Journal of Pharmaceutical Research International

33(37B): 111-116, 2021; Article no.JPRI.71157
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Assessment of Awareness Regarding Heavy Metal Toxicity in School Children

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Authors' contributions

This work was carried out in collaboration between both authors All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i37B32028
Editor(s):
(1) Dr. Mohamed Fawzy Ramadan Hassanien, Zagazig University, Egypt.
Reviewers:
(1) Ayobami Aigberua Omozemoje, Anal Concept Ltd, Nigeria.
(2) Ivona Nuić, University of Split, Croatia.
Complete Peer review History: https://www.sdiarticle4.com/review-history/71157

Original Research Article

Received 10 May 2021
Accepted 15 July 2021
Published 19 July 2021

ABSTRACT

Background: Heavy metal toxicity is increasing rapidly due to the increased use of products containing heavy metals daily life. It can cause acute or chronic toxicity if they used for long term unknowingly especially by the children.

Objectives:

1) To assess whether the school children have information about products containing heavy metal which are used in daily life and their hazardous effects with the help of structured questionnaire.
2) To sensitize the school children about the products containing heavy metal which are used in daily life and their hazardous effects.

Methods: Descriptive (cross sectional) observational study was designed among 300 primary and secondary school children. The questionnaires containing fifteen questions each carrying two marks (total 30 marks) about the products containing heavy metal and their hazardous effects on human body were given to students to fill the information and answers to the questions. Next day a sensitization program was conducted which was followed by the same questionnaire. The questionaries were assessed as pre and posttest.

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Result: All the students scored zero marks in the pretest. Hence, they were graded in no awareness category. After sensitization, in posttest 155 students (51.6%) scored between 21-30 marks and 144 students scored between 11-20 marks. The score of marks in posttest is highly significant.

Conclusion: Results indicate that there was no awareness in school children about the products containing heavy metal and their hazardous effects on human body. Awareness increased after the sensitization. Hence, to avoid the heavy metal toxicity in school children, it is highly recommended to make them aware regarding sources of heavy metals which are used in daily life and their hazardous effects on body. It can be done through awareness programs to be conducted at schools. It may be achieved by incorporating this point into the syllabus of the school children.

Keywords: Awareness; heavy metal; acute toxicity; chronic toxicity.

1. INTRODUCTION

A heavy metal may be defined as on the basis of density or atomic number or chemical behavior [1]. Heavy metals include Cadmium (Cd), Lead (Pb), Arsenic (As), Mercury (Hg) Manganese (Mn), Copper (Cu), Zinc (Zn), Nickel (Ni), Chromium (Cr), Fluoride(F), Iron (Fe), Aluminum (Al), Selenium(Se) etc**.** There are over 30 heavy metals but approximately ten of them are important in terms of exposure and health effects. There are four routes by which the heavy metals can enter the body: inhalation, skin (or eye) absorption, ingestion and injection. Many metallic elements in trace quantities are essential for various biological processes. Some of them activate enzymes; others facilitate exchange and utilization of oxygen and carbon dioxide. While most of these trace elements are acquired in adequate quantities through food, excessive exposure (nutritional, occupational or environmental) can lead to progressive accumulation and toxicity resulting in serious consequences [2-3]. Though the general perception is that heavy metal poisoning is uncommon, the actual fact is just converse. Heavy metal poisoning: acute or chronic is a major cause of morbidity and mortality all over the world and in India.

Heavy metal poisoning has been a main threat to living world. Even though adverse effect due to heavy metals is known, still exposure continues the same in most of the developed and developing countries. Traces of many heavy metals are required for proper functioning of the body. Most of our foods and drinks that we consume contain small traces of heavy metals but in general, these traces are not harmful. But the incorporation of excess heavy metals in the body results in toxic effects.

