International Journal of Global Science Research
Vol. 9, Issue. 1, April 2022, pp. 1767-1776
*Available Online* at www.ijgsr.com

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

**Research Paper**

# Study on the heavy metal pollution in water and their impact on human health based on questionnaire, vicinity of Umrar Dam, Shahdol division in central India

Vandana Ram
Department of Zoology, Pandit S. N. Shukla University, Shahdol, Madhya Pradesh, India
*Email: prayervandana29@gmail.com

Received: 27/02/2022
Revised: 08/03/2022
Accepted: 18/03/2022

**Abstract:** In Umrar Dam the Lead (0.840±0.000) concentrations in the water was highest in the summer season whereas lowest concentration found in Rainy season. Iron (0.727±0.001) and Zinc (0.074±0.003) were found in highest concentration in Rainy while lowest in summer. Copper (Cu) is one of the metal, which are essential to human health but we did not found Cu and Hg metals in Dam water. The concentration of Zn in this site was under permissible limit. The Pb concentration in the tissues of *Labeo rohita* was highest in summer whereas lowest concentration found in winter. In *Rasbora daniconius* Pb concentration reached the highest in gills in summer (4.832±0.000) and lowest was found in kidney in winter season (0.725±0.000). In *Ompak bimaculatus* highest concentration was in gonad (3.855±0.001) in summer whereas lowest in kidney in winter seasons (0.789±0.000). In this study I observed that, lead levels were above the recommended limits (0.01ppm) for water and Fish tissues. Pb is a toxic element, which has no significant biological function and shows their carcinogenic effects on aquatic biota and humans even at low exposures. Pb exposure is known to cause musculo-skeletal, renal, ocular, neurological, immunological, reproductive and developmental effects.

**Keywords:** Umrar Dam, Heavy Metal Pollution, Permissible limit, Health hazards, Fisheries.

## Introduction:

Umrar Dam is constructed in Ufri; Umaria district on the Umrar River in 1990.Water capacity of the dam is 18.9 million m3. Irrigation was the main purpose for constructing this Dam but now it is being used for fish culture by fisheries department of Umaria and irrigation too. Water of this dam is also used by the villagers living around this dam for domestic purposes. This is also known as Kaari Maati (Black Soil) Dam. This is one of the most beautiful places around Umaria Town, Coordinates, 23°29'2"N 80°49'25"E.

**International Journal of Global Science Research** **ISSN: 2348-8344 (Online)**
**Vol. 9, Issue. 1, April 2022, pp. 1767-1776** **DOI: 10.26540/ijgsr.v9.i1.2022.206**
***Available Online* at www.ijgsr.com**


Umrar River is the main water source for Umaria residents, which flows from the middle of the town. A stop dam was constructed on the river looking at the low level of water during Monsoon. The situations during summers turned worse due to heavy dependence on the river. Around 1000 families would use water of Umrar River for drinking purpose.

Umaria district is located to the North East of Madhya Pradesh. Mathematically the coordinates of the District extend from $23^{o}38'$ to $24^{o}20'$ North and $80^{o}28'$ to $82^{o}12'$ East. It has geographical area of 4548 sq.km. The greatest length of the district is about 150 km. from north to south and the greatest width is about 60km from east to west. The population of the district on the basis of 2011 census is 644,758. Out of which about 83% population resides in rural areas.

The district has extensive forests. About 42% of the total area is covered by forests only. The District is rich in minerals. The most important mineral found in the district is coal and as a result 8 mines are being operated by South Eastern Coalfield Limited in the district. It is situated at a distance of about 69 Km. from Shahdol.

Umaria Coalfield is located in Umaria district in the Indian state of Madhya Pradesh in the valley of the Umrar River, a tributary of the Son River.

In Umaria Coalfield, the Lower Gondwana rocks are well developed. The coalfield has an estimated reserve of 181.29 million tonnes, spread across six coal seams. The coals are relatively high in moisture (7-10%) and high in ash (18.6-29.4%). South Eastern Coalfields Limited operates eight mines.

## Materials and Methods:

**Heavy Metal Analysis in water:** - heavy metals Cu, Zn, Pb, Fe and Hg concentration measured using the Atomic Absorption Spectrophotometer (AAS model ELICO, SL-168) the obtained results were expressed as ppm.

