

**ASSESSMENT OF WATER, SANITATION AND HYGIENE AMONG BASIC SCHOOLS
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ABSTRACT

Background: Water and sanitation improvements, in association with hygiene behavior change, can have significant effects on population and health by reducing a variety of disease conditions such as diarrhea, intestinal helminths, guinea worm, and skin diseases. **Objective:** The objective of this study is to assess water, sanitation and hygiene among Basic schools in El-Obied, North Kordofan State. **Methodology:** This facility based cross-sectional study comprised of 428 students selected from 12 schools. Data were collected via questionnaire as well as the interviews, observation checklist and bacteriological tests of water. Data were analyzed by SPSS software, version 11.5. **Results:** The study showed that 13 samples of drinking water contain coliform organism, and 10 samples of water contain E.Coli while 4 samples of water without pollution. In addition study showed that 33% of schools under study in El-Obied have unsafe primary water source. The quantity of water was not adequate in all schools under study, and there is no any hand washing facilities in all schools surveyed so the student did not practice handwashing in their schools. The present study showed that a toilets was not available in about three (25%) of schools under study. The study showed that all toilets of schools are dirty, improper design and contains insects of medical important such as flies, and cockroaches. **Conclusion:** the study conclude that; most of water samples were contaminated, the storage of water in schools was inappropriate and the latrines were dirty insufficient and there is no handwashing facilities in all school under study.

KEYWORDS: Water, Sanitation, Hygiene, basic school, El-Obeid, Sudan.**INTRODUCTION**

Diseases related to inadequate water, sanitation and hygiene are a huge burden in developing countries. It is estimated that eighty-eight per cent of cases of diarrhoea worldwide are attributable to unsafe water, inadequate sanitation or insufficient hygiene. These cases result in up to 1.5 million child deaths (for under the age of 5) each year. The only way to sustainably reduce this massive burden of disease is through the provision and use of safe drinking water, sanitation and improved hygiene practices.^[1,2,3]

A Special Session on Children of the United Nations General Assembly (2002) reported that nearly 5,500 children die every day from diseases caused by contaminated food and water.^[3]

Inadequate sanitation is a major cause of disease worldwide. Globally over one billion people have no access to safe drinking water and 2.6 billion lack adequate sanitation. This leads to 1.8 million people dying every year from water and sanitation related diarrhoeal diseases, 90% being children under 5 years, mostly in developing countries.^[4,1]

Handwashing interrupts the transmission of disease agents and so can significantly reduce diarrhea and respiratory infections, as well as skin infections and trachoma. A recent review^[5] suggests that handwashing with soap, particularly after contact with feces (post-defecation and after handling a child's stool), can reduce diarrheal incidence by 42-47 percent.

Sanitation facilities and services for the safe disposal of human urine and faeces, garbage collection and wastewater disposal are crucial to maintain health and protect water resources.^[4,1]

Water, sanitation, and hygiene interventions reduce diarrheal disease on average between one-quarter and one-half.^[6]

MATERIALS AND METHODS**Study area**

El-Obeid is the capital of North Kordofan State. Its area have been estimated by 81 km² and the distance from Khartoum is about 560 km. El Obeid is connected to Khartoum by an asphalt motorway, a railway line and air-flights taking off its airport several times a week.

North Kordofan state located in central Sudan latitude 13° 20' N longitude 30° 15' E, 570 m above sea level, the semi arid area of north kordofan receive an annual precipitation of about 280 – 450 mm in the months from July to September, temperature is generally high averaging 37°C in the summer and 18°C in the winter.^[7]

The population of the City estimated by 440483 person. There are 38000 houses, 40000 families.

Drinking water supply in El-Obied has two main sources

1. Water collected from heavy rainfall in hafir through large area (El-Khazan) and then passed to the water treatment plant in El-Obied.
2. Ground water from wells (Bara Basin).^[7]

Water in Basic Schools

Most of schools in El-Obied connected with public network of drinking water either from Bara basin or from El-Khazan. The schools in the peripheral of El-Obied use water from hafir and pumps and either from road vendors of water.

