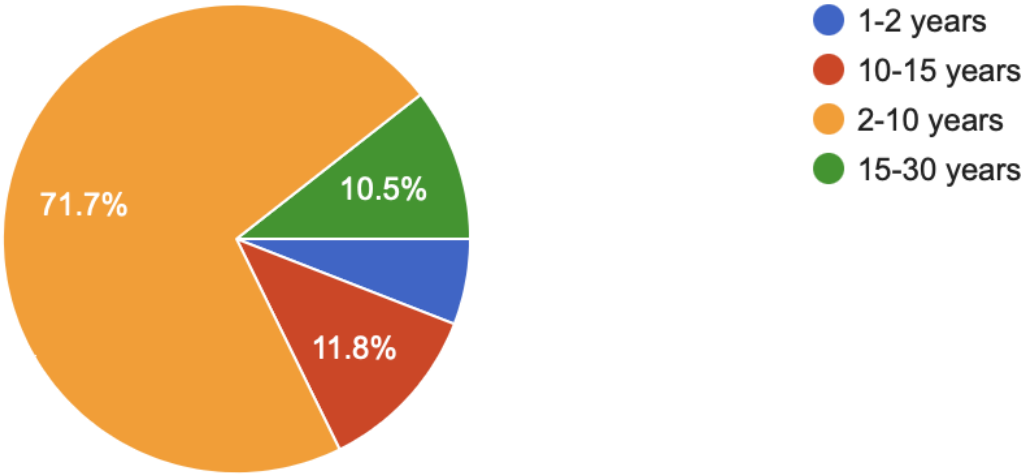

Figure 8: This pie chart depicts the respondents knowledge about how long it takes to develop visible symptoms. Blue denotes 1-2 years, red denotes 10-15 years, yellow denotes 2-10 years and green denotes 15-30 years. 71.7% of the respondents said the visible symptoms develop in about 2-10 years, 11.8% of the respondents said the visible symptoms develop in about 10-15 years, 10.5% of the respondents said the visible symptoms develop in about 15-30 years and 5.9% of the respondents said the visible symptoms develop in about 1-2 years.

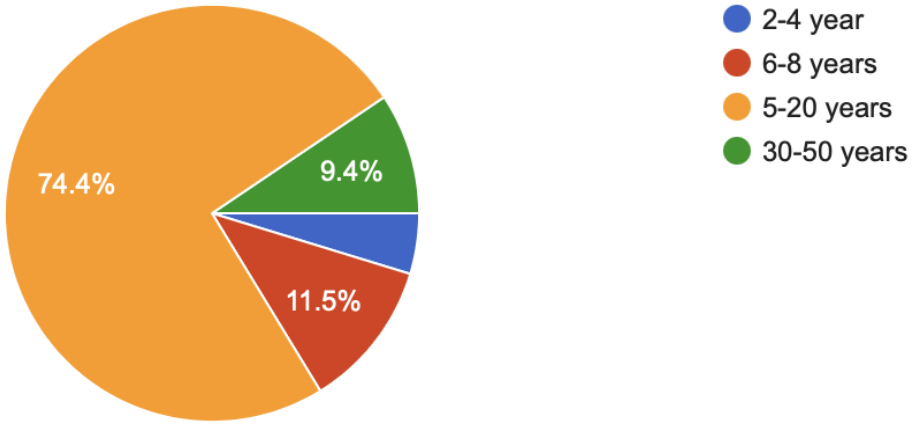

Figure 9: This pie chart depicts respondents' knowledge about duration to develop cancer due to arsenic poisoning. Blue denotes respondents who chose the option 2-4 years, red denotes respondents who choose the option 6-8 years, yellow denotes the respondents who choose the option 5-20 years and green denotes the respondents who choose the option 30-50 years. 74.4% of the respondents choose the option 5-20 years, 11.5% of the study population choose the option 6-8 years, 9.4% of the respondents choose the option 30-50 years and 4.7% of the respondents choose the option 2-4 years.

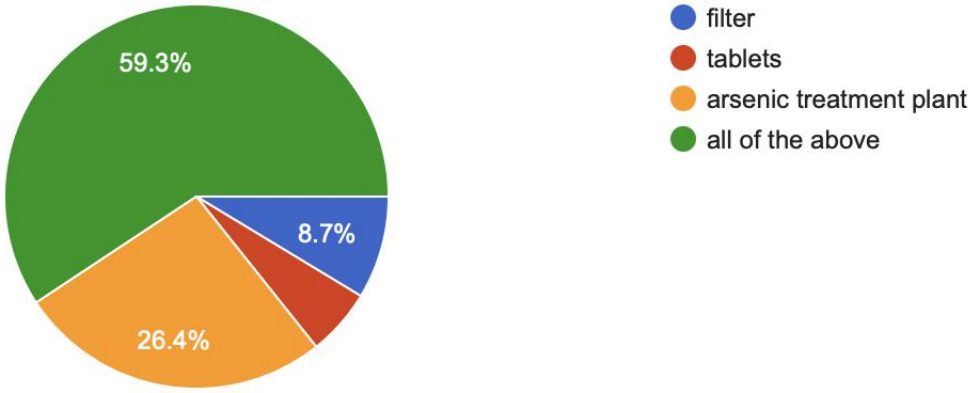

Figure 10: This pie chart depicts respondents Knowledge about Preventive Measures to combat arsenic poisoning. Blue denotes the use of filters, red denotes the use of tablets, yellow denotes the use of arsenic treatment plant and green denotes all of the above option. 26.4% of the respondents choose the option arsenic treatment plant, 8.7% choose the option filters, 5.6% of the respondents choose the option tablets and 59.3% of the respondents choose the option all of the above.

