Poll Res. 41 (1) : 244-250 (2022) Copyright © EM International ISSN 0257–8050 DOI No.: http://doi.org/10.53550/PR.2022.v41i01.036

# HEAVY METALS AND POLLUTED WATER IMPACTS THE HEALTH OF PEOPLE DWELLING NEAR SOME SELECTED WATER BODIES OF HALDIA

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(Received 7 July, 2021; Accepted 20 August, 2021)

# ABSTRACT

An interview-based survey was conducted involving the inhabitants at the periphery of the four water bodies selected for our study at Haldia. Questions were asked to human subjects who were directly or indirectly dependent on the water sources of those stations. The people were interviewed using a questionnaire. The study revealed that 40% of the respondents had expressed a high degree of health impact and 80% of the respondents reported short duration morbidity. A few inhabitants displayed symptoms indicating the presence of trace heavy metals toxicity in one of the water bodies where lead and cadmium toxicity was found in one station. Lack of awareness and knowledge is leading to more polluted water exposure which depicts a gradual recession on the quality of human health.

KEY WORDS : Water pollution, Heavy metals, Human health, Survey, Respondents

## INTRODUCTION

Haldia is a major river port and industrial belt located approximately 125km southwest Kolkata near the mouth of Hooghly River and township is bordered by the Haldi River, an off shoot of the Ganges (Haldia - Wikipedia, the free encyclopaedia). In our previous studies had selected water bodies were chosen to investigate the water condition of the port city. It was found that in the selected few stations, water contain toxic substances which were affecting the physio-chemical and microbiological parameters of water (Maity and Banerjee, 2018). Studies also established that the selected water bodies had toxic impacts on the flora and from there it was concluded that incremental water pollution affected and decreased the level of growth of plants in most cases (Maity et al., 2019). Even the water affected the faunal aquatic species to severe detrimental biochemical and histopathological generation was demonstrated (Maity and Banerjee, 2021). Such previous studies concluded the water bodies demand for an immediate remediation and restoration of the water quality, as most of them have human-animal interface activities and anthropological activities within their niche.

In order to understand the enviro-toxicological effect of the humans dwelling around the selected water bodies and attempt to report their state of toxic exposure and on their awareness, a survey was conducted on a few people who have an anthropological touch with water directly or indirectly. Few heavy metals were also studied in one station where people showed most health issues. This study attempts to present the linkage between the environmental condition and consequent public health, highlighting their concern about the water bodies.

## Methodology

Four sites were selected in Haldia city where four different types of water bodies are present and

people are directly or indirectly dependent on those water sources (Table 1, Fig. 1).

# **Data Collection**

The "Questionnaire Survey" by house interview was carried out as method of data collection. A random selection of houses beside the four stations was done and the householder/occupant's interviews were taken. The questionnaire was organized to get the information on their environmental awareness and knowledge, condition of water bodies and the effect on their health condition, finally if they took up any responsibilities for water protection.

One-way ANOVA was also employed by using SPSS to analyse if there was any significant difference or not between the selected sites on basis of health reported problems including children of the families.

## Water Parameters Study Method and Heavy Metals Analysis Method

The surface of water bodies was collected in the glass jars which were rinsed with HCl, then thoroughly washed with distilled water and dried. Dissolved Oxygen was fixed by using Winkler's reagent immediately after collection of samples. All the parameters were analyzed by Standard Methods (Andrew *et al.*, 2005) and APHA (2005) methods. For Biochemical Oxygen Demand and Chemical Oxygen Demand sample was diluted as needed. For microbial analysis, samples were filtered and thereafter series of dilutions were made with sterile saline to give dilution 10<sup>-1</sup> up to 10<sup>-5</sup> and were incubated in routine culture media (Dubey and Maheshwari, 2010).

Heavy metals were detected by Atomic Absorption Spectrophotometer and test methods are presented in Table 2.

#### **RESULTS AND DISCUSSION**

The survey comprised of 44% males and 56% female respondents who belong to the age group of 30-60 years and a few were between an age group of 10-20 years. The respondents are residents have been residing near the water bodies for more than fifteen years.

