Knowledge and Practices on Water, Sanitation, Hygiene and Waterborne Diseases Among Under-Five Children in Temeke District, Dar Es Salaam

Abstract

This study assessed knowledge and practice towards water, sanitation, hygiene, and water-borne diseases amongst 220 respondents from three wards of Temeke Municipality in Tanzania. The study employed a mixed-method approach involving quantitative data from the household survey and qualitative data from key informant interviews. Quantitative data were analysed using SPSS and qualitative data analyzed with the help of content analysis. The findings revealed thatthe majority of the respondents depend on public water sources (i.e. 40% on public taps and 36.9% on public water kiosk and of them all, only 16% treat their drinking water by boiling. Furthermore, respondents acknowledged the importance of hand-washing at critical times. Only 31.7% and72.6% 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%). It is concluded that respondents have a satisfactory understanding of sanitation and hygiene although the practices are still disappointing. The study recommends that any efforts to improve access to sanitation and hygiene have to be joined with strategies to promote effective utilization of such services.

Keywords: Sanitation, Hygiene, Hand-Washing practices, Water-borne Diseases, Temeke Municipality

1. Introduction

Water, sanitation, and hygiene (WASH) are critical determinants of 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 fewsignificantly increase the rate of under-five mortality mostly in developing countries (McMichael, 2019). It is estimated that over 2 billion people worldwide drink water that is contaminated with faeces and around 4.5 billion families use inadequate sanitation systems that pose harm to their families (WHO, 2018). Globally, communicable diseases such as diarrhoea account for about 4.1% of the burden of disease especially in developing countries where access to safe drinking water is still a challenge (WHO, 2017). Diarrhoea remains the leading cause of mortality and morbidity among under-fives at an estimate of 502 000 children exceeding the mortality rates of malaria and tuberculosis combined (Mshida*et al.,* 2017; WHO, 2018; Zahid, 2018).

A lack of affordable access to WASH wastes resources that could be used to advance the nation's development agenda (TDHS - MIS, 2015-2016). In Tanzania, the government spends an estimated 70% of its health budget on preventable WASH-related infections (NBS *et al.,* 2016). This is because the majority of the population (68%) do not have access to improved sanitation and around 46% do not

have access to clean drinking water (UNICEF, 2017). 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 (World Bank, 2023).As reported by TDHS - MIS (2016) the use of unimproved sanitation and poor hygienic practices contribute up to 12% of the childhood illnesses especially diarrhoea among the under-five resulting in high mortality of that age group. In addition, 80% of the rural residents still use inadequate and unimproved sanitation facilities while in urban areas it is as low as 2% coverage (WHO, 2018). 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) (UNICEF, 2019). Communicable diseases especially water-borne diseases could be managed easily and effectively by the improvement of general sanitation conditions and hygienic behaviours (Safari *et al.*, 2019). Sanitation problems at the household level especially in low-income areas are not fully recognized by the government hence much effort is seen in the provision of water supply treating sanitation as the last option in the political agenda and budget reservations (Tuju, 2015; DAWASA Business Plan 2013/2016).

In Dar es Salaam city especially in the informal settlements such as Temeke Municipality, sanitation provision is still poor as pit latrines (the toilet and shower) are in adverse conditions, sewage systems are damaged, and management of water resources is not of much concern (Sakijege*et al.*, 2012). 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 (Saria & Thomas, 2013). 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 (Pastore, 2015). 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 (Kwizela*et al.*, 2018). Studies (i.e. Van Dijk, 2014; Kasala*et al.*, 2016) done in some informal settlements of Temeke Municipality such as Keko Machungwa, Ukonga, and Majumbasita revealed that groundwater often rises above the water-table resulting in an overflow of pit latrines and pollution of the shallow wells. A study by Kumi-Kyeremeand Amo-Adjei (2016) in Temeke Municipality suggests that education levels, poor quality of water storage containers, and unimproved sanitation facilities are among the major contributing factors for poor WASH practices among households in the area.