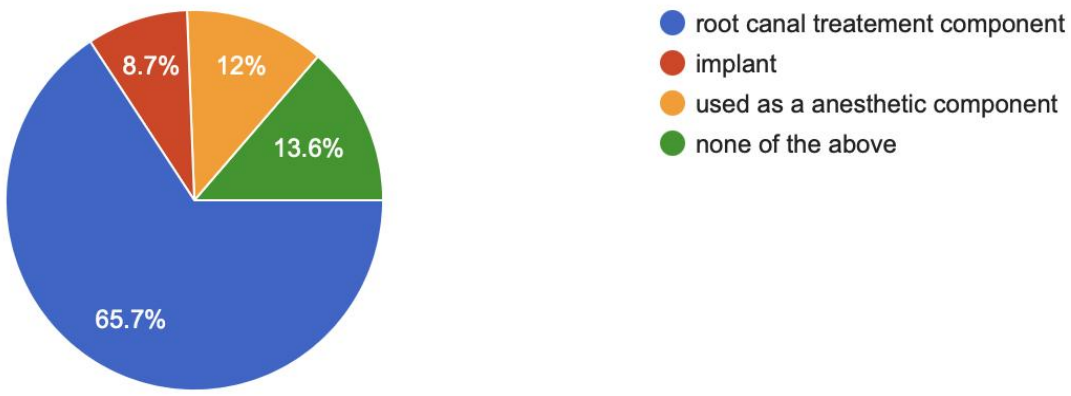

Figure 11: This pie chart depicts Respondents Knowledge about use of Arsenic in dentistry. Blue denotes its use as a root canal treatment component, red denotes its use as a component in implant, yellow denotes its use as a component in anesthetic agent and green denotes none of the above option. 65.7% of the respondents choose the option as a root canal treatment component. 8.7% of the respondents choose the option as a component of implant, 12% of the respondents choose the option as a component in anesthetic agent and 13.6% choose none of the other option.

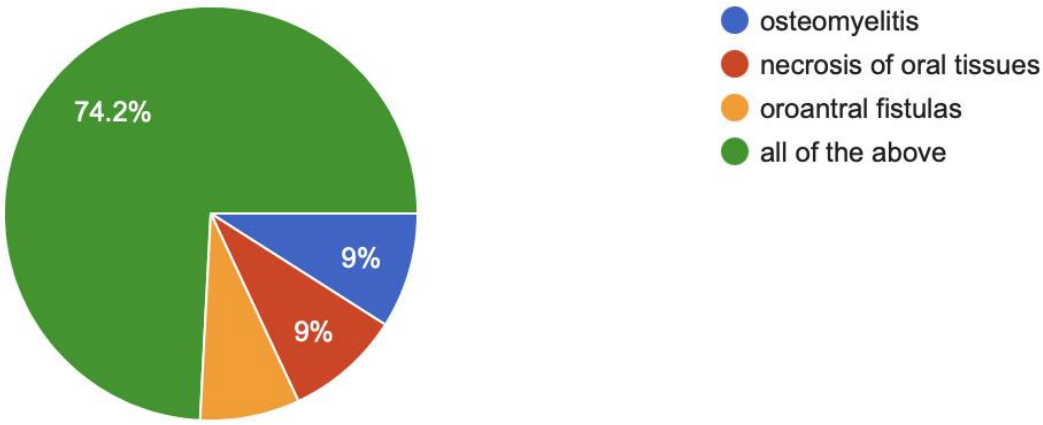

Figure 12: This pie chart depicts respondents knowledge about common oral symptoms due to arsenic leakage into oral cavity, blue denotes osteomyelitis, red denotes necrosis of oral tissue , yellow demotes oroantral fistulas and green notes all of the above option. 9% of the respondents choose the option osteomyelitis, 9% of the respondents choose the option necrosis of oral tissue, 7.8% of the respondents choose the option oroantral fistula and 74.2% choose all of the above.

CONCLUSION

The survey helped the students to understand the causes , symptoms and ways to prevent arsenic poisoning. They also were exposed to knowledge about use of arsenic in dentistry and the various oral symptoms that can be manifested. It was evident that students did have a well rounded understanding about arsenic poisoning.