**Determination of Metal Concentration in fish tissues:-** Preparation of subsamples and analysis were done according to FAO technical paper No.212 (21).For metal analysis frozen fish were partially melted and each fish was dissected using stainless steel instruments for avoiding metal contamination. Muscle, Liver, Kidney, Gills and Gonads were taken out and separated organs were put in Petri dishes to dry at $120^{O}C$ until reaching a constant weight, after that one gram of samples of each organ were digested with concentrated nitric acid ($HNO_3$) on hot plate. Heating process were started at $40^{O}$ C and increased according to need until all tissue samples dissolved completely in the acid and the solution become clear (Al-Weher (2008). All digested samples were let to cool at room temperature.

Now samples were filtered by using a filter paper of 0.45 micron of porosity with the help of swinex then transferred to 25 ml volumetric flasks and made up to mark with deionized water then packed in polyethylene bottles and kept in the refrigerator for further experiment. The metal analyses of samples (Cu, Zn, Fe, Pb and Hg) were carried out by using an ELICO-SL 168 Atomic Absorption Spectrophotometer. The concentration of heavy metals is expressed as ppm for water and mg/kg dry weight for tissue. (Olaifa *et. al*., 2004, Kh.M.El-Moselhy *et. al*., 2014)

**Determination of impact of water pollution on human health:** - For collecting information regarding impact of water pollution on human health in study sites, we did survey based on questionnaire. Questionnaire was based on health problems caused by metal pollution.

International Journal of Global Science Research
Vol. 9, Issue. 1, April 2022, pp. 1767-1776
*Available Online* at www.ijgsr.com

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

During survey people have been divided into four categories.

1. Who were using only water
2. Who were using only fish
3. Who were using both water and fish
4. Who were not using both water and fish

As our observations explained metal pollution in water and fish in this site therefore drinking this water and using fish as a food were not safe. That is why we designed questionnaire comprising questions related to health problems caused by heavy metal, especially from Mercury and Lead.

## Questionnaires:

1. Name 2. Age 3. Occupation 4. How many years have you been living here? 5. Do you use the water here? 6. If yes, for what work? 7. Do you drink this water too? 8. Do you think this water is not drinkable? 9. If yes, why? 10. Do you also eat the fish of this river? 11. If yes, how many days in the week? 12. Do you have these health problems? 1. Skin problems 2. Cardiovascular disease 3. Vitiligo disease 4. Respiratory illness 5. Joint pain 6. Abdominal pain 7. Reduced vision 8. Burning sensation in the limbs 9. Cancer 10. Blood pressure 11. Anemia 12. Diabetes 13. Sterility 14. Miscarriage 15. Kidney problem 13. Is there any health problem that is more visible in the people here?

**Result and Discussion:**

In Umrar Dam the Lead (0.840±0.000) concentrations in the water was highest in the summer season whereas lowest concentration found in Rainy season. Iron (0.727±0.001) and Zinc (0.074±0.003) were found in highest concentration in Rainy while lowest in summer. Copper (Cu) is one of the metal, which are essential to human health but we did not found Cu and Hg metals in Dam water. The concentration of Zn in this site was under permissible limit. (Table-1)

**Table 1. showing mean (±SD) concentrations of heavy metals (ppm) in water collected from Umrar Dam**

| Heavy Metals | Cu | Zn | Fe | Pb | Hg |
|---|---|---|---|---|---|
| **Summer** | ND | 0.043±0.002 | 0.691±0.001 | 0.840±0.000 | ND |
| **Rainy** | ND | 0.074±0.003 | 0.727±0.001 | 0.824±0.001 | ND |
| **Winter** | ND | 0.071±0.010 | 0.724±0.000 | 0.827±0.001 | ND |
| Permissible limits (WHO) 2017 | 2 | NG | No Guideline | 0.01 | 0.006 |
| IS(2012) | 0.05 | 5.0 | 0.3 | 0.01 | 0.001 |

**International Journal of Global Science Research** **ISSN: 2348-8344 (Online)**
**Vol. 9, Issue. 1, April 2022, pp. 1767-1776** **DOI: 10.26540/ijgsr.v9.i1.2022.206**
***Available Online* at www.ijgsr.com**