The National Sanitation and Hygiene Campaigns was launched in 2012 as a way of improving WASH practices and reducing the associated infections yet these interventions have received minimal attention in sanitation programs up to date (Blumenthal *et al.*, 2018; Humphries *et al.*, 2018). Efforts made to address problems

of WASH diseases in different areas in Dar es Salaam mainly focus on the issue of water supply. Several studies (Sakijege*et al.*, 2012; Mshida*et al.*, 2017; Blumenthal *et al.*, 2018) have linked poor sanitation and hygiene practices of the people with the transmission of WASH-related infections. These studies conducted in urban areas however have not looked at the understanding of such aspects. WASH-related infections among under-five occurring in Temeke Municipality may be associated with poor understanding of mothers/ caregivers on issues related to water use, sanitation, and hygiene. Therefore, the main objective of this study was to assess mothers' knowledge and practices regarding water, sanitation, hygiene, and water-borne diseases in three wards of Temeke Municipality for the implementation of recommended strategies against WASH-related diseases specifically diarrhoea. Specifically, the study aimed at examining peoples' knowledge and practices onsanitation, hygiene, and associated infections. Secondly, thestudy aims at evaluating practices on water (use and management) concerning sanitation and hygiene.

This study intendedto fill some of the scientific gaps by expanding on the understanding of various factors that might be contributed to the outbreak of common infections among the under-five children. The findings of this study will contribute knowledge to the existing body of literature on programs/ projects concerning water use, sanitation, and hygiene such as 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

study aimsto help stakeholders including end-users, local government authorities, government and non-government institutions in improving health promotions regarding sanitation and hygiene. The study addresses the United Nations Sustainable Development Goals (SDGs) number 6 (UN, 2015) whose thrust is on ensuring availability and sustainable management of water and sanitation for all.

2. Methodology

2.1 Description of the study area

The study was conducted in Temeke District, Dar es Salaam region 39°12' - 39° 33' East and 6° 48' - 7° 33' South. Until 2016, Temeke was estimated to have 1 443 629 people and 368 416 households with an average population growth rate of 4.6% per annum (see Figure 1) (Temeke Investment Profile, 2018). Temeke is the industrial district of the city where the manufacturing centres (heavy and light industry) are located and the port of the city is found in the Eastern side of the area. The area was selected, as it is one among the districts with high concentration of unplanned (informal)settlements and medium-low income residents whose sanitary conditions are poor (Kihupi*et al.,* 2016; URT, 2019). Furthermore, the majority of the residents have low understanding of issues regarding water use, sanitation, and hygiene as supported by several studies (Chaggu*et al.,* 2002; Kasala*et al.,* 2016; Kihupi*et al.,* 2016; URT, 2019).