In most of schools, water was stored in ground tank made of cement and bricks while other schools storing water in barrels and Aziar (*local word for a pot made of burning mud to keep water*).

Sanitation

Sanitation provision in El-Obied is deficient, most people do not have access to hygienic toilets, and the large amounts of fecal waste are discharged to the environment without treatment because there is no sewerage system in El-Obied this may assist in spread of infectious diseases.

Solid waste disposal

In El-Obied solid wastes were collected through door to door strategy which taken by garbage truck once a week, while in some area the residents dispose their wastes at communal collection points in open spaces and in water ways. The majority of households store their wastes in open containers and plastic bags which associated with presence of insects of medical importance (flies, cockroaches). All solid wastes in El-Obied was carried and disposed in the landfill located in the western of El-Obied, City.^[7]

Study population

- Basic schoolchildren
- Basic schools

Study design

Facility based cross-sectional study.

Sample size

- A total of 428 schoolchildren were selected as a study subject. The sample size calculated with the formula; $n = z^2 \cdot pq / d^2$ ^[8] multiplied by design effect.

- Twelve schools.

Sampling technique

El-Obied, City was divided into four equal quarters (Clusters). The different types of schools (boys – girls – boys and girls) were considered as strata where three schools (boys, girls, and mixture) was selected from each quarter of El-Obeid City following a process of simple random sample using the table of random numbers, so the total number of schools selected was **twelve** schools.

The sample (428) was divided over the schools following a process of stratified sampling combined with systematic sampling with probability proportional to size to distribute the sample over the selected schools where selection was at random in each stage.

Data collection methods and tools

- An interview with headmasters of schools
- A structured pre coded and close-ended questionnaire of school children
- An observation checklist to collect data on water supply and sanitation within the basic schools in El-Obied.
- Laboratory test: Bacteriological examination of water.

Bacteriological testing of water

Samples Collection

Water samples for bacteriological examination were collected in the sterilized bottle. The outside of the tap was sterilized by flame, and then water was allowed to run for two minutes to wash out any organism in the pipe. The bottle was then filled with water and closed immediately. A total of 27 water samples (two samples from each school one from primary and the other from secondary source and three samples from the main water source of the City) of 100 milliliters each in labelled and tightly sealed sterile bottles packed in cool box then submitted to public health laboratory in Khartoum in the same day for analysis.

In the laboratory, the bacteriological analysis of water was performed through using the presence-absence test, as shown below

Preparation of medium

The constituents of the medium used for the presence-absence test for coliform bacteria are as follows:

Lactose broth (dehydrated)	13.0g
Lauryl tryptose broth (dehydrated)	17.5g
Bromocresol purple	0.0085g
Distilled water	1 litre

The medium were prepared in the following stages:

- (a) Dissolve the dehydrated lactose broth and lauryl tryptose broth sequentially in water, without heating.
- (b) Dissolve the bromocresol purple in 10 ml of sodium hydroxide solution (4g of NaOH in 1 litre of water). Sodium hydroxide pellets are caustic and great care

should be taken during the preparation of the solution; in particular, gloves and eye protection should be worn.

(c) Add the bromocresol purple solution to the broth solution.

(d) Dispense 50 ml of the medium into screw-cap glass dilution bottles of capacity 250–300 ml.

(e) Autoclave for 15 minutes at 121°C.

(f) Measure the pH of the medium after autoclaving; it should be 6.8 ± 0.2 .

Procedure

(a) Mix the sample thoroughly by inverting the sample bottle several times.

(b) Add 100ml of the sample to the dilution bottle.

(c) Incubate at 35 ± 0.05 °C and examine after 24 and 48 hours.

(d) A positive result (acid production) is indicated by a distinct yellow colour in the medium. Shake the bottle gently and examine for foaming, which indicates the production of gas.^[9]

Any test in which gas and/or acid is produced should be regarded as a positive presumptive test.