**Table-2: Showing mean (±SD) concentrations of heavy metals (mg/kg) in some organs of fish species collected from Umrar Dam.**

| FISH SPECIES | ORGANS | Metals | Cu | Zn | Fe | Pb |
|---|---|---|---|---|---|---|
| *Labeo rohita* | Muscles | Summer | 0.292±0.001 | 0.045±0.001 | 0.325±0.004 | 0.840±0.001 |
| | | Rainy | 0.021±0.001 | 0.043±0.001 | 0.296±0.002 | 0.789±0.000 |
| | | Winter | 0.022±0.001 | 0.046±0.000 | 0.298±0.002 | 1.788±0.000 |
| | Liver | Summer | 1.463±0.001 | 2.204±0.096 | 0.883±0.003 | 1.846±0.001 |
| | | Rainy | 0.299±0.001 | 0.102±0.000 | 0.802±0.001 | 1.841±0.001 |
| | | Winter | 0.297±0.000 | 0.101±0.000 | 0.786±0.003 | 2.841±0.001 |
| | Gills | Summer | 1.298±0.000 | 2.873±0.016 | 0.228±0.002 | 3.081±0.000 |
| | | Rainy | 0.998±0.001 | 1.852±0.001 | 0.202±0.001 | 3.068±0.001 |
| | | Winter | 0.978±0.009 | 2.643±0.001 | 0.203±0.001 | 2.056±0.000 |
| | Kidney | Summer | 3.440±0.005 | 0.198±0.096 | 0.837±0.002 | 0.043±0.000 |
| | | Rainy | 2.452±0.002 | 0.120±0.000 | 0.824±0.003 | 0.099±0.001 |
| | | Winter | 2.401±0.001 | 0.197±0.000 | 0.794±0.005 | 0.085±0.000 |
| | Gonad | Summer | 1.177±0.001 | 0.218±0.115 | 0.903±0.003 | 3.050±0.001 |
| | | Rainy | 1.065±0.001 | 0.122±0.000 | 0.853±0.002 | 3.046±0.000 |
| | | Winter | 1.049±0.001 | 0.123±0.000 | 0.786±0.001 | 2.067±0.000 |
| *Rasbora daniconius* | Muscles | Summer | 0.226±0.001 | 0.201±0.002 | 1.224±0.002 | 0.788±0.001 |
| | | Rainy | 0.201±0.000 | 0.200±0.001 | 1.204±0.001 | 0.776±0.000 |
| | | Winter | 0.242±0.000 | 0.201±0.001 | 1.222±0.001 | 0.776±0.000 |
| | Liver | Summer | 1.562±0.000 | 1.204±0.000 | 1.788±0.010 | 0.806±0.001 |
| | | Rainy | 1.432±0.002 | 0.199±0.001 | 0.778±0.001 | 1.804±0.001 |
| | | Winter | 1.422±0.001 | 0.198±0.000 | 0.680±0.002 | 1.801±0.001 |
| | Gills | Summer | 1.280±0.001 | 2.883±0.001 | 0.205±0.004 | 4.832±0.000 |
| | | Rainy | 0.988±0.001 | 2.879±0.001 | 0.201±0.001 | 3.765±0.001 |
| | | Winter | 0.989±0.002 | 1.852±0.001 | 0.202±0.001 | 3.752±0.000 |
| | Kidney | Summer | 3.241±0.002 | 0.200±0.002 | 0.759±0.005 | 0.799±0.000 |
| | | Rainy | 1.990±0.001 | 0.196±0.001 | 0.754±0.001 | 0.726±0.001 |
| | | Winter | 2.984±0.004 | 0.194±0.000 | 0.752±0.002 | 0.725±0.000 |
| | Gonad | Summer | 2.210±0.002 | 0.218±0.000 | 2.886±0.003 | 3.786±0.001 |
| | | Rainy | 1.122±0.001 | 0.216±0.001 | 1.979±0.002 | 3.740±0.000 |
| | | Winter | 1.124±0.001 | 0.216±0.001 | 2.870±0.002 | 2.755±0.000 |
| *Ompak bimaculatus* | Muscles | Summer | 0.229±0.001 | 0.268±0.000 | 0.326±0.004 | 0.810±0.001 |
| | | Rainy | 0.122±0.001 | 0.260±0.002 | 0.220±0.002 | 0.806±0.000 |
| | | Winter | 0.117±0.000 | 0.260±0.002 | 0.363±0.002 | 0.805±0.000 |
| | Liver | Summer | 2.010±0.001 | 1.201±0.000 | 1.854±0.001 | 2.837±0.001 |
| | | Rainy | 2.778±0.001 | 0.200±0.001 | 0.853±0.000 | 1.837±0.001 |
| | | Winter | 1.763±0.002 | 0.200±0.001 | 1.705±0.010 | 1.826±0.001 |
| | Gills | Summer | 0.823±0.002 | 2.562±0.003 | 1.490±0.002 | 2.880±0.002 |
| | | Rainy | 0.725±0.004 | 1.558±0.002 | 0.400±0.004 | 3.821±0.001 |
| | | Winter | 0.993±0.003 | 2.502±0.003 | 0.339±0.002 | 2.798±0.002 |
| | Kidney | Summer | 4.001±0.001 | 0.255±0.001 | 0.685±0.004 | 0.844±0.000 |
| | | Rainy | 3.994±0.005 | 0.253±0.002 | 0.782±0.002 | 0.790±0.001 |
| | | Winter | 2.872±0.003 | 0.250±0.001 | 0.699±0.002 | 0.789±0.000 |
| | Gonad | Summer | 2.452±0.002 | 0.288±0.001 | 2.738±0.002 | 3.855±0.001 |
| | | Rainy | 0.654±0.001 | 0.270±0.000 | 0.863±0.002 | 2.789±0.001 |
| | | Winter | 1.582±0.002 | 0.271±0.000 | 1.764±0.000 | 2.789±0.001 |