As this was a descriptive survey, people were given few options to understand an environmental scenario, their awareness and health effects. Majority of the respondent believed that water quality in most stations were not so good. The water is deteriorating day by day but respondents showed a big lack of concern and awareness. In station C the

Table 1. Types of water bodied of the selected sites

Legend Used in Study	Type of Water Body	Latitude, Longitude	
А	A domestic pond	22.050916, 88.068316	
В	An Aquaculture (fish) pond and also used for domestic purposes	22.049066, 88.069395	
С	An Aquaculture (fish) pond	22.037996, 88.057880	
D	A canal where many industrial effluents are discharged	22.060393, 88.130769	



Fig. 1. Location of water bodies on map; (A) Source A; (B) Source B; (C) Source C; (D) Source D.

people were very much unaware about that water body conditions than the people of other sites. During the survey a significant amount of response were in the category "do not know" which revealed that the respondents required a proper knowledge on water pollution. However, even if they know the source of pollution, they are either not concerned about the necessity to prevent its entry or do not know how to prevent (Fig. 2 to Fig. 5). When inquired about the increase in eutrophication within the water bodies, 60-90% of them reported of visible eutrophication. They also reported of decrease in the flow of water, change in visible quality of water in terms of transparency (turbidity), colour and odour. Some also reported of obnoxious smell in water too. Some reported of unusual algal blooms and floating of dead fishes etc at different times of the year. Some of the respondents are aware of the type of pollutants that may have entered to water body. That pesticide, domestic waste, industrial sewage both in liquid as well as solids forms were dumped was reported by the residents but they were not sure of the exact source and origin of entry.

In Table 3 the studied water parameters are presented for four stations. The microorganisms involved in biodegradation of organic matter in waste water consume a lot of oxygen which not only kill the aquatic creatures but also responsible for microbiological infections of human health. Station D indicated a polluted water body presence. Many waterborne diseases are spreading man to man (Halder and Islam, 2015). Most water borne infectious diseases are linked with fecal pollution of water sources and results in fecal-oral route of transmission and infection (Nel and Markotter, 2009). Contaminated water has large negative effects on those women who are exposed to chemicals during pregnancy; leading to the increased rate of low birth weight as a result of affected fetal health (Currie et al., 2013; Haseema et al., 2017). The present survey revealed about more than 50% of the respondents had expressed a high degree of health

Table 2. Test method of heavy metal analysis

Test Parameters	Test Method
Cadmium	APHA 23 <sup>rd</sup> Edition, 3113B
Zinc	APHA 23 <sup>rd</sup> Edition, 3111B
Lead	APHA 23 <sup>rd</sup> Edition, 3113B
Mercury	APHA 23 <sup>rd</sup> Edition, 3112B
Arsenic	APHA 23 <sup>rd</sup> Edition, 3114C
Copper	APHA 23 <sup>rd</sup> Edition, 3111B
Chromium	APHA 23 <sup>rd</sup> Edition, 3111B

impact. Although site A respondents faced less skin problems in last five years, whereas for the other sites' respondents faced in very high rate (Fig. 6) since a very long time. Dry scaly skin, skin rashes, itching were common skin problem in site D. Sometimes depigmentation, skin peeling, black skin patches with infection were found as skin problems (Picture 1, 2, 3).



Fig. 2. Water quality concern by respondents



Fig. 3. Eutrophication observed in last five years

In kingdom of Saudi Arabia, Al-dosari, (2017) has found majority of respondents have health impacts from sewage. The finding of the study is in agreement with those of Minh and Ngugen-viet (2011), as they also mention that an improved sanitation has reflected to have great impacts on people's health and economy.

Other health impact like headache, loss of muscle power, fever, amoebic dysentery, rough or dry skin, hair loses; appetite loss are very common health issues of the respondents in every site (Fig. 7). In site D, most of the respondents believe that industrial wastes are responsible for the high pollution of water. As the industry disposal rate is high, industrial waste may contribute adverse human health impacts due to potentially toxic materials. The leached concentrations of arsenic, cadmium, copper, chromium lead in the disposed industrial wastes. Basically, the industrial pollutants are leading pollutants in site D which is flowing very



Fig. 4. Sources believed to be responsible for the pollution of water body



Fig. 5. Fertilizers, pesticides, antibiotics and other chemicals were added to water body

close to some chemical, battery and petrochemical industries. The power and battery company's wastes, pesticides herbicides also serve as source of heavy metals. These metals get into the soil and flow into water bodies which can be taken up by plants and also can be accumulated in fish body and hence human exposure through food (Engwa *et al.*, 2019;



**Pic. 1.** Depigmentation of skin (may be due to metal poisoning)



**Pic. 2.** Skin peeling and skin infection (probably a cause of overexposure to certain chemicals)

Wani *et al.*, 2015). In site A, B and C there is a chance of pollutant leaching from surrounding agricultural field which affect the fish health directly. For site B and C extensive use of fish feed fish growth

Table 3. Physico-chemical parameters and microbial load of water bodies in four sites

	Total solids (mg/l)	BOD <sub>5</sub> (mg/l)	COD (mg/l)	Hardness (mg/l)	Colony Count
Site A	420	3.5	43.6	232	250x10 <sup>3</sup> /ml
Site B	180	3.2	48	252	$460 \times 10^3 / ml$
Site C	2990	3.9	36	1044	108x10 <sup>3</sup> /ml
Site D	4220	65.5	268	268	1250x10 <sup>3</sup> / ml

stimulators, health stimulators and antibiotics also can be responsible for health impacts.



**Pic. 3.** Black skin patches (an early symptom of heavy metal toxicity)

Acute exposure of lead can cause headache, loss of appetite, abdominal pain, fatigue, sleeplessness while chronic exposure can result muscular weakness, allergies, mental retardation etc. (Martin and Griswold, 2009). So, it can be speculated that the stations are polluted with lead which adversely



Fig. 6. Respondents faced skin problems in last five years

<b>Table 4.</b> Heavy meta	als load in site D	
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affect the human health. Lead toxicity was found in site D (Table 4) and observed health issues are very familiar with lead exposure symptoms. Unusual tastes, delirium, cognitive deficits, mental retardation in children are other symptoms of lead toxicity were reported by respondents. Though other metals were found in low range but as there are metals residues in water body which can affect the health indirectly and also there is a chance of increasing. The allergic reactions due to chromium include severe redness and swelling of the skin. Skin allergies are also a common problem in those four sites. Neurological problems, hypertension, cardiovascular diseases, skin lesions are common symptoms of long-term exposure of arsenic exposure (Huy et al., 2014). Increased blood pressure, muscle pain, respiration problem, anaemia of respondents emphasizes the cadmium toxicity and the found range is higher than ISI standards. When humans eat antibiotic infested meat, then their bodies become resistant to these medicines (Gandhi, 2018). Our survey showed that people are very much unaware of it. After the interviews with the respondents we have come to know about the use of fish feed, use of antibiotics in site A, B and C. In most cases those are non-biodegradable and



Fig. 7. Health aspects of water pollution

Test Parameters	Results (mg/l)	CPCB Standards for inland surface water (mg/l)	ISI Standard 2000 (mg/l)	
Cadmium	0.024	2.0	0.01	
Zinc	0.078	5.0	5.0	
Lead	0.6	0.1	0.1	
Mercury	< 0.001	0.01	0.001	
Arsenic	0.020	0.2	0.05	
Copper	0.027	3.0	0.05	
Chromium	<.01	2.0	0.05	

remain in the aquaculture environment for long periods of time which encourages the growth of bacteria which can survive in the presence of antibiotics. Those antibiotics may be found in fish meat or in fish products. Consumption of such fishes affects the health and makes the body more susceptible to bacterial infection.

Bacterial infections also reported by the respondents. As they do not have the proper knowledge, their practices affecting the environment and human health side but side is observed. Lack of knowledge among the farmers, is making the water bodies more polluted with microorganisms and persistent exposure is rendering the human the body more resistant to the antibiotics. The used antibiotics can cause genotoxicity and developmental disorders in fish. Several antibiotics, such as quinolones are known to bioaccumulate in fish tissues (Yang and Whasun, 2020).

In site D- both point and non-point sources of pollutants are present that's why the pollution rate is high and health effect rate of respondents in this area is also very high. Site D is a canal which flows besides the premises of many industries like Exide, Indian Oil Corporation Limited, Hoogly Met Coke and Power Company, Bharat Petroleum Corporation Limited etc. Presence of heavy metals in site D, the respondent reports that the fish caught for consumption from this canal, the flesh smells very badly which are the evidences of high rate of pollution. Not only that fish kill is also a common phenomenon in site D. In other sites the non-point sources with people's unawareness, lack of knowledge about water pollution, neighbourhood pollution, leading the water body more polluted.

#### Morbidity Prevalence Rate (MPR)

Morbidity information was collected in two parts:

Short Duration Morbidity (SDM) and Chronic/ Major Morbidity (MM). Fevers, cough and colds, water-borne diseases, abdominal pain, loss of appetite, hair losses etc. that are temporary were considered as SDM. Skin problems, asthma, heart disease, muscular weakness, hypertension, neurological problem was considered as MM. More than 55% respondents reported SDM and 30% respondents reported chronic morbidity, where children were also included of the respondents (Fig. 8).



Fig. 8. Morbidity Prevalence Rate

#### Analysis of Variance (ANOVA)

SPSS One-Way ANOVA was carried out to find out if there is a significant difference between the stations on the basis of reported health problems per family. The result showed there was no statistically significant differences between the groups, as the computed F did not exceed the critical  $F_{.05}$ ; the computed F is considered not significant (p>0.05). This concludes four stations are in same condition on basis of health aspects of water pollution. The group variance is homogeneous variance. Levene

on Mean on Median on Median and with adj on trimmed mean	usted df	.714 .565 .565 .745	3 3 3 3	76 76 74.939 76	.547 .640 .640 529
on Median on Median and with adj on trimmed mean	usted df	.565 .565 .745	3 3 3	76 74.939 76	.640 .640 .529
on Median and with adj on trimmed mean	usted df	.565 .745	3 3	74.939 76	.640 529
on trimmed mean		.745	3	76	529
uares df	Mean Sq	uare	F	S	ig.
	2 713	2 713		-	67
76	1.564	1	1000		
79					
1	uares df 3 76 79	uares df Mean Sq 3 2.713 76 1.564 79	uares df Mean Square 3 2.713 76 1.564 79	uares df Mean Square F 3 2.713 1.735 76 1.564 79	uares df Mean Square F S 3 2.713 1.735 .1 76 1.564 79

Table 5. Test of Homogeneity of Variances

Statistic is not significant, and hence it is found that the stations are not statistically significantly different (Table 5, 6).

## CONCLUSION

Study concluded that the people are dwelling in unsafe environmental sites where sewage, sanitation systems are not properly managed. Water at Site D is polluted with lead and cadmium. As most of the families in site D belong to below poverty line so a very low cost technique should be thought of to prevent overexposure of the polluted water by these people. Poor personal hygiene, neighbourhood pollution, industrial wastes, agricultural pesticides, fish feed, antibiotics etc. are polluting the water bodies in Haldia which is gradually surmounting to some life-threatening phenomenon. People have direct and indirect effect on his health due to this pollution and it is confirmed no stations are safe for human health. Delirium is common health issues in Haldia. This survey can conclude that pesticides antibiotics from water also have indirect affect after consuming fish as food. Lack of knowledge is also a main factor to abate or mitigate environment pollution. Educational and awareness program should be organized to control the water pollution in parallel with abating the entry of pollutant into the water bodies.

## ACKNOWLEDGEMENT

The authors are thankful to the department of Food Technology, Haldia Institute of Technology, Haldia, WB, India for the infrastructural support provided during the study.

# **Conflict of Interest**

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this research article.

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