Cadmium (Cd) causes high blood pressure, liver and kidney damage and anemia. Lead (Pb) affects red blood cell chemistry, delays normal physical and mental development in babies and young children, increase in blood pressure in some adults. Exposure to the arsenic (As) causes the high risk of cancer of lung, skin, bladder and kidney, skin lesions such as hyperkeratosis and pigmentation changes. Mixture of Lead (Pb), Cadmium (Cd) and Arsenic (As) induces anemia type condition with decrease in RBC count and haemoglobin concentration [4-5]. Study on oestrous cycle revealed that sub chronic treatment with the mixture of heavy metals Cadmium (Cd), Lead (Pb) and Arsenic (As) causes irregularities in the reproductive cycle [6-8]. The study on implantation showed a significant pre implantation and post implantation loss in mixture of heavy metals cadmium (Cd), lead (Pb) and arsenic (As) treated animals with decrease in the number of live foetus [9]. Most of these heavy metals are carcinogens. Heavy metals are environmental pollutant due to their toxic effects on plants, animals and human being. They are toxic even at low concentrations [3,10].

Heavy metal toxicity is the main concern since seventy decades. The production of chemicals (including metals and their variants) around the world has increased dramatically in recent years. It has been reported that there has been a tenfold increase in the global output of chemicals worldwide. Chemicals including metals account for significant mortality and morbidity.

Now, it has entered in our daily routine life. Since morning to night people are using the products made up of heavy metals. Unknowingly, people are consuming heavy metals in traces or less quantity for years together which can cause chronic heavy metal poisoning. Especially, primary and secondary school going children are having habit of chewing pencil, pen, indirectly consuming ink and other metal products. Unawareness of immediate or late health effects

of consumptions of these products can lead to serious local and systemic toxic effects in future.

Hence, the study was planned to assess the awareness among school children regarding the knowledge of products containing heavy metals which are used in daily life and their hazardous effects on the body with the help of structured questionnaire. After the assessment, the students were sensitized regarding heavy metal products and their health effects.

2. MATERIALS AND METHODS

Descriptive (cross sectional) observational study was designed among 300 primary and secondary school children in Salod (Hirapur), District Wardha of Maharashtra state in India.

IEC approval was received with ref no. DMIMS (DU)/IEC/Sept-2019/8458 dated: 10/10/2019. Questionnaire about the common products containing heavy metals used in daily routine life and their effects on body was prepared in regional language (Marathi).

Primary and secondary schools were identified and selected from Neri Punarvasan, Salod (H), District Wardha. Written permission was taken from the headmasters of the respective schools. Total 300 students were selected from Jilha Parishad Primary School and Model High School Neri Punarvasan, Salod (H), District Wardha. All the students from the same school who were present on the day of assessment were included in the study irrespective of their achievement in the academic examination. The first section of the questionnaire included demographic information of the school children like name, age, sex, address, class in which they study. The second part included fifteen questions each carrying two marks (total 30 marks) about the products containing heavy metal and their hazardous effects on human body. The questionnaires were given to students to fill the information and answers to the questions. Half an hour was allotted to write the answers of the question. The following items were assessed during the study.

2.1 Awareness Assessing Items

a. Awareness regarding products containing heavy metals used in daily life.
b. Awareness regarding hazardous effects of products containing heavy metals used in daily life
c. Awareness regarding hazardous effects of Arsenic
d. Awareness regarding hazardous effects of lead
e. Awareness regarding hazardous effects of mercury
f. Awareness regarding hazardous effects of copper

The questionnaires were collected, checked and analyzed. The score ranging from 0-30 was categorized into three grades as: score less than 10 marks would indicate low awareness, score between 11-20 marks would indicate moderate awareness and score between 21-30 marks would indicate high awareness.

It was found that the students could not write answer to any questions. It indicated that students are unaware about the products containing heavy metal and their effects on body.

Hence, an awareness program was conducted at each school in which the students were given information about the products containing heavy metals, their sources and hazardous effects on human body. Visual presentation was given using LCD projector. The post test was conducted using the same questionnaire. The questionnaires were collected and checked. A master chat was prepared and data was analyzed by using unpaired t test. The data was presented as Mean$\pm$ SEM. The level of confidence was decided at 0.05.

3. OBSERVATION AND RESULTS

The students participated in the study were of age ranging from 8-15 years. Maximum numbers of students (20%) were of age 10 years.

The marks obtained in post test were highly significant ($P < 0.001$) at 5% level of significance.