**International Journal of Global Science Research** **ISSN: 2348-8344 (Online)**
**Vol. 9, Issue. 1, April 2022, pp. 1767-1776** **DOI: 10.26540/ijgsr.v9.i1.2022.206**
***Available Online* at www.ijgsr.com**


**Table 3: Showing maximum permissible limit (MPL) of heavy metals in fish tissues (mg/kg) according to international standards.**

| | Cu | Zn | Fe | Pb | Hg |
|---|---|---|---|---|---|
| FAO/WHO limit(2011) | 30 | 40 | 43 | 0.5 | |
| *FAO(1983) | 30 | 30 | --- | 0.5 | |
| **WHO (1989) | 30 | 100 | 100 | 02 | |
| ***FSAI(2009) | - | - | - | 0.3 | |
| ****FSSAI(2011) | 30 | 50 | | 2.5 | |
| ANSG | 0.5 | | | 0.5 | 1.0 |
| EU Regulation1881/2006/EU | | | | 0.30 | 0.5 |
| European Commission Decision 93/351/EEC | | | | | 0.5 |

*Food and Agriculture Organization, **World Health Organization
***Food Safety Authority of Ireland, ****Food Safety and Standard Authority of India
ANSG- Australian national seafood (fish, molluscs and crustaceans) guidelines for heavy metals

In Umrar Dam, the copper concentration in the tissues of *Labeo rohita* was highest in the summer season in almost all organs taken for observation .Copper concentrations were reached the highest level in kidney in summer (3.440±0.005) whereas lowest concentrations found in muscles in rainy season (0.021±0.001).In *Rasbora daniconius* copper concentration reached the highest in kidney in summer (3.241±0.002) and lowest was found in muscle in rainy season (0.201±0.000) and in *Ompak bimaculatus* highest concentration was in kidney (4.001±0.001) in summer whereas lowest in muscles in rainy season (0.122±0.001). Copper concentrations varied highly significantly (P<0.001) from season to season in organs of all experimental fishes.

The Zinc concentration in the tissues of *Labeo rohita* was highest in summer whereas lowest concentration was found in winter. Zn concentration was reached the highest level in gills in summer (2.873±0.016) whereas lowest concentration found in muscles in rainy season (0.043±0.001). Zn concentrations varied highly significantly (P=0.001) from season to season in organs of *Labeo rohita*. In *Rasbora daniconius* Zn concentration reached the highest in gills in summer (0.194±0.000) and lowest found in Kidney in winter season (2.883±0.001). Zn concentrations varied highly significantly (P<0.001) from season to season in organs of *Rasbora daniconius* and in *Ompak bimaculatus* highest concentration was in gills (4.001±0.001) in summer whereas lowest in liver in rainy and winter seasons (0.200±0.001). Zn concentrations varied highly significantly (P<0.001) from season to season in organs of *Ompak bimaculatus.*

The Fe concentration in the tissues of *Labeo rohita* was highest in summer whereas lowest concentration found in winter. Fe concentration was reached the highest level in gonad in summer (0.903±0.003) whereas lowest concentration found in gills in rainy season (0.202±0.001). Fe concentrations varied highly significantly (P<0.001) from season to season in organs of *Labeo rohita*. In *Rasbora daniconius* Fe concentration reached the highest in gonad in summer (2.886±0.003) and lowest was found in gills in rainy season (0.201±0.001). Fe concentrations varied highly significantly (P<0.001) from season to season in organs of *Rasbora daniconius* and in *Ompak bimaculatus* highest concentration was in gonad (2.738±0.002) in summer whereas lowest in muscle in rainy seasons

International Journal of Global Science Research
Vol. 9, Issue. 1, April 2022, pp. 1767-1776
*Available Online* at www.ijgsr.com

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

(0.220±0.002). Fe concentrations varied significantly (P=0.05) from season to season in organs of *Ompak bimaculatus.*
The Pb concentration in the tissues of *Labeo rohita* was highest in summer whereas lowest concentration found in winter. Fe concentration was reached the highest level in gills in summer (3.081±0.000) whereas lowest concentration found in kidney in summer season (0.043±0.000). Pb concentrations varied highly significantly (P<0.001) from season to season in organs of *Labeo rohita*. In *Rasbora daniconius* Pb concentration reached the highest in gills in summer (4.832±0.000) and lowest was found in kidney in winter season (0.725±0.000). Pb concentrations varied highly significantly (P<0.001) from season to season in organs of *Rasbora daniconius* and in *Ompak bimaculatus* highest concentration was in gonad (3.855±0.001) in summer whereas lowest in kidney in winter seasons (0.789±0.000). Pb concentrations varied highly significantly (P<0.001) from season to season in organs of *Ompak bimaculatus.*

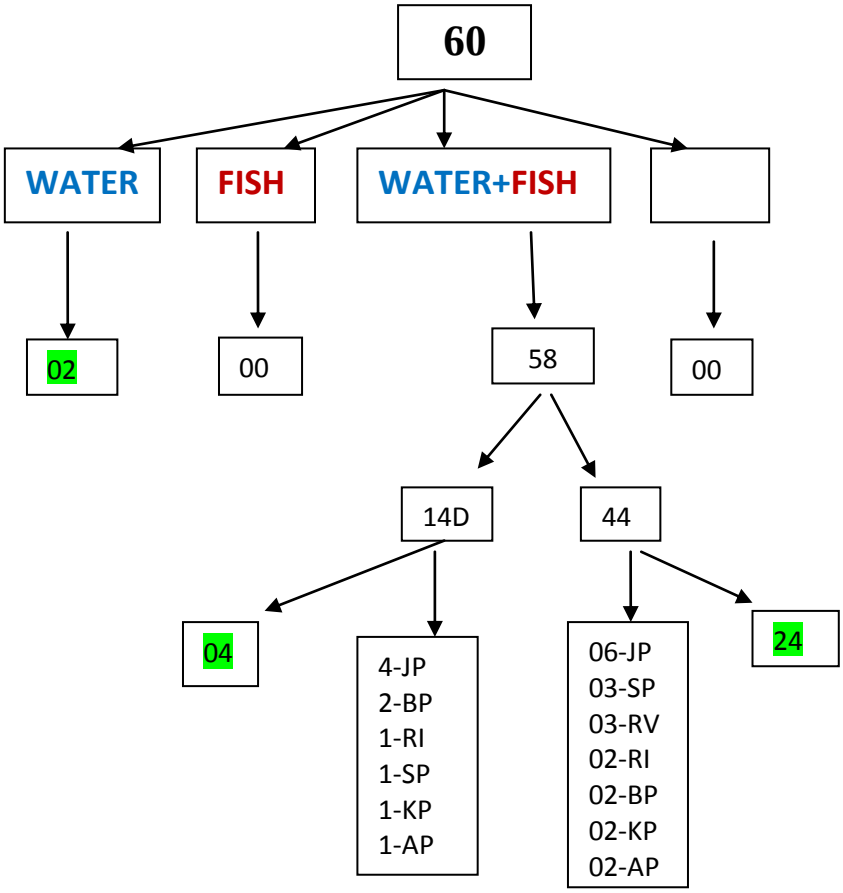



**Figure showing distributions of people according to health issues near Umrar Dam**

International Journal of Global Science Research
Vol. 9, Issue. 1, April 2022, pp. 1767-1776
*Available Online* at www.ijgsr.com