(e) Positive presumptive tests should be confirmed by inoculating a tube of brilliant-green lactose–bile (BGLB) broth with cultures that show acid and/ or gas production and incubating at 35 ± 0.5 °C. Growth and the production of gas in the BGLB broth culture within 48 hours confirm the presence of coliform bacteria.^[10]

Data processing & analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version (11.5).

Ethical consideration

Ethical permission for the study was obtained prior to collect data, by contacting and receiving approval from the appropriate management authority (North Kordofan State Ministry of Education). Participants were assured of the confidentiality of their responses and provided informed verbal consent

RESULTS AND DISCUSSION

The study showed that about (13) samples of drinking water from schools were containing coliform organism. This result in contradicting with WHO guidelines for drinking water which reflect that total coliform bacteria must not be detectable in any 100-ml sample.^[9] Also 10 samples of water contain E.Coli, these findings in contrast with WHO guidelines which reflect that E.Coli must not be detectable in any 100-ml sample of water for drinking.^[9] Those samples considered as unsafe water, because it contains bacteria indicating faecal pollution.^[11] The study showed that the water sample taken from the main source of water coming from Bara basin (ground water) was free from contamination and also the sample taken from main source of El-Khazan (surface water) after treatment was free from contamination. Whereas the samples from main sources in El-Obied was free from contamination, and this indicate that the contamination that occur in schools water samples tested may be due to leakages in the distribution system or bad handling and storage methods in schools.

Table (1) Microbiological quality of drinking water in schools under study

Sample results	Tests							
	Coliform test	%	Thermotolerant coliform test	%	Presumptive E.coli test	%	Confirmed E.coli test	%
Primary sources								
Positive	12	100	6	50	5	42	5	42
Negative	-	-	6	50	7	58	7	58
Total	12	100	12	100	12	100	12	100
Secondary sources								
Positive	10	83	6	50	5	42	5	42
Negative	2	17	6	50	7	58	7	58
Total	12	100	12	100	12	100	12	100

Table (2): Microbiological quality of water from the main sources of drinking water in El-Obied City

Test used for samples	Coliform test	Thermotolerant coliform test	Presumptive E.coli test	Confirmed E.coli test
Sources of water				
El-Khazan (Flow before treatment)	Positive	Positive	Negative	Negative
El-Khazan (Main tap after treatment)	Negative	Negative	Negative	Negative
Bara ground basin (Main tap)	Negative	Negative	Negative	Negative

As shown in (fig. 1) most (81.5%) of respondents using public cups for drinking, this may favour transmission of waterborne diseases.

