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Knowledge and Practices on Water, Sanitation, Hygiene and Waterborne Diseases among under-Five Children in Temeke District, Dar Es Salaam, Tanzania

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Authors' contributions

This work was carried out in collaboration between both authors. Author HSM designed the study, performed the statistical analysis, wrote the protocol, managed the analyses of the study, managed the literature searches, and wrote the first draft of the manuscript. Author JKM supervised the whole paper, including corrections in all stages up to the final submission. Both authors read and approved the final manuscript.

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ABSTRACT

This study assessed the knowledge and practice of 220 respondents from three wards of Tanzania's Temeke Municipality regarding water, sanitation, hygiene, and water-borne diseases. The study used a mixed-methods approach, combining quantitative data from the household survey with qualitative data from key informant interviews. The quantitative data were analysed using

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SPSS, while the qualitative data were analysed using content analysis. The results showed that the majority of respondents rely on public water sources (i.e. 40% on public taps and 36.9% on public water kiosk and of them all, only 16% of people boil their water before drinking. Furthermore, respondents recognised the importance of hand-washing during critical times. Only 31.7% and 72.6% use soap to wash their hands before and after meals, respectively. Based on respondents' self reporting, diarrhoea was among the widely known WASH incidence (10.5%). Other mentioned incidences were cholera (8.2%) and typhoid (2.3%) and they were mainly affecting the under-five children (14.5%). The study concludes that respondents have a satisfactory understanding of sanitation and hygiene, though their practices remain disappointing. According to the study, any efforts to improve access to sanitation and hygiene must be combined with strategies to promote effective use of these services.

Keywords: Sanitation; hygiene; hand-washing practices; water-borne diseases; temeke municipality.

1. INTRODUCTION

Water, sanitation, and hygiene (WASH) are critical factors influencing human health. Unsafe water, sanitation and hygiene can have fatal effects on children and their health impacts such as diarrhoea, cholera, typhoid to mention a few significantly increasing the rate of under-five mortality, primarily in developing countries [1]. Over 2 billion people worldwide are estimated to drink faecal-contaminated water, and approximately 4.5 billion families rely on inadequate sanitation systems that endanger their families. Transmissible illnesses such as diarrhoea constitute approximately 4.1% of the global disease burden, particularly in nations with developing economies where the availability of clean water for drinking remains a challenge [2]. According to a recent population-based survey conducted in 2015/16 in various parts of Tanzania, the prevalence of diarrhoea was 12% [3]. Diarrhoea continues to be the most prevalent cause of death and sickness among children under the age of five, killing an estimated 502 000 children each year, surpassing the death tolls of malaria and tuberculosis together [4,5,6].

A lack of affordable access to WASH wastes resources that could be used to advance the nation's development agenda [3]. The Tanzanian government spends approximately 70% of its health funds on avoidable WASH-related illnesses [3]. This is due to more than half of people (68%) does not have a means of better sanitation, and approximately 46% have no access to pure water for drinking [7]. Over 10% of Tanzania's deaths may be prevented, and the estimated 31,000 deaths annually attributed to inadequate WASH services cost the country's economy more than $2.4 billion in additional medical expenses and lost productivity [8]. According to TDHS-MIS [3], inadequate sanitation and insufficient hygiene lead to up to 12% of childhood illnesses, particularly diarrhoea, leading to a high mortality rate among children under the age of five. Furthermore, 80% of rural residents continue to use insufficient and unaltered water and sanitation services, while cities have as little as 2% insurance [5]. In urban areas, Only 47% of Tanzanians have access to basic sanitation, and only 23.5% have access to facilities for basic hygiene (hand-washing with soap and water) [9]. Basic sanitation is referred to as the availability of services for secure disposal of bodily waste (excrement and urine), and also the capacity to keep sanitary conditions via amenities such as garbage pickup, handling of industrial and hazardous waste, and waste-water treatment and disposal.

Transmissible illnesses, particularly those caused by water, can be readily and successfully handled by improving overall sanitation conditions and hygiene habits [10]. Sanitation issues at the home level, particularly in regions with low incomes, are not fully recognised by the government, and most diligence is placed in ensuring the availability of water supply, treating sanitation as a last resort on the political agenda and funds reservations [11,12].

Sanitation provision remains inadequate in Dar es Salaam city, particularly in remote areas such as Temeke Municipality, as pit latrines (the toilet and shower) are in a state of disrepair, sewer systems have been damaged, and managing water resources is not a major concern [13]. In Dar es Salaam City, shallow well water is typically bacteriologically and chemically polluted of which on-site waste management and inadequate hygiene education are the sources of contamination [14]. In places like Tambukareli, which is in the Azimio district of Temeke Municipality there are many private wells which

are often shallow, frequently salinous, and, especially during the rainy season, contaminated with human excrement [15]. Lack of coordination amongst important players and a dearth of readily available, accurate data have been issues that have plagued everyone involved in the WASH industry in Temeke Municipality. Due to the area's numerous unplanned settlements, it is very difficult to acquire basic utilities like water, sanitation and hygiene [16]. Research studies [i.e. 17,18] conducted in some slums of Temeke Municipality, including Keko Machungwa, Ukonga, and Majumba sita, showed that underground water frequently goes up above the water table, leading to pit latrines overflowing and shallow well pollution. According to a study conducted by Kumi-Kyereme and Amo-Adjei [19] in Temeke Municipality, insufficient educational attainment, low-quality water storage vessels, and insufficient sanitation services are major contributors to poor WASH habits among local households.

