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**Research paper**

## Impact of water pollution on Human health: A case study based on questionnaire survey near Bansagar Dam, Madhya Pradesh India

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**Abstract:** This study investigates the impact of water pollution on human health in communities surrounding the Bansagar Dam, located on the Son River in Madhya Pradesh, India. Utilizing a structured questionnaire-based survey, the research targets local populations reliant on the river for drinking, domestic activities, and fish consumption. Analysis reveals significant correlations between exposure to contaminated water and various health issues including skin disorders, abdominal pain, respiratory ailments, and kidney-related problems. The primary pollutants identified are heavy metals such as mercury and lead, stemming from regional coal mining, industrial waste, and thermal power plants. The findings underscore the urgent need for systematic water quality monitoring and public health interventions to mitigate environmental health risks in the region.
**Keywords:** Pollution, Human health, Bansagar dam, Son River, Environmental health.

**Introduction:**
Water is a critical resource for sustaining life and ecological balance. However, increasing industrialization, population growth, and anthropogenic activities have led to significant degradation of freshwater sources worldwide. The Son River, originating from the Satpura hills in Amarkantak, is a vital waterway in central India. As it flows through towns including Anuppur, Amlai, Dhangawan, and ultimately to Deolond, it gathers various pollutants from industrial, agricultural, and domestic sources. At Deolond, the Bansagar Dam, a multipurpose river valley project jointly developed by the Government of Madhya Pradesh and the Government of India, was completed in 2006. Apart from facilitating irrigation and generating 435 MW of hydroelectric power, the dam also supports fish farming. Despite its economic importance, the surrounding aquatic ecosystem faces considerable pollution threats.

Heavy metal contamination, particularly from coal deposits, thermal power plant discharges, and effluents from paper mills and fertilizers has emerged as a critical environmental issue in the region. These pollutants accumulate in the river water and bioaccumulate in aquatic fauna, especially fish, which are consumed by local populations. Previous studies (Alrumman et al., 2016; Briggs, 2003; Khan et al., 2013) have documented the health effects of heavy metals, noting their role in dermatological, renal, respiratory, and neurological disorders. However, there is a lack of region-specific epidemiological data to connect water pollution with public health outcomes. This study aims to fill that gap by conducting a comprehensive survey among residents near the Bansagar Dam, examining the correlation between water and fish consumption and the incidence of health disorders. The findings offer insight into the pressing need for environmental regulation, clean water initiatives, and public awareness campaigns.

## Methodology:
### Study Area
The study was conducted in the vicinity of the Bansagar Dam, located in Deolond village, Shahdol district, Madhya Pradesh, India. This dam is situated at 24°11′30″ N latitude and 81°17′15″ E longitude, and is part of a region with significant industrial activity, particularly coal mining and thermal power generation, both of which contribute to environmental contamination.

### Data Collection
To evaluate the health impact of water pollution, a structured questionnaire-based survey was administered to 80 individuals between the ages of 15 to 70. These participants were divided into two groups:
Group A: 60 individuals residing within close proximity to the river and directly dependent on it for water and fish consumption.
Group B: 20 individuals living farther from the river, with minimal or no use of river water or fish.

The survey included demographic questions, water usage habits (domestic, drinking, bathing), dietary practices (particularly fish consumption), and self-reported health problems. Particular attention was paid to symptoms commonly linked to heavy metal exposure, such as skin irritations, joint pain, abdominal discomfort, respiratory distress, and kidney disorders.

### Data Analysis
Survey responses were analyzed using basic statistical methods, including frequency distribution and percentage calculations. Health conditions were categorized and correlated with exposure pathways (water use, fish consumption). Visual representations, including bar charts and pie charts, were used to illustrate trends.

## Result:
The survey revealed a distinct pattern in health outcomes based on proximity to the river and usage of its resources:
### Demographics and Socioeconomic Background
60% of participants near the river belonged to marginalized tribal groups (Kol, Baiga, Kewat, Panika).
Most respondents had low education levels and were employed in manual labor: fishing, farming, construction, and local trade.
### Health Impact Based on Water and Fish Usage
**10 individuals** used river water for domestic chores only: 5 had skin issues, 1 had joint pain.
**4 individuals** consumed river water for drinking: 2 had respiratory issues, 1 had kidney problems.

**7 individuals** did not use river water but consumed river fish: 4 reported abdominal pain, skin irritation, or limb discomfort.

**39 individuals** used both river water (non-drinking purposes) and consumed fish regularly:

**6** suffered from skin conditions (itching, discoloration)

**7** experienced abdominal and joint pain

**2** reported kidney stones

**3** had burning sensations in limbs

**2** had kidney-related conditions

**1** had a diagnosed heart condition

**1** was physically handicapped

Only **15** individuals in this group were symptom-free

**Health Status Comparison**

**Group A (near river)**: 61.67% reported health problems

**Group B (farther from river)**: 30% had chronic issues (mainly unrelated, like diabetes or hypertension)

**Health Problem Distribution (Group A)**

| Health Problem | Percentage (%) |
|---|---|
| Skin Issues (Itching, Rashes) | 20.00% |
| Abdominal Pain | 18.33% |
| Joint Pain | 13.33% |
| Burning Sensation in Limbs | 6.67% |
| Kidney Problems | 5.00% |
| Kidney Stones | 3.33% |
| Respiratory Problems | 3.33% |
| Heart Disease | 1.67% |
| Physical Handicap | 1.67% |

These results clearly indicate a higher prevalence of health issues among individuals exposed to polluted river water and fish, suggesting a direct link between environmental contamination and public health.

**Discussion:**

The results of this study strongly suggest that communities residing near the Bansagar Dam and regularly utilizing the Son River for domestic use, drinking, and fish consumption are at heightened risk of waterborne and heavy metal-induced health disorders. These findings are consistent with earlier studies highlighting the health hazards of mercury, lead, and arsenic contamination (Alrumman et al., 2016; Briggs, 2003; Halder and Islam, 2015).

The prevalence of dermatological issues (20%), abdominal pain (18.33%), and joint pain (13.33%) among the exposed population aligns with symptoms typically associated with chronic exposure to heavy metals, especially mercury and lead. These metals are known to accumulate in aquatic organisms and persist in the human body, causing long-term cellular and organ damage (Salem et al., 2000; Jabeen et al., 2011).

The primary sources of pollution in this region include:

Emissions from thermal power plants (notably mercury vapor from high-temperature coal combustion).

Industrial effluents from paper mills and cement industries (containing Pb, Cd, Zn, Cr, and Cu).

Agricultural runoff containing pesticides and fertilizers.

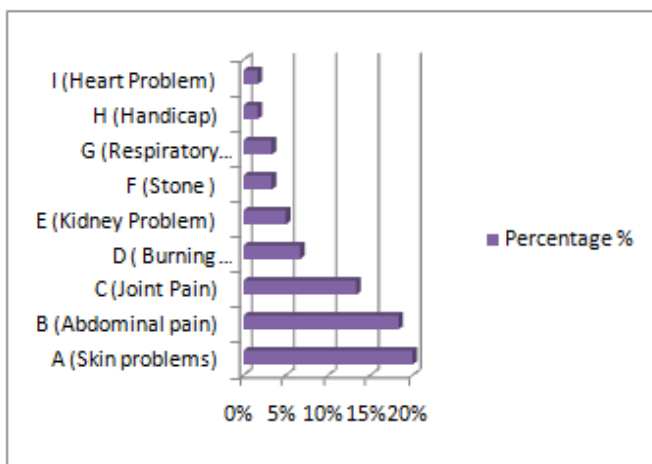Untreated sewage and domestic waste.

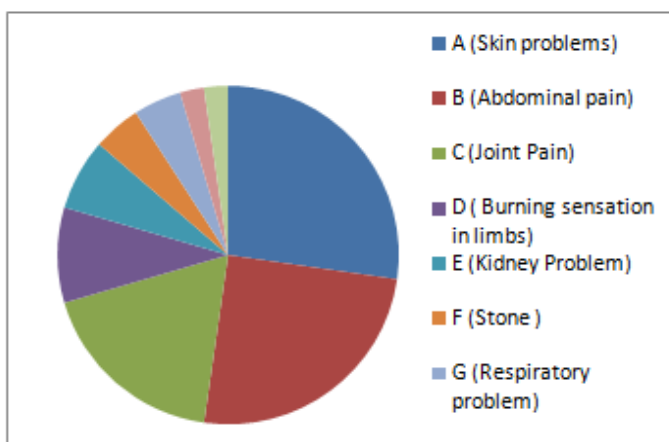Image-: -Histogram showing health problems and their percentage near Bansagar Dam



Image: -Pie chart showing health problems and their percentage near Bansagar Dam

This constellation of pollutants enters the aquatic ecosystem via direct discharge, runoff, and atmospheric deposition, adversely affecting not only water quality but also the safety of the food chain, particularly through bioaccumulation in fish, a staple dietary component for local communities.

The comparison with individuals living farther from the river strengthens the hypothesis: those with limited or no exposure to the river's water or fish reported significantly fewer health problems. This stark contrast reinforces the role of environmental exposure in the manifestation of health risks.

Moreover, the study raises broader environmental justice concerns, as the most affected populations are often those with the least access to clean water alternatives, healthcare, or education. These findings demand a more comprehensive public health response and policy intervention.

**Conclusion:**
This study highlights a clear and alarming correlation between water pollution from industrial and anthropogenic sources and the prevalence of health problems among populations residing near the Bansagar Dam. The contamination of the Son River, exacerbated by discharges from coal mines, thermal power plants, and factories, is not

only an environmental issue but a critical public health threat.

Key findings include:

- Over 60% of people near the river suffer from one or more chronic health issues.
- Most reported conditions are strongly associated with heavy metal exposure, particularly from mercury and lead.
- Communities farther from the river, who do not consume its water or fish, show significantly lower rates of these health problems.

## Recommendations:

1. Regular water quality monitoring in the Son River and around Bansagar Dam using standardized testing for heavy metals.
2. Public health education campaigns targeting local populations, especially tribal communities, on the dangers of polluted water and fish consumption.
3. Implementation of water purification systems and promotion of safe drinking water alternatives.
4. Stricter enforcement of environmental regulations for industries in the region to reduce pollutant discharge.
5. Further research to establish long-term epidemiological links between pollution exposure and chronic disease patterns.

## Acknowledgements:

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