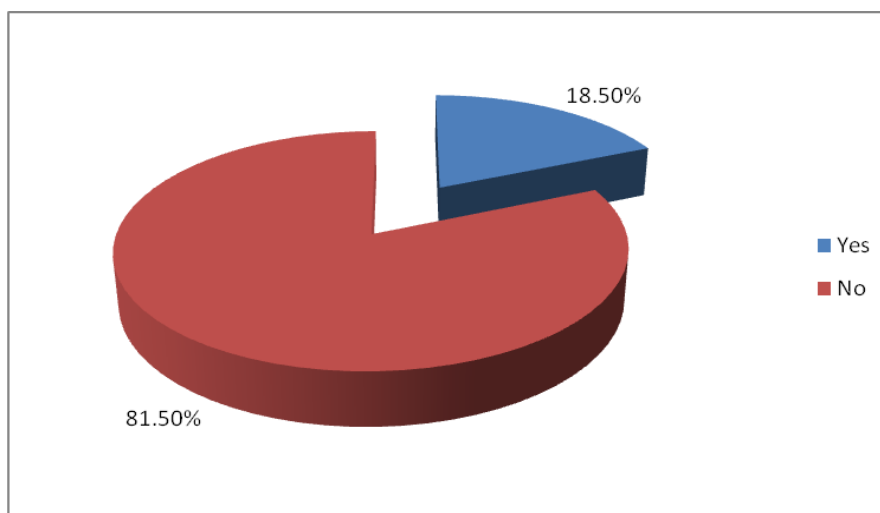


Figure (1): Use of personal cups for drinking water among the study group

n=428

In this study the observation checklist showed that 33% of schools under study in El-Obied have unsafe primary water source. This percentage was very high when compared with survey carried out in the West Bank, Palestine, however up to 10% of schools, mainly in rural areas, do not have safe sources of drinking water.^[12] Unsafe water sources contribute in waterborne disease, this point consistency with^[13] finding which estimated that 88% of diarrhoeal disease is caused by unsafe water supply, and inadequate sanitation and hygiene.

The quantity of water was not adequate in all schools under study. This is consistency with finding of UNICEF

survey which revealed that one water point available for 62 students which is almost the double the number of students per water point when compared with MoE guidelines for WASH in schools which recommend that at least one water point for every 30 students.^[12]

The study showed that all schools water in ground tanks, Aziar and barrels are open to any pollutants. This has the potential for water contamination at the point of storage. This situation is worse as compared with similar study conducted in the occupied Palestinian territory which showed that 50 per cent of school water tanks in Gaza are open to the elements.^[12]

Table (3): The parameters and handling of drinking water among schools under study

Safety of water source	frequency	percent
Safe	8	67%
Not safe	4	33%
Adequacy of water quantity		
Adequate	0	0.00%
Not adequate	12	100%
Appearance of water		
Clean	12	100%
Turbid	0	0.00%
The storage of water		
Appropriate	1	8%
Not appropriate	11	92%

As shown in **fig.2** most (69%) of respondents drinking from water available in their schools, 17% from their homes, while 14% of them drinking from water available outside their schools.

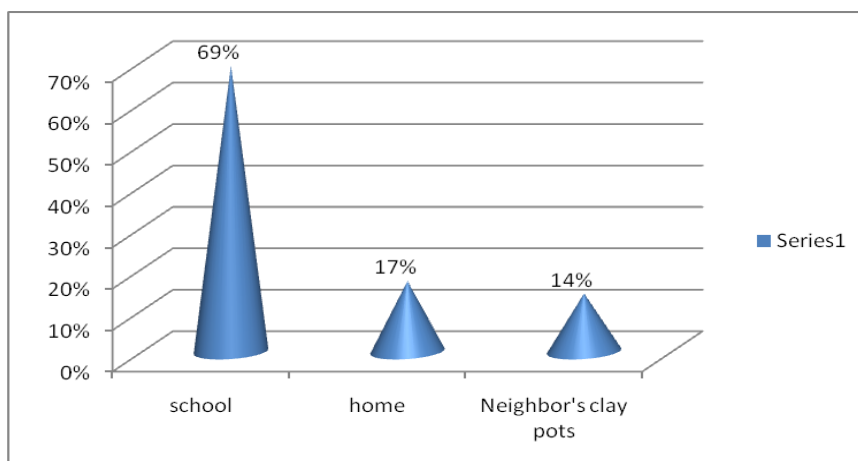


Figure (2): Source of drinking water during the school day among the study group

n=428

The present study illustrated that about (17%) of schools they obtained water from Hafir (*underground reservoir designed for storing rain water carried by streams*) via Karo (*donkey cart with tanker to carry drinking water*), this is in contradiction with ^[14] which found that Hafirs are recipients of contamination of all sorts such as dust, animal manure, human excreta and other contaminants. In the other side water handling via Karo (road vender) this finding contrast with ^[15] which found that there are a number of health concerns associated with water supplied to consumers by water vendors. These include access to adequate volumes and concern regarding inadequate treatment or transport in inappropriate containers, which can result in contamination, where the source of water is uncertain or the quality of the water is unknown.

The study showed that there is no any hand washing facilities in all schools surveyed; this finding contrast with study conducted in Vhembe District, Limpopo, South Africa which reflects that there was 100% coverage of hand washing facilities in the schools. These findings are also in contrast with study in Viet Nam which reflect that (29%) of schools had access to hand

washing facilities with sufficient water. ^[16] Also this result in contradiction with the result of similar study carried out in the schools of Moldova which revealed that availability of wash basins was registered in 98.4% of schools, however in 15.2% of them they were in an unsatisfactory condition. ^[17]

The present study showed that a toilets was not available in about 25% of schools under study, this result corresponding with the result of similar study carried out in Haitian Schools in the Time of Emergency which revealed that 14 schools have no sanitation at all (33%).^[18] So this result disagrees with ^[19] which mentioned that if people don't have a good water supply or access to a good sanitation facility their health will suffer.

The study showed that toilets were not adequate to students, this finding in contrast with standard mentioned with ^[13] which reflect that Sufficient toilets are available - one per 25 girls and one for female staff; one toilet plus one urinal (or 50 cm of urinal wall) per 50 boys, and one for male staff.

Table (13): The situation of sanitation facilities among schools under study

Availability of toilets	frequency	percent
Available	9	75%
Not available	3	25%
Adequacy of toilets		
Adequate *	0	0.00%
Not adequate	9	100%
Availability of hand washing facilities		
Available	0	0.00%
Not available	12	100%
Distance of latrines from water source		
Suitable **	9	100%
Not suitable	0	0.00%

* One toilet per 25 girls and one for female staff; one toilet plus one urinal per 50 boys, and one for male staff. ^[13]

** More than 30 m ^[13]

The study showed that about 7 (58%) of the schools in El-Obied have solid wastes around it this finding in consistence with similar study which reveal that In the West Bank, one-third of schools (32.9 %) have rubbish around the school, while in Gaza about 41.2 % of schools have rubbish nearby.^[12]

The study showed that all schools toilets were dirty, improper design and contains insects of medical important (flies, cockroachs), this finding in contradiction with (WHO) which revealed that high fly densities will increase the risk of transmission of *Shigella* dysentery.^[20]

The study showed that in about 2 (17%) of schools the students practice open defecation in the peripherals inside the schools this unhealthy practice in contrast with (WHO) facts which reflect that human faeces may contain a range of disease-causing organisms, including viruses, bacteria and eggs or larvae of parasites. The microorganisms contained in human faeces may enter the body through contaminated food, water, eating and cooking utensils and by contact with contaminated objects. Diarrhoea, cholera and typhoid are spread in this way and are major causes of sickness and death.^[20]

The study showed that there is no any role from schools managers in the maintenance of sanitation with regard to provision of hand washing facilities, this result in contradiction with finding of similar study carried out in Palestine which revealed that (71%) out of all teachers in surveyed schools in occupied Palestinian territory report having participated in activities or events to promote student's health in school.^[13]

The study illustrated that there was a handwashing promotion program in about 67% of schools specially before eating and after using toilet, through health education messages in class or in the morning program, this corresponding with similar survey conducted in Palestine which showed that about, 90.9 % of interviewed teachers report having taught within the past six months about proper hand-washing.^[13]

The study revealed that about (58%) of school managers have role in the maintenance of sanitation with regard to provision of latrines, this result corresponding with finding of similar study carried out in Palestine which revealed that (71%) out of all teachers in surveyed schools in occupied Palestinian territory report having participated in activities or events to promote student's health in school.^[12]

CONCLUSION

The storage of water in schools is inappropriate, and the latrines in all schools surveyed were dirty and students were defecating surround the seat, while in schools where toilets is not available the student practicing open defecation inside a school in El-Obied. The study revealed that there were no any hand-washing facilities

found in all schools under study in El-Obied. Thus, there is need for appropriate storage of drinking water at schools, build new toilets in enough numbers in schools and encourage good behavior of school children for water utilization and personal hygiene.

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