REFERENCE

1. Matschullat J. Arsenic in the geosphere--a review. Sci Total Environ. 2000 Apr 17;249(1-3):297–312.

2. Gebel T. Confounding variables in the environmental toxicology of arsenic. Toxicology. 2000 Apr 3;144(1-3):155–62.

3. Zaw M, Emett MT. Arsenic removal from water using advanced oxidation processes. ToxicolLett. 2002 Jul 7;133(1):113–8.

4. Chowdhury UK, Biswas BK, Chowdhury TR, Samanta G, Mandal BK, Basu GC, et al. Groundwater arsenic contamination in Bangladesh and West Bengal, India. Environ Health Perspect. 2000 May;108(5):393–7.

5. Nickson R, McArthur J, Burgess W, Ahmed KM, Ravenscroft P, Rahmanñ M. Arsenic poisoning of Bangladesh groundwater [Internet]. Vol. 395, Nature. 1998. p. 338–338. Available from: http://dx.doi.org/10.1038/26387

6. Mukherjee AB, Bhattacharya P. Arsenic in groundwater in the Bengal Delta Plain: slow poisoning in Bangladesh [Internet]. Vol. 9, Environmental Reviews. 2001. p. 189–220. Available from: http://dx.doi.org/10.1139/a01-007

7. GuhaMazumder DN, Haque R, Ghosh N, De BK, Santra A, Chakraborty D, et al. Arsenic levels in drinking water and the prevalence of skin lesions in West Bengal, India. Int J Epidemiol. 1998 Oct;27(5):871–7.

8. Syed EH, Melkonian S, Poudel KC, Yasuoka J, Otsuka K, Ahmed A, et al. Arsenic exposure and oral cavity lesions in Bangladesh. J Occup Environ Med. 2013 Jan;55(1):59–66.

9. National Research Council, Division on Earth and Life Studies, Commission on Life Sciences, Subcommittee on Arsenic in Drinking Water. Arsenic in Drinking Water. National Academies Press; 1999. 330 p.

10. Müller S. Melanin-associated pigmented lesions of the oral mucosa: presentation, differential diagnosis, and treatment. DermatolTher. 2010 May;23(3):220–9.

11. Khlifi R, Hamza-Chaffai A. Head and neck cancer due to heavy metal exposure via tobacco smoking and professional exposure: a review. ToxicolApplPharmacol. 2010 Oct 15;248(2):71–88.

12. Gupta DK, Chatterjee S. Arsenic Contamination in the Environment: The Issues and Solutions. Springer; 2017. 218 p.

13. Saha KC. Melanokeratosis from arsenic contaminated tubewell water. Indian J Dermatol. 1984 Oct;29(4):37–46.

14. Saha KC. Chronic Arsenical Dermatoses From Tube- Well Water In West Bengal During 1983-87. Indian J Dermatol. 1995 Jan 1;40(1):1.

15. Santra BK. Arsenic Contamination of Groundwater in West Bengal: Awareness for Health and Social Problems [Internet]. Vol. 5, International Journal of Applied Science and Engineering. 2017. p. 43. Available from: http://dx.doi.org/10.5958/2322-0465.2017.00005.3

16. Barrett JC, Carl Barrett J, Lamb PW, Wang TC, Te Lee C. Mechanisms of arsenic-induced cell transformation [Internet]. Vol. 21, Biological Trace Element Research. 1989. p. 421–9. Available from: http://dx.doi.org/10.1007/bf02917284

17. Axelson O, Dahlgren E, Jansson CD, Rehnlund SO. Arsenic exposure and mortality: a case-referent study from a Swedish copper smelter [Internet]. Vol. 35, Occupational and Environmental Medicine. 1978. p. 8–15. Available from: http://dx.doi.org/10.1136/oem.35.1.8

18. . Lederer WH, . Fensterheim RJ. Arsenic. Industrial, Biomedical, Environmental Perspectives. 1983. 443 p.

19. Wall S. Survival and mortality pattern among Swedish smelter workers. Int J Epidemiol. 1980 Mar;9(1):73–87.

20. Zaldívar R. Arsenic contamination of drinking water and foodstuffs causing endemic chronic poisoning. BeitrPathol. 1974 Apr;151(4):384–400.

21. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. A Review of Human Carcinogens: Part C : Arsenic, Metals, Fibres, and Dusts. 2012. 501 p.

22. Cantor KP, Lubin JH. Arsenic, internal cancers, and issues in inference from studies of low-level exposures in human populations. ToxicolApplPharmacol. 2007 Aug 1;222(3):252–7.

23. Ratnaike RN. Acute and chronic arsenic toxicity. Postgrad Med J. 2003 Jul 1;79(933):391–6.

24. Yoshida T, Yamauchi H, Fan Sun G. Chronic health effects in people exposed to arsenic via the drinking water: dose-response relationships in review. ToxicolApplPharmacol. 2004 Aug 1;198(3):243–52.

25. Website [Internet]. Available from: https://www.researchgate.net/publication/237299633_Approaches_for_Removal_of_Arsenic_from_Tubewell_Water_for_Drinking_Purpose

26. Hyson JM Jr. A history of arsenic in dentistry. J Calif Dent Assoc. 2007 Feb;35(2):135–9.