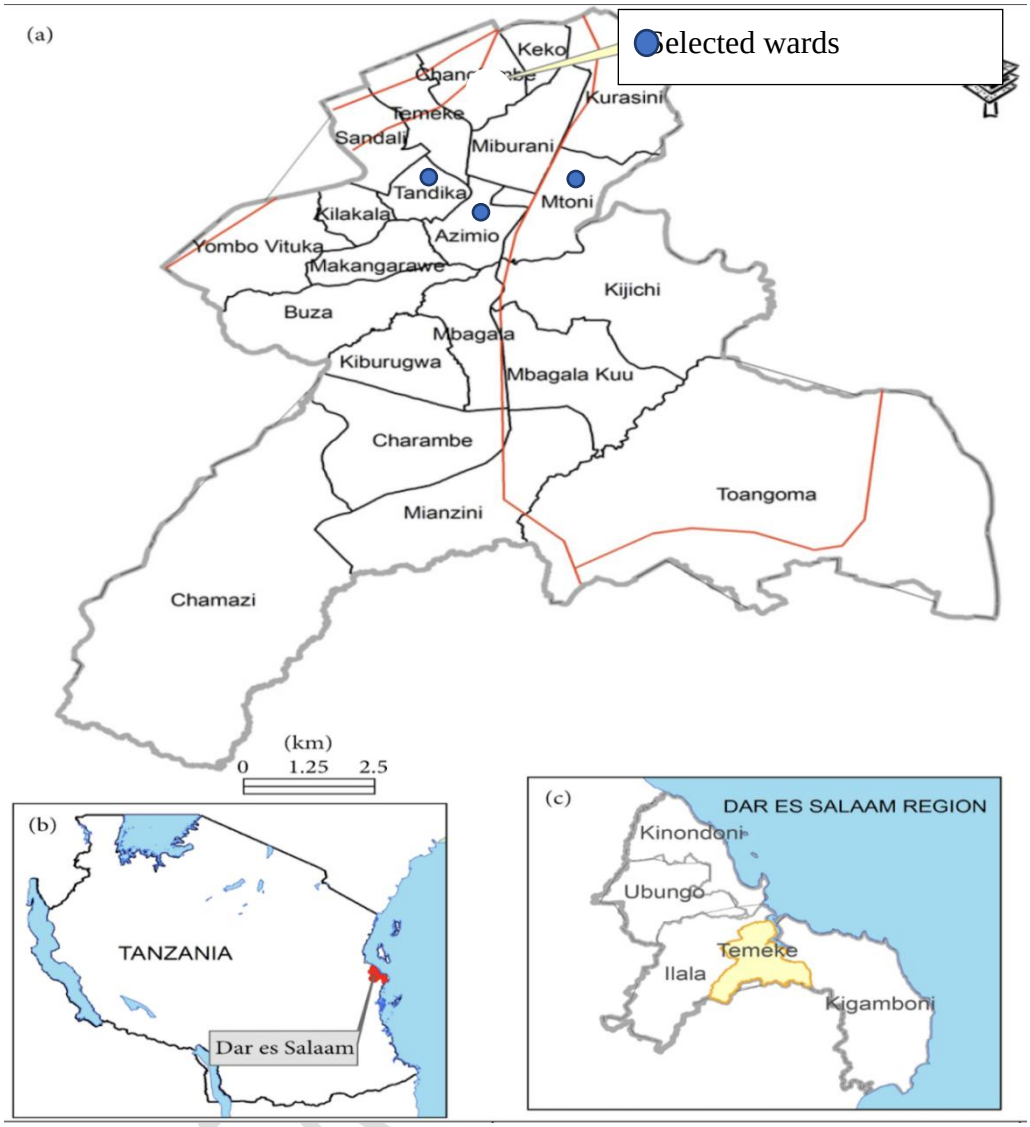

Figure 1: Map of Temeke Municipality showing selected wards

Source: Kacholi and Sahu (2018)**.**

2.2 Research design

The cross-sectional design was employed for the study whereby primary data were collected at one point in time (Neuman, 2014). Datawere obtained through household interviews with mothers and or caregivers with the under-five children as a top priority followed by those with children below 7 years. The eligibility criteria for the study was being a mother or caregiver with at least one under-five child. If an eligible

household contained more than one mother or caregiver with an under-five child, Kish grid technique was employed to randomly select one mother / caregiver for the interview (Kish, 1949). If the selected mother or caregiver contained more than one under-five child, same technique was used to randomly select one child to be involved in the study. This method avoids selection bias as it involves constructing a list of eligible individuals at a particular label then selecting based on the number of the label itself (Lewis-Beck *et al.,* 2003).

2.3 Sampling procedure

A probability sampling method was employed whereby simple random sampling was used to select the study area and study population. The study population was mothers/ caregivers with the under-five children living in Temeke District, as they are the ones taking care of children in a family. The researcher with the help of Temeke Municipal officials from the Department of Sanitation and the Environment obtained the list of 24 wards. A lottery method was used to select three wards out of 24 wards obtained in the list namely Tandika, Mtoni, and Azimio. A list of streets was generated according to the above-selected wards, Tandika had six streets, Mtoni had also six streets, and Azimio had eight streets. A lottery method was again employed to select three streets from each ward making nine streets. The sample size was then divided according to selected streets to ensure equal representation of respondents that is, Tandika 75, Mtoni 75, and Azimio 70. The study population, which involved mothers / caregivers with the under-five children, was selected with the help of street representatives

appointed by the Ward Executive Officer, as they did not have a list of households with the under-five children specifically. In every street selected, one out of five households was randomly selected for interviews and observations.

The total number of households to be selected were 196 as determined by the sample size formula, containing households with the under-five children. Degree of accuracy in sample size determination was set at 7%, in between 5-10%, which is acceptable error resulting to a minimum required sample size of 196 respondents.

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. Therefore, a total of 220 mothers / caregivers were successfully interviewed and included in the analysis.

2.5 Data collection

Data were primarily obtained from inhabitants of Tandika, Mtoni, and Azimio Wards through the administration of a structured questionnaire and observation technique. Quantitative data were collected on respondents' (mothers / caregivers) knowledge and practices towards water, sanitation and hygiene, and waterborne diseases. Qualitative data were collected through key informant interviews with streets and ward representatives, and street and ward health officials. Observation method was used to capture and ensure the practices on household sanitation including latrine facility condition and hand hygiene.

2.6 Data Analysis

The collected data were analyzed using IBM-Statistics SPSS windows version 20.0. Descriptive analysis was employed to analyse the households' perception and practices towards the water, sanitation, and hygiene and waterborne diseases and presented in graphs and frequency tables. The respondents' level of knowledge was measured through ordinal level of measurement as a categorical measurement level that is high and low whereby frequencies and percentages were computed. Overall knowledge and practices of the respondents towards the water, sanitation, and hygiene and waterborne diseases above 50% were regarded as high and below 50% were

regarded as low using a cutoff point of 110 (50%) total number of respondents. Content analysis was employed for qualitative data collected from key informants to add value to the quantitative data collected. The binary logistic regression model was used to estimate key factors associated with diarrhoea incidence. The binary logistic regression model was specified as follow;

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

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

Source:(Hoffman, 2004)

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

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

3. Findings

3.1 Sociodemographic features of respondents

In Table 2, out of 220 respondents, 16% were within the age range of 18-25 years, 32.7% were within the range of 26-33 years, and 26.4% were within the range of 34-40 years. The majority (67%) were married, 16.9% were single with an average family size of four and more people per household. The majority (72%) had basic education, 23% completed secondary school. Moreover, 47.7% were mainly engaged in small businesses such as a kiosk, selling bites and fried fish just outside their houses, tailoring, and ice creams.

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**

3.2 Main sources of potable water, storage facilities, and water purification measures by the Respondents

Water use and management were assessed based on self-reporting and observation of actual sources of water and storage facilities used. The majority of the households depends on public water sources i.e. 40% depends on public taps/ standpipes "visima," while 36.9% get water from public water kiosks most of which are dug

wells covered with concrete on top making a total of 76.9% of all the households. In addition, 4.7% get water from small-scale water vendors including pushcarts and borehole water vendors where one can carry up to 15 gallons of water. In addition, a 20ltr bucket was sold at 50 – 200 TZS depending on where the vendor gets the water. Different water suppliers have different prices, for instance, for public sources; the price is 100 TZS while for private taps and vendors is 200 – 400 TZS indicating the addition of 200 TZS hence hampering the daily household water consumption needs.In addition, 8.2% use piped water that goes directly to their house and 14.3% use piped water where the pipes are inside their plots connected to a stopcock. 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. The respondents do not consider cleaning sanitation facility (25.2%) or hand washing (17.4%) as part of their daily routine in water use. 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. In addition, daily water consumption within the household ranges from 20 - 200 litres with an average of eleven (11) 20 litres buckets in both dry and rainy seasons covering up to more than 85% of water uses for all households. The water safety measure used by the respondents was boiling (16%) and only 4 (1.7%) reported using chemicals such as water guard.

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**

3.3 Knowledge and practices towards Sanitation and Hygiene

3.3.1Hand-washing practices

Hand washing practices were assessed through self-reporting data. Respondents admitted that, it is important to wash hands soon after visiting the toilet the underlying reasons however varied widely. Among the reasons given, include prevention of disease transmission, which was mentioned by 64.3% of the respondents in Azimio.