3. DISCUSSION

A heavy metal may be defined as on the basis of density whereas in physics the distinguishing criterion might be atomic number and in chemistry the distinguishing criterion might be chemical behavior. Density criteria range from above 3.5g/cm^3 to above7g/cm^3. Atomic weight definitions can range from greater than sodium (atomic weight 22.98)[1]; (greater than 40 (excluding s- and f block metals, hence starting with scandium) or more than 200, i.e. from mercury onwards.

Table 1. Sources of heavy metal poisoning: [11]

SN.	Heavy metals	Sources
1	Arsenic	Crayons, Toys, Candles, Fabric, Wallpaper, Pesticides, Household lawn and garden chemicals, arsenic-treated wood
2	Mercury	Dental amalgam fillings, all fish, Mercury treated seeds
3	Lead	Pencil, small cells of the watches, Batteries, Pesticides, foods, Old house paint, a few hair dyes, lubricants, medications, cosmetics such as lipstick, inks, Glazes used on cookware, Household lawn and garden chemicals
4	Copper	Electric wires, Dental amalgams
5	Nickel	All hydrogenated oil products such as commercial peanut butter, all margarines, and vegetable shortening.
6	Fluoride	Rat poison, ground water supplies, reconstituted vegetable, fruit juices and foods processed with water containing fluoride.
7	Iron	Red meat, iron pills or mineral supplements, iron-enriched foods such as breads and most other products made with white flour
8	Aluminum	All anti-perspirants and many cosmetics

Table 2. Showing number of students according to age

Age of students (yrs)	Number of students	Percentage of students (%)
8	46	15.33
9	44	14.66
10	60	20.00
11	30	10.00
12	28	9.33
13	29	9.67
14	32	10.67
15	31	10.33
Total	300	100

Table 3. Gradation of awareness after post test

Gradation of awareness	Range of score	Number of students	% of students
No awareness	Score equal to 0 marks	00	00
Low awareness	Score > 1 and less than 10 marks	1	0.33
Moderate awareness	Score between 11-20 marks	144	48
High awareness	Score between 21-30 marks	155	51.6

Table 4. Comparison between pretest and post test marks

	Sample Size (n)	Mean	Std Dev	SEM
Pre test marks		0.000	0.000	0.000
Post test marks	300	20.573	3.621	0.209

Heavy metal toxicity has been increased since seventy years. Since then it is increasing due to the increased use of heavy metals in the daily life in various forms. Commonly children are victims of accidental or chronic poisoning. Exposure of any heavy metal since childhood can cause its chronic toxicity. Hence, awareness is needed in students as well as their parents to avoid the heavy metal toxicity.

In the present study, it was found that all the students scored zero marks in the pretest. Hence, they were graded in no awareness category. After sensitization, in post test 155 students (51.6%) scored between 21-30 marks and 144 students scored between 11-20 marks. The score of marks in posttest ishighly significant. It indicates that the awareness increased after the sensitization. Unawarenessregarding sources of heavy metals and their continuous exposure can lead to acute or chronic toxicity. Hence, to avoid the heavy metal toxicity in school children, it is highlyrecommended to make them aware

regarding sources of heavy metals which are used in daily life and their hazardous effects on body. It can be done through awareness programs to be conducted at schools. It may be achieved by incorporating this point into the syllabus of the school children. Few of the related studies have been reported in literature. Wadnerwar et. al. reported chronic toxicity evaluation of Ayurvedic arsenical formulation *Rasamanikya* with special reference to heavy metal toxicity [12]. Related studies on awareness and school children were reviewed [13-17] Studies on different child health aspects have been reported [18-22].

4. CONCLUSION

- Awareness regarding sources of heavy metals which are used in daily life and their hazardous effects on body was not found in the studied population i.e, school children from age 8 years to 14 years.
- Unawareness regarding sources of heavy metals and their continuous exposure can lead to acute or chronic toxicity.
- To avoid the heavy metal toxicity in school children, it is highly recommended to make them aware regarding sources of heavy metals which are used in daily life and their hazardous effects on body.
- It can be done through awareness programs to be conducted at schools. It may be achieved by incorporating this point into the syllabus of the school children.
- The study can be conducted at multicentre in future to create awareness regarding acute or chronic toxicity due to products containing heavy metal which are used in daily life.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONSENT

On behalf of the 300 students, written consents were taken from the Headmasters and teachers of the school.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here: