

# Analysis of Microbes in Air, Drinking Water and Soil Samples And Survey of Health, Hygiene and Nutrition in Slum Areas of Bengaluru

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**Abstract:** According to the census of 2011 it is estimated that about 65,000 million people live in slums across India. Nearly 20 percent of Bangalore's population reside in slums. A small-scale survey on health, hygiene and nutrition was done in 4 different slum areas of Bengaluru like Uttarahalli, Uttarahalli Hobli, Hebbal and Hoskerehalli to analyze the health conditions of those people. People of the age group 18-60 were surveyed with different aspects of health. A total of 85 households were surveyed and around 430 people were screened for their health conditions in all the 4 slum areas. From the survey it was observed that 82.57% of people were in good health conditions. Distinct cases of ill health conditions observed were chest pain, splenomegaly, tumor, pregnant lady suffering from typhoid. 41.25% of the male members were addicted to smoking, drinking and chewing tobacco. Air, drinking water and soil samples were further analyzed by different methods for analysis of microorganisms. Analysis of these samples provide a direct measurement of the infectious microorganisms present for which measures can be taken to prevent microbial infections. From the microbial analysis done it was observed that the most common microorganisms observed in the air sample of Uttarahalli Hobli and Uttarahalli were Gram positive cocci, Bacillus, Cladosporium, Mucor, Aspergillus and Rhizopus. The common microbes observed in water sample were Gram positive cocci, Gram negative rods, Penicillium and Fusarium. Bacillus and Mucor were commonly observed in the soil sample of both the areas.

**Keywords:** survey, analysis, health, hygiene, nutrition

## 1. INTRODUCTION

A slum area may be described as overcrowded establishments that are densely filled with small congested houses that has confined paths, improper sanitation facilities and lacking primitive amenities such as potable drinking water, proper sewage facilities, electricity, schools, medical centers and other concerned factors. [13] Slum areas have developed and are expanding due to the incapability of overcoming the necessities of the increasing population in most of the under developed countries.[4] Access to safe drinking water, proper sanitation facilities, electricity, proper waste collection system, health facilities and literacy is a fundamental right of each and every citizen. These factors are also mandatory for the advancement of a country. [9] From the data of 2011 census it can be observed that the total Indian population was found to be 1210.2 million. Out of this population around 65.5 million of the population resides in slums. Bangalore has a population of 1.27 crores. And nearly 20% of this population lives in slums. According to the Karnataka board there are 2387 slums in Bangalore.

Due to increased percentage of urbanization, the countries have not been developed statistically. The main problem faced due to urbanization triggers lack of infrastructure facility and the basic needs of the population which is necessary for drastically increasing population. This drastic increase in the population leads to the accumulation of slums. Since the slum populations are crowded, infection transfer will be fastidious. The main causes behind poor health conditions are diseases, improper diet, injury, lack of hygiene, unhealthy life style, polluted environment etc. The vital step in providing the required health care facilities to the slum dwellers is to analyze, examine and to figure out the main health problems they are suffering from. [10]

Our project is mainly concerned with the slum areas of Bengaluru because it is a place where its infrastructure is deteriorated and primarily inhabited by impoverished people. The sources like air, drinking water, soil, etc. Also has impacts on the health of the people dwelling in those areas.

By conducting surveys and analysis of samples one can understand the challenges faced by the people of slum locality. So from this, one can make advancements in designing the measure for the betterment of the nature of the slums. It's our duty to create awareness among uneducated and unprivileged, as educated citizen of the country.

## **2. METHODOLOGY**

To understand the health, hygiene and nutritional aspects of slum dwellers a small scale survey was performed. A small scale survey was done in 4 different slum areas of Bengaluru like **Uttarahalli, Uttarahalli hobli, Hebbal and Hoskerekhalli**. A total of 85 households were surveyed and around 430 people were screened for their health conditions in all the four slum areas. It included simple questionnaire about food, health and hygienic practice, etc.

### **2.1 Survey on health, hygiene and nutrition**

A team of 4 along with the project guide was involved in conducting the survey. A survey form with survey questionnaire was used. People of the age group 18-60 were surveyed with different aspects of health, hygiene and nutrition such as physical pain, chronic disorder, abdominal disorder, vision defects, fatigue or tiredness, menstrual health, addiction to alcohol, cigarette, drugs, personal hygiene and the type of food they consume. The houses were checked for overcrowding and proper ventilation. Questions such as how many people were living in the house, was the house ventilated properly, did they consume milk, fruits and vegetables on a daily basis, how many meals was consumed by them per day, whether they suffered from any breathing problems or physical pain, whether they were addicted to alcohol, smoking and chewing tobacco, whether they used boiled or filtered water, etc. were asked during the survey.

### **2.2 Microbial analysis of air, drinking water and soil samples**

The samples of air, drinking water and soil were collected from Uttarahalli and Uttarahalli hobli slum areas and brought into laboratory for further analysis. These samples might contain abundant number of microorganisms. The collected samples were inoculated and then incubated in laboratory conditions. Nutrient agar (NA) was used for the isolation of bacteria and Martins rose Bengal agar (MRBA) and Potato dextrose agar (PDA) were used for the isolation of fungi. For the identification of bacterial and fungal colonies formed upon incubation gram staining and lactophenol blue staining were performed respectively.

### **2.3 Isolation of air microorganisms**

Air samples were inoculated by plate exposure method. Pre-solidified sterile nutrient agar, Martins rose Bengal agar and potato dextrose agar were used for plate exposure technique. The sterile petri plates with the agar medium was exposed to air aseptically for 20-30 minutes at different locations of the slums and was incubated at 37°C for 24 to 48 hours for bacterial growth and at 28°C for 3 to 5 days for fungal growth.

### **2.4 Isolation of microorganisms from drinking water**

Sterilized bottles were used for the collection of drinking water samples. The water samples were subjected to serial dilution and the different dilutions were transferred to the petri plates containing the agar medium either by streak/spread/pour plate method. The inoculated plates were incubated in an incubator at a temperature of 37°C for 24 to 48 hours for bacterial growth and at a temperature of 28°C for 3 to 5 days for fungal growth. And the colonies developed on incubation were examined.

For the analysis of potability of water most probable number (MPN) test was performed. MPN test checks for the presence of coliforms in fecally contaminated water. Lactose broth of single and double strength was used. Then 10 ml of the water sample was inoculated into double strength lactose broth, 1ml and 0.1 ml of the water sample was inoculated into single strength lactose broth and incubated at 37°C for 24 hours. The test tubes were observed for the presence of gas in Durham's tube. Acid production was checked by the change in the color of the broth. Most probable number of total coliforms was established by comparing the number of positive tubes by MPN chart.

The sample from the lactose broth tubes which showed positive results were streaked on to sterile petri plates with Eosine methylene blue(EMB) agar and Salmonella-Shigella(SS) Agar and incubated at 37°C for 24 hours. Presence of coliforms or salmonella and shigella were checked after the incubation.

### **2.5 Isolation of soil microorganisms**

The soil samples were collected in sterilized containers under aseptic conditions. The soil samples were then serially diluted and the different dilutions were then plated onto the sterile petri dish with pre solidified agar medium for the isolation of microorganisms. After the incubation of bacterial plates at 37°C for 24 to 48 hours and fungal plates at 28°C for 3 to 5 days the colonies formed were examined.

## **3 RESULTS**

### **3.1 Health, hygiene and nutrition survey**

From 85 households around 430 people were surveyed regarding health, hygiene and nutritional aspects. Out of the 85 households surveyed almost all houses were overcrowded with 4 to 5 people in small huts and lacked proper ventilation.

### **3.2 Nutritional analysis**

30.76%, 36.36%, 75% and 47.82% of people consumed milk on a daily basis in Uttarahalli, Uttarahalli hobli, Hebbal and Hoskerekhalli slum areas. 92.30% and 90.90% of people consumed adequate fruits and vegetables in Uttarahalli and Uttarahalli hobli. Everyone in Hebbal and Hoskerekhalli consumed adequate fruits and vegetables. Almost everyone took

3 meals per day. In all the four slum areas it was seen that everyone consumed home cooked food and did not have food from outside on a daily basis.

### 3.3 Health analysis

The main occupation of most of the people surveyed were labor/mortar work. So since they were involved in good physical activity most of them enjoyed good health conditions with strong immunity. From the survey it was observed that 82.57% of people were in good health conditions. It was estimated that 19.23% of the people suffered from physical pain/body pain/joint pain in Uttarahalli slum. In Uttarahalli hobli slum area no one suffered from any kind of physical pain. 10% and 17.39% of the people suffered from body pain in Hebbal slum and Hoskerehalli slum areas respectively. Joint pain and vision defects was seen commonly in the elderly. Only 1 case of vision disorder was seen in Uttarahalli and 2 cases in Hoskerehalli slum was seen.

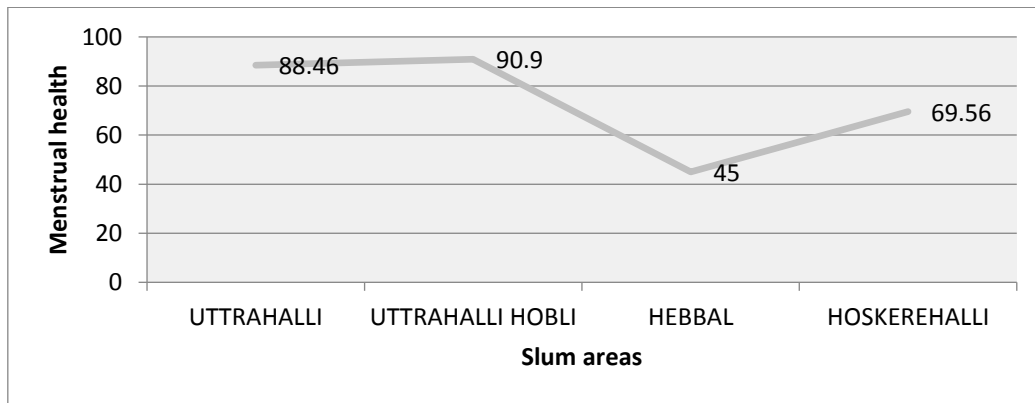


Fig 1. Comparison of proper Menstrual Health conditions of the females of all the 4 areas.

88.46%, 90.90%, 45% and 69.56% of the females’ had proper reproductive cycles in Uttarahalli, Uttarahalli hobli, Hebbal and Hoskerehalli slum respectively. 61.53%, 72.7%, 15% and 26% of the males were engrossed to smoking, alcohol and tobacco chewing in Uttarahalli, Uttarahalli hobli, Hebbal and Hoskerehalli slums respectively. It was found that only male members were addicted to this. Only rare cases of ill health conditions was seen. An Uttarahalli slum resident was suffering from chest pain. A case of splenomegaly was seen in 8 year old boy in Hoskerehalli slum and each month blood transfusion had to be given to the boy. A lady suffered from tumor in fingers and knees and a pregnant lady was infected with typhoid in Hebbal slum area.

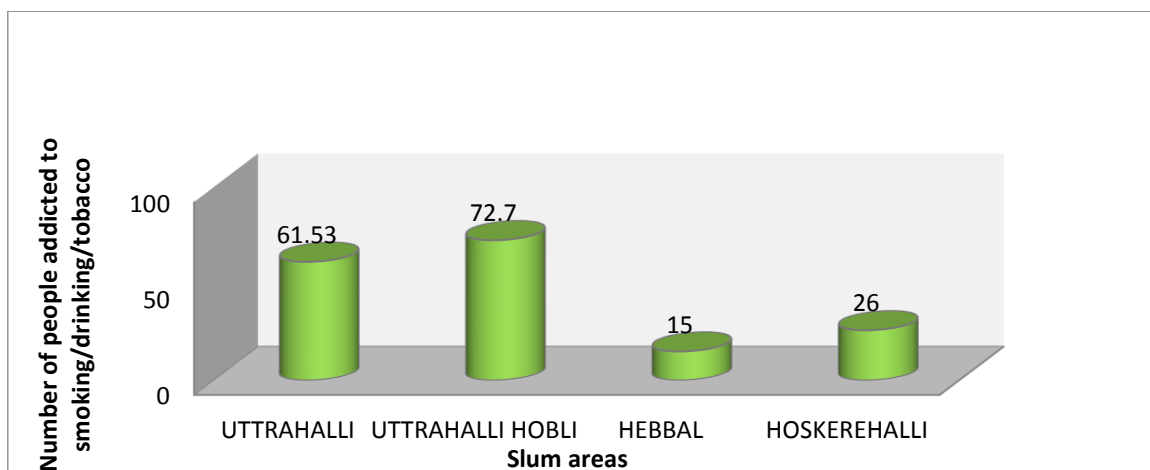


Fig 2. Comparison of people addicted to alcohol/smoking/tobacco of all the 4 slum areas.

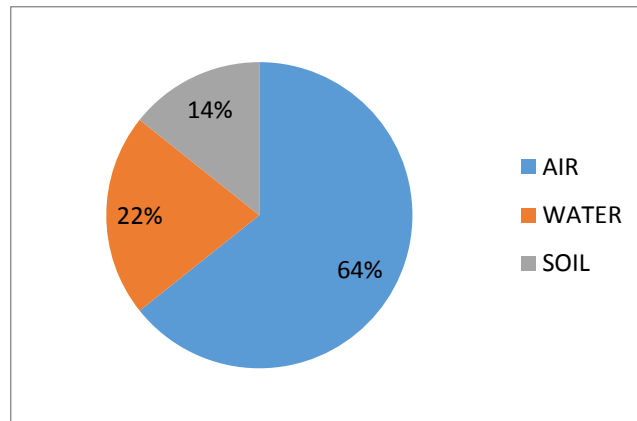
### 3.4 Hygiene analysis

Most of the people did not take bath on a daily basis. Everyone used tap water for drinking purpose without filtering or boiling. Runoff water, Sewage and stagnant water was seen in Uttarahalli and Hebbal slum area. Stagnant waters harbored mosquito breeding in both the areas. Proper sanitation facility was not seen in any of the four slum areas. They did not ensure any appropriate measures for garbage disposal and disposed garbage in the surrounding areas only. People were negligent about personal hygiene and roamed with uncovered foot. Women ensured hygiene by routine washing of their

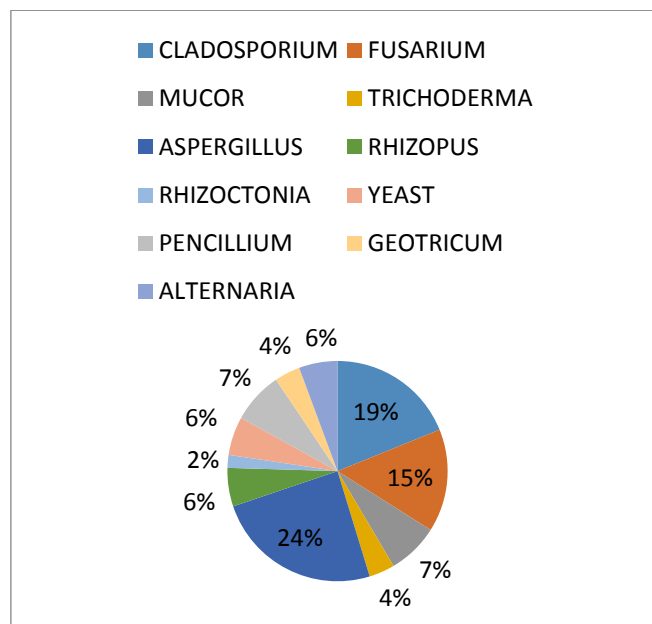
hands before cooking and eating. Only 38.46%, 27.27%, 40% and 36.84% of the females used sanitary napkins during their menstrual cycle in Uttarahalli, Uttarahalli hobli, Hebbal and Hoskerehalli respectively.

**3.5 Results of microbial analysis**

It was observed that the most common microorganisms observed in the air sample of Uttarahalli and Uttarahalli hobli were Gram positive cocci, Bacillus, Cladosporium, Mucor, Aspergillus and Rhizopus. The common microbes observed in water sample were Gram positive cocci, Gram negative rods, Penicillium and Fusarium. Bacillus and Mucor were commonly observed in the soil sample.



**Fig 3. Bacterial growth rate.**



**Fig 4. Fungal growth rate.**

**3.6 Air sample**

From the air sample of Uttarahalli and Uttarahalli hobli Bacillus, chained bacillus, spored bacillus, gram positive cocci in chains, Aspergillus, Penicillium, Cladosporium, Rhizopus, Geotrichum, Mucor, and gram positive cocci, Bacillus, Clostridium, Cladosporium, Fusarium, Mucor, Trichoderma, Aspergillus, Rhizopus, Yeast were isolated respectively.

**3.7 Water sample**

Gram positive cocci, Aspergillus, Penicillium, Alternaria, Yeast, and Gram positive cocci, Cladosporium, Penicillium, Fusarium, Trichoderma were the microorganisms isolated from the drinking water samples of Uttarahalli and Uttarahalli hobli respectively. The MPN tests of Uttarahalli and Uttarahalli hobli showed 23 MPN and 1100 MPN per 100ml respectively.

### 3.8 Soil sample

From the soil samples of Uttarahalli and Uttarahalli hobli spored Bacillus, gram positive cocci in clusters, bacillus, bacillus in chains, gram positive cocci, Aspergillus, Cladosporium, Mucor, Yeast, Alternaria, Penicillium and Bacillus, gram negative rods, Trichoderma, Mucor, Fusarium, Nigrospora were isolated respectively.

## 4 DISCUSSION

Out of all the 85 households surveyed it was seen that everyone were below poverty line and dwelled in small huts with more than 4 or 5 people leading to crowdedness. Proper aeration was not present and this allows the fast spreading of infectious diseases, especially air borne diseases.

Milk consumption was not much in Uttarahalli, Uttarahalli hobli and Hoskerehalli slum areas on a daily routine. Adequate fruits and vegetables was used in their diet only with few exceptions. Efficient amount of non-veg was consumed by almost everyone in a week. 3 meals per day was consumed by all, which proves that no one had to remain hungry due to shortage of food. Their jobs are chiefly based on manual labor which includes more of physical work. Thus they are immune and strong. On the contrary people leading dormant life without any physical activities are more prone to obesity and other related disorders than the slum dwellers.

Cases of Body or physical pain was seen less among them only with few exceptional cases. Joint pain and vision defects due to aging was seen in the elderly which is not uncommon. Females with improper reproductive cycles was seen more in Hebbal and Hoskerehalli. Females in Uttarahalli hobli slums used the least sanitary napkins during their menstrual cycles. This is due to the lack of awareness and knowledge and also due to poverty they cannot afford sanitary napkins every month. Highest percentage of addiction to alcohol, smoking and chewing tobacco was seen in Uttarahalli hobli slum area.

A study described that 39 to 75% of the children under the age of 5 were underweight in various places of the country. Conducting health screening to the slum residents is an immense use since slum dwellers does not get access to the proper and required health care facilities. This will help in the overall improvement of the health of the slum. [1] Individuals suffering from chest pain, splenomegaly, tumor and typhoid could not take proper medications due financial causes since everyone were below poverty level. They consulted doctors and did not proceed further for the required treatment. The 8 year old boy awaited a liver donor and had to continue taking blood transfusions once a month. Since they does not have access to proper household, water and sanitation facility maintaining personal hygiene becomes difficult and hence they did not take bath on a daily basis and usually took bath on alternative days or once in 3 to 4 days. 30-40% of the serious water borne diseases such as diarrhea can be prevented using treated or filtered water and following proper measures for storing of water in a household. Practice of open defecation is a very big risk to the health of the minors in India, mainly in the rural and the slum areas. According to the National sample survey 52% of India's rural population follows open defecation. Deaths due to diseases such as diarrhea is highest among the children of 10-19 years and then among the 10-14 year old around the globe. Thus access to safe drinking water and proper sanitation facilities is a must for everyone. [3] A study in Kenya showed the contamination of the ground water with E.coli, Clostridium paffringens and staphylococcs aureus. Presence of these organism indicates faecal contamination of the water. [7]

According to a study many of the deaths occurs in the newborns in the slum areas. It was seen that many of the kids suffered from health issues and malnutrition in the slum areas. Malnutrition and health issues in the kids may be by the reason of lack of essential and healthcare facilities in the slum populations. [8]. A study in Mumbai slums reported that 35% of the children were underweight, 17% were wasted and 47% of them had undergrowth. [5] Due to lack of availability and access to clean water, people used tap water directly for consumption without boiling or purifying. When defiled or unclean water is used it may lead to serious ailments or waterborne diseases like cholera, amoebic dysentery, typhoid, shigellosis, etc. Only if the coliforms are present few in number then the water can be considered safe for consumption. From the Most probable number test conducted 23 and 1100 was the most probable number seen in the water samples of Uttarahalli and Uttarahalli hobli. Though Salmonella, Shigella or any coliforms was not isolated from the water samples using SS and EMB agar, from the MPN results it was seen that water being used in Uttarahalli hobli was more unsafe than that of Uttarahalli slum area. Investigation of the presence of coliforms indicates faecal contamination. Faecal streptococci are resistant than the E.coli or the coliforms which resists desiccation. Presence of coliforms in the water indicates the lack of treatment or contamination after treatment. [2]

Since garbage was disposed in the surrounding areas itself it leads to the accumulation of wastes and makes the area even more unpleasant. Sewage water gets collected around the houses and leads to the breeding of mosquitoes and infections. Sewage water rushes into the dwellings at the time of rainy season and spoils the water used for drinking purpose [14] Analysis of air quality becomes an important tool to prevent air borne infections. Clostridium species was isolated from the air sample of Uttarahalli hobli. Clostridium causes food poisoning, necrotic enteritis or gas gangrene by producing potent neurotoxin. According to one of the study the prevalent microorganisms isolated from ambulance air samples and surfaces were Stapylococcus spp and Aspergillus spp. [12] Bioaerosols are thought to induce cancer along with infections associated with lungs. [16] Certain Bacillus species may even cause infections such as Anthrax, ear infections, etc. Cocci

may cause pneumonia, various skin diseases, etc. Cladosporium might causes allergies and asthma in certain cases. Rhizopus or mucor may affect immunocompromised patients. Aspergillus causes aspergillosis. Kids come in direct contact with soil and contaminated polluted sewage and stagnant water while playing. So they are at high risks of getting infected. A study reported that fungi are found in ample amounts in soil and may constitute 80% of the microbial biomass of the soil. [11] Around 24% of the people around the globe will be infected with soil- transmitted helminths. These soil-transmitted helminths will be extensively present in soil and mainly affects the slum localities and the regions lacking sanitation facilities. [15]

## 5 CONCLUSION

Proper access to clean water and sanitation facilities has impacts on the health and hygiene of an individual. Thus the chief causes of most of the diseases in the developing countries and even in India is due to use of contaminated drinking water, lack of access to proper sanitation facilities and absence of hygiene. [6] To improve the health conditions of the slum dwellers systematic health surveys and periodic checking of the status of the health has to be done. Health surveys become important protocol for analyzing the public health. A survey conducted in Devarajeevanahalli slum reported that poverty, unemployment, health issues such as hypertension, diabetes, anemia and childhood malnutrition was seen and this adds up to the proof of the slum health. [1]

Government of India has taken steps to eradicate slums and to provide all the basic necessities for the slum dwellers. National Slum Development Programme (NSDP), Valmiki Ambedkar Malina Basti Awas Yojana (VAMBAY), Nirmal Bharat Abhiyan (NBA), The Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Integrated Housing and Slum Development Programme (IHSDP) and the Pradhan Mantri Awas yojana (PMAY) are some of the policies and schemes implemented by the government for improvement and eradication of the slums. Proper infrastructural facilities, Proper sanitation facilities and access to safe drinking water should be provided to improve the conditions of the slums. Most of the slums practically have no drainage systems and some areas will be located near the drains with filthy stagnant water. Hence proper measures should be taken to prevent stagnant water by making proper drainage and sewage system. Immense job opportunities should be given to eradicate poverty, thereby slums can be eradicated. Providing proper education also becomes necessary to create awareness to lead a better life. Creating awareness among them about the negative aspects of smoking, alcohol and tobacco on their health and families will help them to overcome these habits. Continuous analysis of air, water and soil should be done to prevent and take precautions against microbial infections or contaminations. Health, hygiene and nutritional aspects are the major asset to improve the quality of life and contribute to health promotion of the society.

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