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

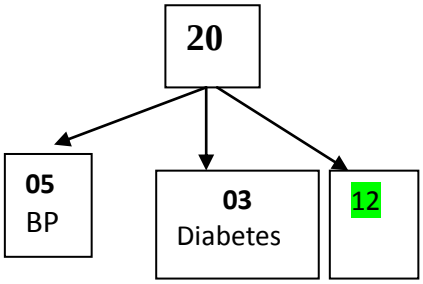



**Figure showing distributions of people according to health issues away from the Umrar Dam**

We asked questions to 60 people (16-70age) living on the bank of river and 20(15-67age) living away from the river. According to our survey, we found following results:-

1. Peoples living here are belonging to mostly Baiga, Kol, Kewat, Panika (about 67%) and others (33%).
2. They were not much educated and working as a Labor, Driver, Farmer and Fisherman.
3. Among 60 people 02 people were using water for domestic work, bathing and washing clothes but not for drinking and they had not any health problem.
5. 58 peoples among 60 were found, using water and fish both, in which 14 peoples were using water for drinking too and we observed that among these 04 people were suffering from Joint Pain,02 had Blood Pressure problem,01 had Respiratory illness,01 was suffering from Skin rashes,01 had kidney Problem and 01 was suffering from abdominal pain.
6. Among 58, 44 peoples were using water for other work (washing, bathing, planting, and cooking) except drinking and fish as food about 3-4 days in a week. In these peoples 03 had Skin problem, 06 had Joint Pain, 03 had Reduced Vision problem, 02 had Respiratory illness, 02 were suffering from Blood Pressure problem and 02 had Kidney Problem and abdominal pain, 28 people had no health issues.
7. In this site 50 % people were suffering from health issues 50% had not any permanent health issues.
8. Except this, we observed, 20 other people living near village but not using water and fish in any form. We found that only 05 people were suffering from blood pressure and 03 had diabetes, 12 people had not any health problem. (60% were not any permanent health issues)