The National Sanitation and Hygiene Campaign was launched in 2012 to improve WASH practices and reduce related infections, but these efforts have attracted little consideration in sanitation programmes so far [20,21]. Attempts to address WASH diseases in various areas of Dar es Salaam are primarily focused on water supply. Several studies [13,4,20] have connected insufficient hygiene and sanitation practices among people to the spread of WASH-related illnesses. However, these research efforts have not addressed the comprehension of such aspects. WASH-related diseases among children under the age of five in Temeke Municipality could be linked to poor knowledge of mothers and caretakers regarding water use, sanitation, and hygiene. As a result, the primary goal of the present research was to evaluate mothers' understanding and behaviours regarding water, sanitation, hygiene, and illnesses caused by water in three Temeke Municipality wards to carry out suggested WASH-related disease prevention strategies, particularly diarrhoea. In particular, the study sought to investigate people's knowledge and practices regarding sanitation, hygiene, and associated infections. Second, this investigation aims to assess water-based practices (use and management) in terms of sanitation and hygiene.

This study sought to fill certain academic gaps by broadening our knowledge of the different variables that may have played a role in the outbreak of prevalent infections among children under the age of five. The results of this investigation will add to the current collection of published material on projects or initiatives related to water use, sanitation, and hygiene, including the National Sanitation Campaign (NSC), Water, Sanitation, and Hygiene, Sanitation and Water for All (SAWA), Dar es Salaam Water Supply and Sanitation Project (DWSSP), and Water Sector Programme (WSP). The objective of this investigation is to assist stakeholders such as end users, local government authorities, and government and non-governmental organisations in improving sanitation and hygiene promotion. The research investigation focuses on the United Nations Sustainable Development Goal (SDG) number 6 [22], which aims to ensure accessibility and effective use of water and sanitation for all.

2. METHODOLOGY

2.1 Description of the Study Area

The study was carried out in Temeke District, Dar es Salaam, at 39° 12' - 39° 33' East and 6° 48' - 7° 33' South. Until 2016, Temeke was projected to have 1 443 629 residents and 368 416 houses, with a yearly increase in population of 4.6% (Fig. 1) [23]. Temeke is the city's industrial district, home to production centres (heavy and light industry), and the port is situated on the eastern side of the area. The location was chosen because it is one of the municipalities with a significant number of unplanned (informal) populations and medium-low-income residents with inadequate sanitation [24; 25]. Additionally, a large percentage of inhabitants have little awareness of issues concerning water use, sanitation, and hygiene, as demonstrated by multiple studies [26,18,24,25].

2.2 Research Design

The study applied a mixed-method approach, combining qualitative and quantitative research designs. Quantitative design was used as the study involves the application of surveys and questionnaires in data collection and analysis. In addition, quantitative data analysis uses statistical methods to process and interpret numerical data. Qualitative design was used as its methods supplement quantitative research by focusing on non-numerical data, which enhances understanding. The study used a cross-sectional design, with the primary information gathered at a single point in time [27]. Data was gathered via household interviews with mothers and/or carers,

with children younger than five being the top priority, followed by those with children under the age of seven. The study's eligibility criteria included being a mother or carer of at least a single child at the age of five. If a qualified family had an additional mother or carer with an under-five child, the Kish grid technique was used to choose at random a single for the interview [28]. If the chosen mother or carer had multiple kids under the threshold of five years, the same method was used to select at random a single child to take part in the study. This approach prevents selection bias by creating a list of those who qualify at a specific label and then choosing according to the size of the mark itself [29]. The exclusion criteria for the study was all the households with no under-five children.

2.3 Sampling Procedure

A probability sampling method was used, with simple random sampling utilised for choosing the study area and population. The study population consisted of carers or mothers with under-five children living in Temeke District, as they are the primary carers for children in their families. The investigator obtained a list of 24 wards with the assistance of Temeke Municipal officials from the Department of Sanitation and Environmental Protection. A lottery was carried out to choose three wards from the list of 24, namely Tandika, Mtoni, and Azimio. A list of streets was produced based on the wards mentioned above; Tandika had six streets, Mtoni had six, and Azimio had eight. A lottery was used once more to choose three streets from each ward, totalling nine streets. To guarantee a comparable proportion of participants, the sample size was divided by a street, with 75 respondents from Tandika, 75 from Mtoni, and 70 from Azimio. The study population, which included mothers and carers with under-five children, was chosen with the assistance of street agents appointed by the Ward Executive Officer since they weren't provided with a registry of homes with under-five children in particular. In each street, a single member of each of the five households was chosen at random for surveys and observations.

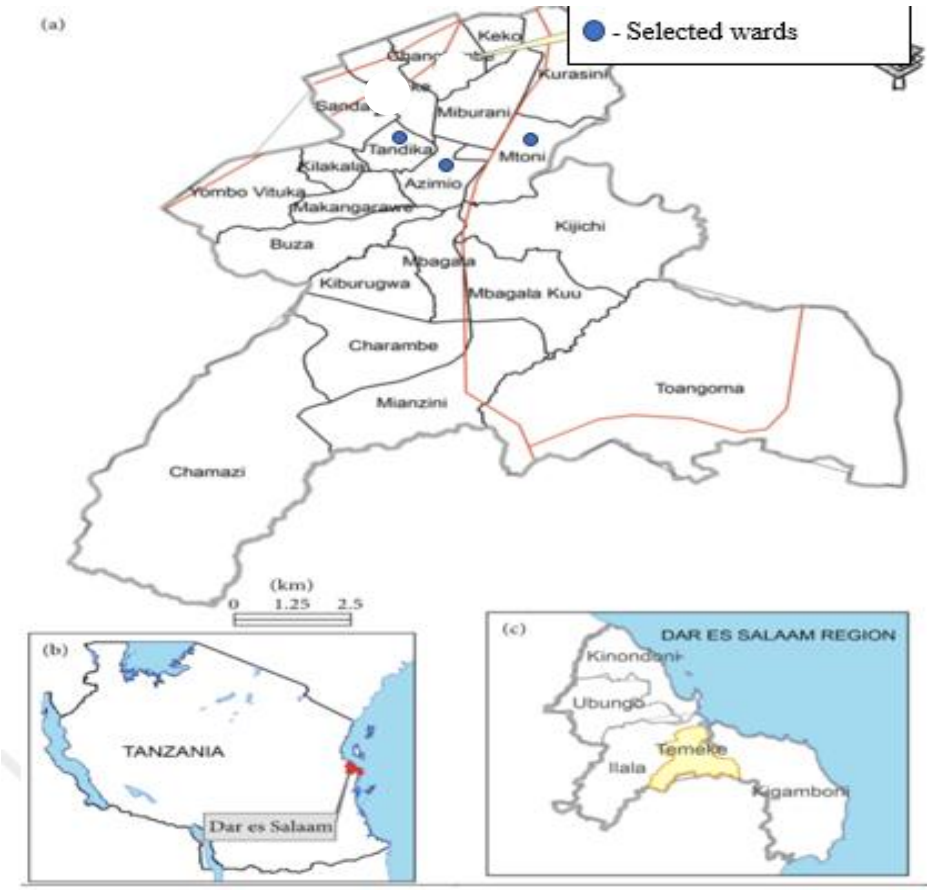

Fig. 1. Map of temeke municipality showing selected wards
Source: Kacholi and Sahu [30]

Table 1. Description of variables used in the Logistic Regression model

Variables	Description	Measurement
Age	Actual age of respondents	Age in complete years
Marital status	Marital status of respondents	1 = Married 0 = Otherwise
Education level	Education level of respondents	1 = Secondary and Tertiary level 0 = Otherwise
Income sources	Income sources of respondents	1 = Self-employed 0 = Otherwise
Water sources	Water sources used by respondents	1= Piped into the house 0 = Not piped into the house
Water safety measures	Water safety measures used by respondents	1= Let water settle 0 = Otherwise
Hand washing practices	Hand washing before meals with soap	1 = Yes, with soap 0 = No soap
	Hand washing after meals with soap	1 = Yes, with soap 0 = No soap

The sample size equation identified that 196 households with children under the age of five would be chosen. The degree of accuracy in determining the sample size was established at 7%, which falls between 5 and 10%, leading to an initial needed sample size of 196 participants.

2.4 Sample size Determination

The total sample size was estimated with the help of a formula by Fisher *et al.* (1991) for larger populations (exceeding or equal to 10,000) as shown below,

$$n = \frac{z^2 \times p \times (1-p)}{d^2}$$

Where;

n = is the sample size required; z = standard normal deviation, set at 1.96 corresponding to 95% confidence level; p = proportion in target population with features of interest (unknown, use 50%); 1 - P = (1 - 0.5) = 0.5 (Expected non-prevalence); d = degree of accuracy desired, set at 0.07 (7%)

$n = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2 = 3.8416 \times 0.25 / 0.0049$

n = **196**

Due to the resources available such as personnel (data clerks) and, the adequate working time frame the study managed to include an addition of 24 respondents making a total of 220 respondents as the number seemed enough to draw a better conclusion. As a result, 220 mothers/caregivers were able to be questioned and incorporated into the analysis.

2.5 Data Collection

Data were collected predominantly from residents of Tandika, Mtoni, and Azimio Wards using an organised survey and observation method. Quantitative data were gathered on respondents' (mothers and carers) expertise and habits regarding water, sanitation and hygiene, and waterborne diseases. Qualitative data were gathered using key informant discussions street and ward representatives, as well as health care officials. The technique of observation was applied to document and ensure household sanitation customs, such as latrine facility conditions and hand hygiene.

2.6 Data Analysis

The information gathered was analysed with IBM-Statistics SPSS Windows version 20.0. The descriptive technique was adopted to examine households' perceptions and practices regarding water, sanitation, hygiene, and waterborne diseases, which were displayed in graphs and frequency tables. The participant's level of understanding was measured using an ordinal level of measurement, which is a categorical assessment level of high and low, with frequencies and percentages estimated. Overall knowledge and habits of respondents regarding water, sanitation, and hygiene, as well as waterborne diseases, were deemed high if they exceeded 50%, and low if they fell below 50%, using an acceptable threshold of 110 (50%) for the entire number of those who responded. To

appreciate the quantitative data gathered, content analysis was applied for qualitative data gathered from key informants. The binary logistic regression model was utilised for estimating key factors associated with diarrhoea incidence, as follows:

$$Y = \text{Ln}\ (P/\ (1 - P))\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$Y = \text{Ln}\ (P/\ (1 - P)) = \beta o_{(\text{constant})} + \beta_{1(\text{regression coefficients})}\ X_{i1(\text{Age})} + \beta_2\ X_{i2(\text{Marital status})} + \beta_3\ X_{i3(\text{Education level})} + \beta_4\ X_{i4(\text{Income sources})} + \beta 5\ X_{i5(\text{Water sources})} + \beta 6\ X_{i6(\text{Water safety measure})} + \beta 7\ X_{i7(\text{Hand washing practices})} + \varepsilon i\ _{(\text{Random error term})}\ldots\ldots\ldots \quad (2)$$

Source: [13]

Where:

Y = Dependent binary variable (contacted with diarrhoea = 1, not contacted = 0), P = Probability of being contacted with diarrhoea, 1 – P = Probability of not being contacted with diarrhoea. Ln = Natural logarithm function.

3. RESULTS

3.1 Socio Demographic Features of Respondents

Table 2 shows that out of 220 respondents, 16% were between the ages of 18 and 25, 32.7% were between the ages of 26 and 33, and 26.4% were between the ages of 34 and 40. The majority (67%) were married, 16.9% were single, and the typical number of households was at least four individuals in each household. The majority (72%) received elementary schooling, while 23% completed secondary school. Furthermore, 47.7% were primarily involved in small enterprises such as a kiosk, selling bites and fried fish right outside their homes, tailoring, and ice cream.

3.2 Main Sources of Potable Water, Storage Facilities, and Water Purification Measures by the Respondents

Water usage and handling were evaluated according to self-reported information and observations of actual water sources as well as storage facilities. Water sources and storage facilities involved multiple responses i.e. a single household can have more than one water source and storage facility. More than half of families rely on public water sources, with 40% relying on public taps/standpipes "visima," and 36.9% getting water via public water kiosks, the majority of which are dug wells wrapped with concrete on top, for a total of 76.9% of all houses. Additionally, 4.7% obtain water through small-scale water vendors, such as pushcarts and borehole water suppliers, who can carry up to 15 gallons of water. In addition, a 20-litre bucket was sold for 50-200 TZS, depending on where the vendor obtained the water. Different water suppliers charge different prices; for example, for public sources, the price is 100 TZS, whereas for private taps and vendors, the price is 200 - 400 TZS, indicating an additional 200 TZS, limiting daily household water consumption needs. Furthermore, 8.2% use piped water that is directly delivered to their home, while 14.3% use piped water that is linked to a stopcock within their property. The majority (64.7%) of the respondents use buckets with a lid to store water, 22.1% use jerry cans with a lid, and 1.7% use water drums ranging from 80 – 160 litres. Participants exclude cleaning sanitation facilities (25.2%) or hand washing (17.4%) within their typical water use routines. The majority of the households had no specific water containers such as buckets or water drums which were present in the facilities for keeping water to be used to clean the latrines or wash hands after use. Furthermore, the daily amount of water used in the home ranges from 20 to 200 litres, with an average of eleven (11) 20-litre buckets in both dry and rainy seasons, accounting for more than 85% of all household water use. According to the participants, their preferred precautionary measure was boiling (16%), with only four (1.7%) reporting the use of chemicals such as water-guard.

3.3 Knowledge and Practices towards Sanitation and Hygiene

3.3.1 Hand-washing practices

Hand-cleaning behaviours were evaluated using self-reported data. Participants agreed that it is essential to wash hands shortly after using the lavatory; nevertheless, the actual causes varied greatly. Among the causes given was the avoidance of disease spread, which was mentioned by 64.3% of Azimio participants. Hand washing was listed as a reason by approximately 70.7% in Mtoni Wards and 86.7% in Tandika Wards; 40% of respondents in Azimio, 52% in Mtoni, and 48% in Tandika, with only 1.3% citing cultural/religious practices. Overall, 63.4%

thought it was a good idea to wash your hands right after using the lavatory, and 16% thought it was vital that you wash your hands to avoid food poisoning. Only a few (31.7%) wash their hands with soap before meals, while most people (62.6%) do so after meals. The primary motives recognised for washing hands before meals consist of washing hands to eliminate dirt (22.6%) and killing pathogenic organisms (bacteria) (7.4%). As stated in Table 4, reasons given for washing hands after meals involve eliminating bad odours ("shombo") (45.2%) and removing stickiness from the hands (14.7%). Respondents' perceptions of hand-washing practices varied. The main reason proposed is that it is a common/cultural practice, as disclosed by 73.8% of Azimio, 62.7% of Mtoni, and 78% of Tandika. Other justifications involve: it is a beneficial habit (16% from Mtoni, 38.7% from Tandika, and neither from Azimio); it aids in the prevention of illnesses (diseases), disclosed by 16% from Mtoni, 29.3% from Tandika, and only 5% from Azimio (Fig. 2). The general impression of hand washing relied on it being a routine that everyone followed, rather than anything else.

3.3.2 Latrine utilization and disposal of child stool

In this subsection, knowledge and practices regarding sanitation and hygiene were evaluated using self-reporting data and the observation of indirect indicators based on the design and general state of the latrine facility, as well as the disposal of child stool. According to the findings, 57.5% of respondents from Azimio, 85.3% from Mtoni, and 72% from Tandika agreed that improving the quality and utilisation of latrines might lower the prevalence of water-related illnesses. The proposed causes include a good facility design with enough space and ventilators (42.1%), having a clean toilet and its overall environment (41.7%), and having water available within the structure at all times (32.1%) to keep it clean. According to 36.3% of Azimio respondents, 22.7% from Mtoni, and 28% from Tandika, not sharing latrines was one of the additional reasons. The participants (72%) disposed of child stool by tossing it into the latrine, which was a good sanitation practice. Other practices include throwing faeces in the trash (9.3%) and allowing children over the age of five to use the lavatory (10.7%). The general understanding of latrine quality and state was 59%, which was considered high based on the knowledge criteria used.

3.3.3 Personal hygiene behaviours

Bathing (79.1%) and wearing fresh clothes, which means washing clothes (45%), were the most commonly identified hygiene-related behaviours. Others cited tooth brushing (35.6%) and hand washing (20.5%), but they did not specify whether they used soap or plain water (Fig. 3). The general perceived knowledge of hygiene-related topics was 36.4%, which is considered low knowledge.

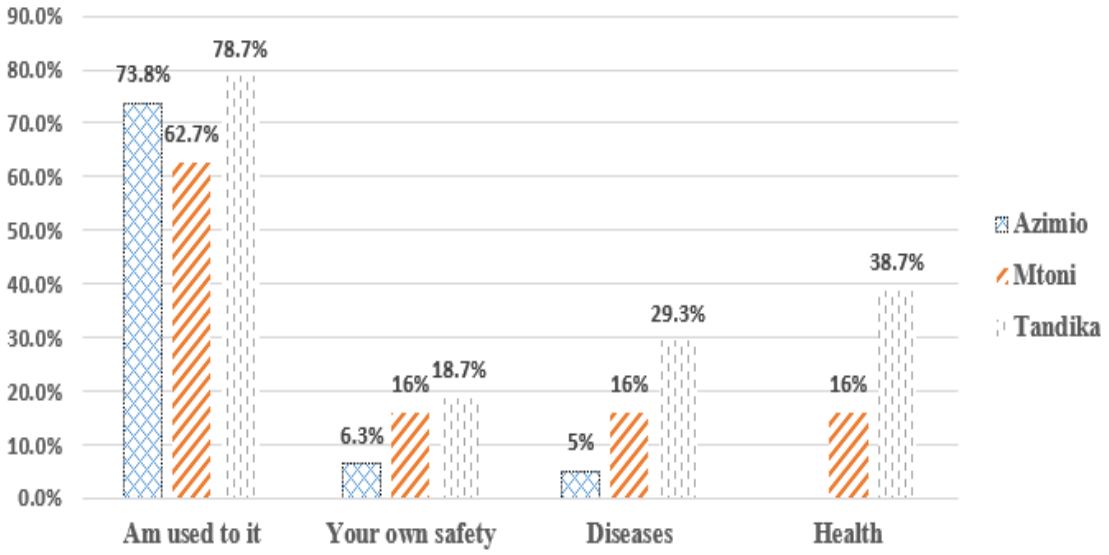

Fig. 2. Respondents' overall perception towards hand-washing practice

Table 2. Socio-demographic information of respondents (n=220)

Variable	Category	Frequency	Percent (%)
Age (in complete years)	18 – 25	37	16
	26 - 33	75	32.7
	34 – 40	58	26.4
	41 and above	50	21.5
	Total	220	100
Marital status	Married	147	67
	Engaged	34	14.8
	Single	39	16.9
	Total	220	100
Educational level	Primary level	158	72.0
	Secondary level	53	23.0
	Tertiary level	1	0.4
	No formal education	8	3.5
	Total	220	100
Household size	< 5 years	203	92.3
	No > 5 children	17	7.0
	Total	220	100
	> 5 years and adults	220	100
	Total	220	100
Income-generating activity	Self-employed	196	87.3
	Casual labour	16	6.9
	Official employment	2	0.9
	Housewife	6	2.6
	Total	220	100

Table 3. Main sources of water for daily domestic activities and treatment methods (n=220)

		Azimio (n = 70)		Mtoni (n = 75)		Tandika (n = 75)		Total (n=220)	
Category	**Variable**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
Water sources	Piped into the house	5	6.3	13	17.3	1	1.3	19	8.2
	Public water kiosk	31	38.8	9	12	45	60	85	36.9
	Piped to yard	2	2.5	24	32	7	9.3	33	14.3
	Public taps/ standpipes	47	58.8	27	36	18	24	92	40
	Small scale water vendors	4	5	3	4	4	5	11	4.7
Safety measures	Boil	10	12.5	15	20	12	16	37	16
	Let water settle	73	91.3	56	74.7	56	74.7	185	80.4
	Chemicals e.g. water guard	1	1.3	3	4	-	-	4	1.7
	Bottled water	1	1.3	2	2.7	-	-	3	1.3

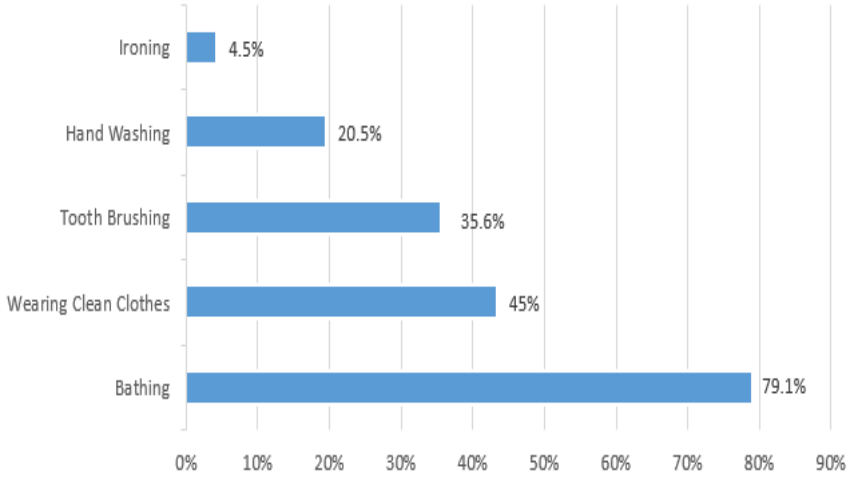

Fig. 3. Respondents' awareness on personal hygiene activities

4. WASH-RELATED INFECTIONS

Mothers/caregivers self-reported WASH-related infections in children under the age of five. Several respondents agreed that their children have had diarrhoea in their lives. Diarrhoea was by far the most prevalent illness disclosed, contributing to 10.5% of all other infections, followed by cholera at 8.2%. The under-five age group was most severely impacted by these WASH-related infections (14.5%). A large number of mothers and carers interviewed reported knowing something about water-related illnesses and how to avoid them. In terms of preventive measures against the aforementioned infections, 77.3% mentioned sanitation in the environment, which includes proper waste management, primarily garbage disposal. Furthermore, 32.5, 22.7, and 17.3% of the participants from Azimio, Mtoni, and Tandika recommended self-cleanliness and food safety (from preparation to consumption) as measures to guard against the aforementioned infections (Table 5). Based on the various responses, the general understanding of WASH- related infections and their countermeasures is quite low, with only 11.8% mentioning hand-washing and 8.6% identifying boiling water as a precautionary measure against diarrhoeal illnesses.

4.1 Factors Associated with Diarrhoea Incidence

Table 6 shows the results of the binary logistic regression model for the main factors linked to respondents contacting diarrhoea. The overall Wald statistic was significant ($p = 0.000$, $p < 0.05$), indicating that the entire model accurately predicted the outcome. The chi-square for the Omnibus Tests of Model Coefficients was not significant ($p = 0.215$, i.e. $p > 0.05$), indicating that the overall model did not accurately predict the final result. The chi-square for the Hosmer and Lemeshow Test was non-significant ($p = 0.433$, i.e. $p > 0.05$). The Nagelkerke R2 of 0.082 indicates that the independent variables included in the model were merely able to predict 8.2% (0.082 x 100) of the dependent variable's variance. One out of the eight independent variables in the binary logistic regression model, washing their hands with soap before meals ($p \leq 0.05$), had a significant relationship with the participant's contacting diarrhoea.

Hand washing with soap before meals had a positive and significant effect on the likelihood of respondents experiencing diarrhoea, as indicated by the highest Wald statistic. Age, marital status, income sources, and hand washing with soap after meals did not correlate significantly with diarrhoea, and all had negative B-values. Variables such as water sources, water safety measures, and educational level were not significantly associated with respondents contacting diarrhoea, despite having positive B-values; however, their Exp(B) values were greater than 1.0, indicating that the variables increased the odds of respondents contracting diarrhoea.

5. DISCUSSION

The study found that the majority (76.9%) depend on public water sources as their main

Table 4. Hand washing practices (n=220)

		Azimio (n=70)		Mtoni (=75)		Tandika (n=75)		Total (n=220)	
Category	**Variable**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
Hand washing	Before meals with soap	18	22.5	25	33.3	30	40	73	31.7
	After meals with soap	45	56.3	44	58.7	55	73.3	144	72.6
Reasons									
Before meals with soap	Dirty hands (cleaning)	13	16.3	14	18.7	25	33.3	52	26.6
	Infectious germs (bacteria)	3	3.8	8	10.7	6	8	17	7.3
After meals with soap	Bad smell	36	45	30	40	38	50.7	104	45.2
	Oily hands	8	10	20	26.7	6	8	34	14.7
	Healthy	-	-	-	-	2	2.7	2	0.9

Table 5. Knowledge on WASH-related infections as reported by respondents

Table 5a. Common WASH-related Incidences (n=220)

		Azimio (n = 70)		Mtoni (n = 75)		Tandika (n = 75)		Total (n=220)	
Category	**Variable**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
Incidence	Diarrhoea	9	11.3	8	10.7	6	8	**23**	**10.5**
	Cholera	8	10	6	8	4	5.3	**18**	**8.2**
	Typhoid	2	2.5	2	2.7	1	1.3	**5**	**2.3**
								Total= 46	**= 21**

Table 5b. Groups affected and prevention measures (n=220)

		Azimio (n = 70)		Mtoni (n = 75)		Tandika (n = 75)		Total (n=220)	
Category	**Variable**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
Group affected	Children < 5 years	13	12.5	10	9.3	9	9.3	32	14.5
	Children > 5 years	2	2.5	4	5.3	-	-	6	2.7
	Youth and adults (18-35) years	4	5	3	4	1	1.3	8	3.6
								Total = 46	= 21
Preventive measures	Environmental cleanliness	58	82.8	54	72	54	72	166	77.3
	Frequent toilet cleaning	1	1.3	2	2.7	24	32	27	11.7
	Boiling water	1	1.3	14	18.7	5	6.7	20	8.6
	Awareness	3	3.8	1	1.3	3	4	7	3
	Food safety	26	32.5	11	14.7	5	6.7	42	18.2
	Hand-washing	-	-	7	9.3	19	25.3	26	11.8
	Self-cleanliness	26	32.5	17	22.7	13	17.3	56	24.3

Table 6. Binary Logistic Regression analysis of factors associated with respondents contacting diarrhoea and not being contacted (n=220)

Independent variables	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% C.I. for EXP(B)**	
							Lower	**Upper**
Age	-.024	.024	1.080	1	.299	.976	.932	1.022
Marital status	-.333	.389	.733	1	.392	.717	.334	1.536
Education level	.224	.458	.240	1	.624	1.251	.510	3.068
Income sources	-.247	.613	.162	1	.687	.781	.235	2.598
Water sources	.391	.669	.342	1	.559	1.479	.398	5.492
Water safety measures	.110	.440	.062	1	.803	1.116	.471	2.642
Hand washing with soap before meals	.971	.409	5.627	1	.018*	2.641	1.184	5.893
Hand washing with soap after meals	-.270	.453	.355	1	.551	.764	.314	1.854
Constant	-1.663	1.090	2.325	1	.127	.190		

** significant level at P ≤ 0.05*

Dependent variable = diarrhoea incidence, Overall Wald statistics = 73.316 (p = 0.000); Omnibus Tests of Model Coefficients Chi-square = 11.968 (p = 0.215); Hosmer and Lemeshow Test Chi-square = 8.005 (p = 0.433); -2log Likelihood = 212.136[a]; Cox and Snell R^2 = 0.051; Nagelkerke R^2 = 0.082 model is not well predicted at 8.2%

water sources for domestic purposes. This implies that, most informal settlement dwellers in Dar es Salaam depend on other reliable sources of water other than pipe network into the house including privately owned boreholes, private taps, tanker trucks and protected wells. Studies [31,32] done in rapidly developing cities like Dar es Salaam reported that most people get their water from boreholes or shallow wells because the government cannot deliver enough fresh water through a piped system. Comparable results were reported in an investigation conducted in Goba, Dar es Salaam, which found that inhabitants in low-income areas rely on alternative water sources such as boreholes because the government hasn't been able to offer water supply to cope with the sudden rise in population [33]. A shortage of water in the city, combined with an immediate rise in population, creates a need for more privately run water suppliers, as they are safe and reliable, however the cost is greater than the official rates charged by DAWASCO. The quality of water provided by private owners and its implications for health remain unknown, as no traceable studies have investigated the dangers of using groundwater [34,33].

Households were reported to consume 20-200 litres of water per day during both the dry and wet seasons, with prices varying according to source.According to the study's findings, the city's rapid population growth is driving up water demand, and because water has no alternative [35], people will choose whatever source of water is available, no matter the cost. A study conducted in Dar es Salaam's slums found that households served by private water vendors spend more cash on water purchases than those served by public water supply companies [36]. Considering that over fifty per cent of slum dwellers are low-income, the cost barrier hinders their regular use of water requirements. Furthermore, water scarcity exists in households served by public utilities such as DAWASCO. Furthermore, this can be inferred from the fact that no water delivery system is trustworthy enough to meet the household water consumption requirements. Hence, people dig their wells to meet the needs of water supply as one of the participants from Kichangani Street had this to say,

> *"Temeke receives water coming from the Ruvu basin via a pipe constructed from the basin to the city. However, due to pipe issues, water has not been available all day for more than a week, so a few individuals chose to construct their own well near their homes to meet their daily water needs. Water is sold to those in need by those with their own wells, and the price varies depending on the storage container used, e.g., a 20-litre bucket costs 100 TZS, a 10-litre bucket costs 50 TZS..."* (Key informant respondent from Tandika ward on 6th April 2019).

The study discovered that 16% of families boil their drinking water, which is very few people. There may be little awareness of the risks related to drinking contaminated water because users depend on their senses or can't afford the cost of boiling water every day. Additionally, the purity of water supplied by private owners is ignored as long as water is safely and consistently available. A study conducted in rural Tanzanian community reported otherwise that, 40% of surveyed households used filtration clay pots to filter their water or boiling as water treatment [37]. These variations could be explained by differences in socioeconomic status and sample size. However, the technique of minimising diarrhoea illnesses at the household level is insufficiently documented. It's possible that, poor water storage and handling mechanisms accounts to re-contamination after boiling. This is evident in an investigation conducted by Ngasala et al*.* [38], in a peri-urban neighbourhood of Dar es Salaam who demonstrated the importance of careful storage of water following treatment for preventing re-contamination. According to study results, most people do not use any sort of purification methods for drinking water because they believe the water sold by private water vendors is safe to drink. A study conducted in a rural Tanzanian community revealed similar findings, indicating that Escherichia coli was found in the water samples from homes in 80% of the cases [37]. Furthermore, the study found that respondents rarely treated the water they drank. This suggests that efforts to fight against the emergence and dissemination of infectious illnesses remain low, as the primary preventive measure for certain transmissible illnesses is to treat drinking water, which ensures that it is free of pathogen contamination.

Regarding hand washing during crucial moments, such as after going to the toilet, the results of the current study revealed that respondents acknowledge the importance of the practice in fighting against disease transmission. A

comparable investigation in Iringa found that participants recognised the value of washing their hands following using the toilet, before eating, and after feeding a child [39]. This suggests that respondents avoid contact with infections caused by faeces, such as Escherichia coli and hepatitis. People wash their hands after using the loo, but few realise how important this practice is for their health. Hand washing with soap before and following meals demonstrates a difference, with most people doing so after meals. This suggests that most of the respondents associate hand hygiene with removing food remains rather than microorganisms, implying that their hands are frequently contaminated with pathogens and other harmful microbes. This finding is consistent with the findings of a study in the Manyara region, which found that 66% of the participants reported washing their hands after meals and that this practice can reduce the risk of diarrheal incidence [40]. Respondents' general impression of hand washing appears to be based on the practice's widespread use, which is that everyone does it. Although, the practice is still poor and common in households with piped water supply in their compounds. From this information, it can be deduced that poor hand hygiene might be caused by the type and nature of water source within the household as the majority depends on other sources apart from pipe network into the house.

In the current study, respondents recognise the significance of having a correctly built and organised latrine facility in reducing WASH-related infections. This is important due to the fact that water wells built closer to sanitation were at higher risk of being contaminated as reported by [41]. The current study's findings are consistent with those of [42], who found that inadequately maintained sanitation facilities may penetrate water wells, leading to contamination of groundwater and disease outbreaks, implying that pit latrines should be properly constructed and managed. The respondents concurred on having an efficient latrine facility as the nature and design of sanitation facilities in the area were of poor quality and had several damages caused by the facility being too old, in need of repair, and shared by many households. A key informant from the Mtoni ward confirmed that respondents had a high level of knowledge about proper latrine utilisation.

> *"In our ward (Mtoni), the available latrines are satisfactory for daily use though some are in bad shape and pose health risks to the surrounding households as majority share latrines. On top of that, recently people start constructing modern latrines like the flush toilets with some decorations inside including tiles."* (Key informant respondent from Mtoni ward 9th April 2019).

Most people dispose of child faeces collected from baby diapers by rinsing them in their toilets or septic tanks, while others throw them away. This implies that most respondents believed the safe disposal of child faeces was to throw them into the latrine or septic tank, indicating poor sanitation facility management practices, particularly septic tanks. Similar findings were reported in an Ethiopian study, which found that the majority of children disposed of their faeces in open pit toilets. This is due to the layout of the latrine facilities utilised in the area, which consisted of pit latrines, so it was easy for them to dispose of the faeces, unlike those with flush toilets, which required them to throw faeces covered in diapers or a piece of cloth into the garbage. This implies that the contamination of well water by poorly managed pit latrines might be caused by throwing hard material into the pits making it hard during dewatering of faecal sludge and pit emptying hence the pit remains full for quite some time and eventually overflows. This indicates that children under the age of five become more susceptible to transmissible illnesses because their carers have a poor understanding of safe sanitation practices and their playing grounds may be contaminated with pathogens and other harmful microbes.

A large proportion of households disclosed high levels of personal hygiene, including bathing and washing clothes. The results presented that respondents are particularly worried about certain hygiene practices that are deemed important. This could be due to a lack of understanding of personal hygiene behaviours, a scarcity of water, and the availability of a limited number of hand washing stations equipped with all necessary supplies. A comparable research study in Bangladesh discovered that respondents ration and reuse their water supply for cooking and drinking due to water scarcity, resulting in poor personal hygiene behaviours such as bathing and laundry [43]. This difference could be attributed to the nature of the study areas and the sample used. Participants in the study had very limited knowledge of personal hygiene activities. This indicates that, among other things, personal hygiene practices among children under

the age of five may contribute to diarrheal incidence.

The most frequent WASH-related infection was diarrhoea, which primarily affected children under the age of 5. This can be explained by study findings as it appears that the under-five children are the most vulnerable to waterborne diseases. Factors such as quality of drinking water, and the level of understanding of issues related to sanitation and hygiene among their caregivers account to such infections. This is evident as reported in Fig. 3 that, respondents' overall perception towards hand washing was very poor as the majority were only used to the practice. Similarly, an investigation in Cameroon found that participants were aware of the incidence of illnesses transmitted by water, vulnerable groups, and the difficulties brought about by such infections [44]. According to the respondents, the primary causes of diarrhoea infection are drinking contaminated water, poor hygiene, poor sanitation, and the surroundings in general. A similar study in Rwanda [45] and Ethiopia [46] found that respondents were aware of the risk factors for waterborne diseases and how to prevent them. Knowledge of WASH-related infections and associated risks was high, as demonstrated by a participant from Tandika ward, who stated,

> *".People today are aware of the dangers of waterborne diseases caused by contaminated water and poor sanitation. Some people are implementing measures by boiling their drinking water and using chemicals, as well as keeping their homes and toilets clean."* (Key informant from Tandika ward on 6th April 2019).

The substantial amount of knowledge about the causes of diarrhoea may be explained by the spread of diarrhoea-related information and the high rate of seeking care from healthcare facilities in the community. This indicates that diarrhoea remains prevalent in Dar es Salaam's slums, and improving access to water supply alone will not solve this issue unless sanitation and hygiene behaviours, as well as their health consequences, are considered.

Hand washing with soap before meals ($p \leq 0.05$) had a significant relationship with participant contact with diarrhoea, with an Exp(B) of 2.641 suggesting that participants were twice as likely to get diarrhoea if they did not wash their hands with soap before meals in contrast to the likelihood that they were not. This could be because your hands were exposed to a variety of infections before eating due to contaminated food and water. These are the primary transmission routes of infectious diseases, increasing the likelihood of coming into contact with a diarrhoea infection if hand washing practices are poorly understood. This study supports the findings of [47] and [48], who discovered that hand-washing practices, such as before eating, were significantly associated with the risk of diarrheal disease incidence. Hand-washing behaviours have been linked with diarrheal incidence, indicating an enormous rise in people's awareness of WASH-related infections and ways to avoid them. In the current study, mothers' level of schooling was positively associated with diarrheal disease. This implies that, although educational level of caregivers is not directly associated with contacting diarrhoea as reported but as it will spread anxiety about the illnesses' negative repercussions, it has the ability to speed up the aforementioned infections.

Identical to [49] study in India, mothers with a minimum of secondary education are more inclined to be informed about diarrheal disease transmission and ways of avoiding it than those without formal education. Water sources and water safety measures also had a positive relationship with diarrhoea incidence, similar to studies in Ethiopia [50] and Afghanistan [51], which found that tube wells, public taps or standpipes, and springs were sources with a greater likelihood of diarrheal sickness among under-five children than piped water.

6. CONCLUSION AND RECOMMENDATIONS

In light of the research's results, we can deduce that water remains inadequate in most households, and drinking water treatments are extremely precarious. Hand washing with soap during crucial instances and personal hygiene practices were lacking. Based on the various responses provided, there is a high level of knowledge about proper latrine utilisation, WASH-related infections, and practical measures for preventing their occurrence. According to the findings, ongoing WASH-related infections in the area have a positive relationship with factors including poor hand-washing practices at critical times, inadequate water purification methods, and mothers' educational levels. This implies that, all those factors had the potential to

accelerate the infections if not taken into account. According to the study's findings, mothers and carers had appropriate knowledge about the triggers of diarrhoea and means of prevention, but their behaviours in these areas remain dubious. Mothers' and carers' comprehension of sanitation and hygiene, water safety measures, WASH-related infections, and prevention was determined not by their level of literacy, but by the amount of information they received through public health education on sanitation and hygiene. The study reveals a significant difference between respondents' knowledge and what they practise, as the majority are knowledgeable about what they do not practise. This might be due to the fact that, the basic knowledge about sanitation and hygiene that respondent have emanated from how much the practices are common in the area and they don not feel responsible about not knowing the health consequences of not practicing them.

The research suggests that data on water, sanitation, and hygiene is fundamental in planning WASH projects based on field results and studies conducted by other scholars. Water, sanitation, and hygiene need to be treated in separate sectors and addressed in accordance if we are to achieve SDG 6 of ensuring the availability and sustainable management of water and sanitation for all. The combination of sanitation and hygiene behavioural modifications with enhanced access to water supply and the establishment of latrines is vital. Policy structures and investments ought to be put in place in all sectors as coverage for people's health and better lives.

The study suggests that the public water distribution company should increase the availability of water in households and implement adequate disinfection methods before usage. The government should create separate budgets for Water, Sanitation, and Hygiene, and encourage private sector participation.

7. STUDY LIMITATIONS

Among the limitations that faced the study include but not limited to size of the study population not having enough power to generalize to the entire population and biasness during data collection due to self-selection in households with more under-fives.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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