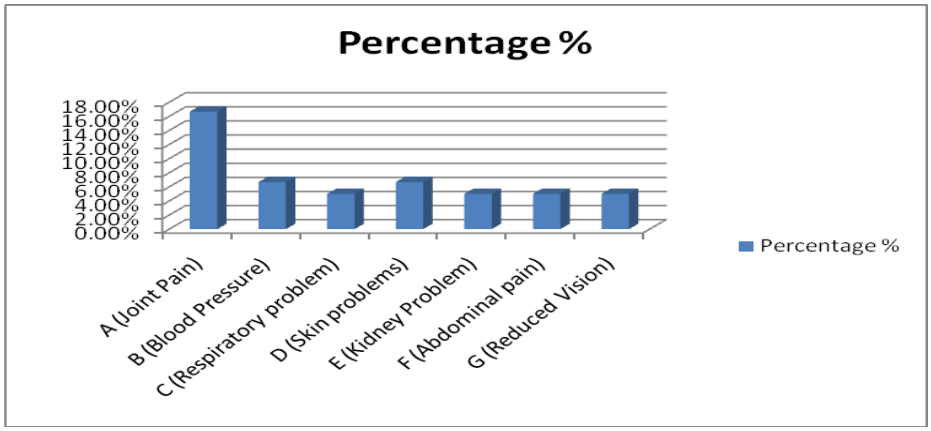
**Conclusion:**

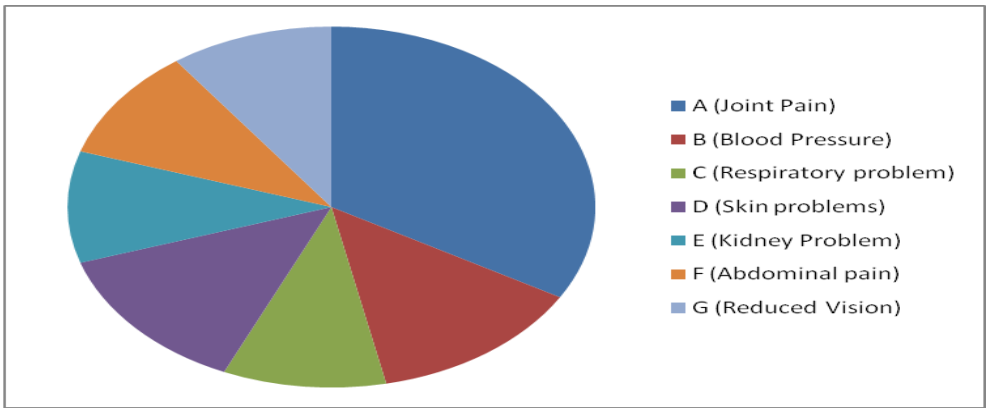
Peoples using water and fish as a food, 16.67% of these are suffering from Joint Pain, 6.67% people had Blood Pressure problem, 05% people were suffering from Respiratory problem, 6.67% had Skin problems, 5% had Kidney Problem, 5% people were suffering from abdominal pain and 5% people had problem of Reduced Vision.

International Journal of Global Science Research
Vol. 9, Issue. 1, April 2022, pp. 1767-1776
*Available Online* at www.ijgsr.com

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

| Health Problems | Percentage % |
|---|---|
| A (Joint Pain) | 16.67% |
| B (Blood Pressure) | 6.67% |
| C (Respiratory problem) | 05% |
| D (Skin problems) | 6.67% |
| E (Kidney Problem) | 05% |
| F (Abdominal pain) | 05% |
| G (Reduced Vision) | 05% |




In this study, lead levels were above the recommended limits (0.01ppm) for water and Fish tissues. Pb is a toxic element, which has no significant biological function and shows their carcinogenic effects on aquatic biota and humans even at low exposures. Pb exposure is known to cause musculo-skeletal, renal, ocular, neurological, immunological, reproductive and developmental effects.

According to results we can say that these health problems specially Joint Pain may caused by water pollution because all peoples who were using water for drinking, Bathing and fish as a food they were found suffering from skin, abdominal

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

and other health problems whereas peoples who were not using water and fish in daily routine they had not these permanent health issues.

So, as previous researchers Alrumman (2016), Briggs (2003), Bibi (2016), Khan et. al., (2013), Pawari and Gawande (2015), Juneja and Chaudary (2013), Khan and Ghouri (2011), Owa (2013), Kamble (2014), Ho YC et. el., (2012), Desai (2014), Jabeen et. al., (2011), Yonglong Lu et. al., (2015), Khurana and Sen (2008), Ebenstein (2008), Halder and Islam (2015), Ahmad et. al., (2014), Corcoran et. al., (2010), Nel and Markotter (2009), Ullah et. al., (2014), Krishnan and Indu (2006), Currie et. al., (2013), Ahmed et. al., (2013), Salem et. al., (2000), Chowdhury et. al., (2015), Ballester and Sunyer (2000) have proved that metals especially Lead pollution might responsible for the Skin, abdominal problems, Cardiovascular problems, respiratory problems in human. In our Study we also found about same cases and this is alarming condition, now the authorities should think about it and take appropriate action.

The study showed that the water of River Umrar is deteriorated very badly due to addition of urban waste, domestic sewage which enters into the river from both the banks through Umaria city. Direct discharge of human and animal waste not only imparts the water quality but human health also where the same water is used for washing, bathing, other domestic purpose and sometimes for drinking too. The urban and rural runoff and continuous dumping of sanitary waste materials are affecting the water quality of river Umrar. Except above reasons, coal mines also responsible for the metal contamination in the river water. There is considerable need for understanding of these small tributaries, which fulfill the basic requirements of human living its bank.

**References:**

Olaifa F. E., Olaifa A. K., Adelaja A. A. and Owolabia A. G. (2004) Heavy metal contamination of Clarias gariepinus from alack and fish farm in Ibadan, Nigeria, African Journal of Biomedical Research, 7, 145-148.

Kh. M. El-Moselhy, A. I. Othman, H. Abd El-Azem and M. E. A. El-Metwally (2014) Bioaccumulation of heavy metals in some tissues of fish in the Red Sea, Egypt, Egyptian Journal of Basic and Applied Sciences, 1, 2, 97-105,

Alrumman S. A., El-kott A. F., Kehsk M. A. (2016) Water pollution: Source and treatment. American journal of environmental Engineering. (3), 88-98.

Briggs D. (2003) Environmental pollution and the global burden of disease. British Medical Bulletin. 68, 1-24.

Bibi S., Khan R. L., Nazir R., et al. (2016) Heavy metals in drinking water of Lakki Marwat District, KPK, Pakistan. World applied sciences journal. 34(1), 15-19.

Khan N., Hussain S. T., Saboor A. (2013) et al. Physiochemical investigation of the drinking water sources from Mardan, Khyber Pakhtunkhwa, Pakistan. International journal of physical sciences. 8(33), 1661-71.

Pawari M. J. and Gawande S. (2015) Ground water pollution & its consequence. International journal of engineering research and general science. 3(4), 773-76.

Juneja T. and Chaudary A. (2013) Assessment of water quality and its effect on the health of residents of Jhunjhunu district, Rajasthan: A cross sectional study. Journal of public health and epidemiology. 5(4), 186-91.

Khan M. A. and Ghouri A. M. (2011) Environmental Pollution: Its effects on life

ISSN: 2348-8344 (Online)
DOI: 10.26540/ijgsr.v9.i1.2022.206

and its remedies. Jouirnal of Arts, Science and Commerce. 2(2), 276-85.
Owa F. D. (2013) Water pollution: sources, effects, control and management. Mediterranean Journal of Social Sciences. 4(8), 65-8.
Kamble S. M. (2014) Water pollution and public health issues in Kolhapur city in Maharashtra. International journal of scientific and research publications. 4(1), 1-6.
Ho Y. C., Show K. Y., Guo X. X., (2012) et al. Industrial discharge and their affects to the environment. Industrial waste, In Tech. 1-32.
Desai N., Vanitaben. (2014) A study on the water pollution based on the environment problem. Indian journal of Research. 3(12), 95-96.
Jabeen S. Q., Mehmood S., Tariq B., et al. (2011) Health impact caused by poor water and sanitation in district Abbottabad Ayub Med Coll Abbottabad. (1), 47-50.
Yonglong Lu, Song S., Wang R., *et al*. (2015) Impact of soil and water pollution on food safety and health risks in China. Environment International. 77, 5-15.
Khurana I. and Sen R. (2008) Drinking water quality in rural India: Issues and approaches-Water Aid. India water Portal.
Ebenstein A. Y. (2008) Water pollution and digestive cancer in China. Institutions and governance program1-45.
Halder J. N., Islam M. N. (2015) Water pollution and its impact on the human health. Journal of environment and human. 2(1), 36-46.
Ahmad S. M., Yusafzai F., Bari T, et al. (2014) Assessment of heavy metals in surface water of River Panjkora Dir Lower, K P K Pakistan. J. Bio. and Env. Sci. 5, 144-52.
Corcoran E., Nellemann C., Baker E., et al. (2010) Slick water? The central role of wastewater management in sustainable development. A Rapid Response Assessment. United Nations Environment Programme,
Nel L. H. and Markotter W. (2009) New and emerging waterborne infectious diseases. Encyclopedia of life support system.1, 1-10.
Ullah S., Javed M. W., Shafique M., et al. (2014) An integrated approach for quality assessment of drinking water using GIS: A case study of Lower Dir.Journal of Himalayan Earth Sciences. 47(2), 163-74.
Krishnan S. and Indu R.. (2006) Groundwater contamination in India: Discussing physical processes, health and socio behavioral dimensions. IWMI-Tata, Water Policy Research Programmes, Anand, India.
Currie J., Joshua G. Z., Katherine M., et al. (2013) Something in the water: contaminated drinking water and infant health. Canadian Journal of Economics. 46(3), 791-810.
Ahmed T., Scholz F., Al-Faraj W., et al. (2013) Water-related impacts of climate change on agriculture and subsequently on public health: A review for generalists with particular reference to Pakistan. International Journal of environmental research and public health. 13, 1-16.
Salem H. M. Eweida E. A., Farag A. (2000) Heavy metals in drinking water and their environmental impact on human health. ICEHM.542-56.
Chowdhury S., Annabelle K., Klaus F. Z. (2015) Arsenic contamination of drinking water and mental health. 1-28.
Ballester F. and Sunyer J. (2000) Challenges to public health I the new millennium. Journal Epidemiol Community Health. 54, 2-5.