About 70.7% in Mtoni and 86.7% in Tandika Wards mentioned cleaning of hands as a reason;40% of the respondents in Azimio, 52% in Mtoni, and 48% in Tandika, and only 1.3% from Mtoni wards cited cultural/ religious practice as a reason of hand washing. Overall, 63.4% suggested that it is a healthy practice to wash hands soon after using the toilet and 16% indicated that it is important to wash hands as prevention from food contamination. Hand washing with soap before meals was practiced by a few (31.7%) while the majority (62.6%) do so after meals. The major reasons identified for washing hands before meals include cleaning hands to remove dirt (22.6%) and killing infectious germs (bacteria) (reported by 7.4%) and reasons for washing after meals include getting rid of bad smell "shombo" (45.2%) and removing stickiness from the hands (14.7%) as shown in Table 4. The overall perception of respondents towards hand washing practice varied. The major reason suggested includes being common /cultural practice, reported by 73.8% for Azimio, 62.7% for Mtoni, and 78.7% for Tandika. Other reasons include it is a healthy practice, 16% from Mtoni, 38.7% from Tandika, and none from Azimio; it helps to prevent infections (diseases), reported by 16% from Mtoni, 29.3% from Tandika, and only 5% from Azimio (Figure 2). The overall perception towards hand washing was based on a practice being common to everyone and not otherwise.

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	Before	18	22.5	25	33.3	30	40	**73**	**31.7**

washing	meals with soap								
	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**

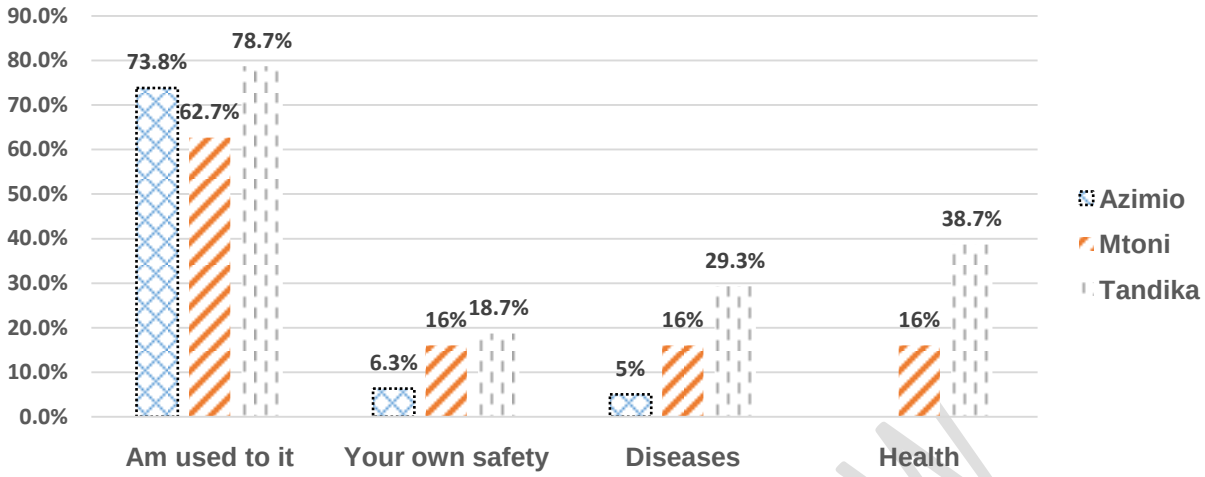

Figure 2: Respondents' overall perception towards hand-washing practice

3.3.2Latrine utilization and disposal of child stool

Knowledge and practices towards sanitation and hygiene in this section were assessed based on self-reporting data and the observation of proxy indicators based on the design of the latrine facility and its overall condition, and the disposal of child stool. The findings indicate that, 57.5% of the respondents from Azimio, 85.3% from Mtoni, and 72% from Tandika agreed that the construction of better quality and proper utilization of latrines could reduce the incidences of waterborne diseases. The suggested reasons include, good design of the facility with enough space and ventilators suggested by 42.1%, having a clean toilet and its overall environment (41.7%), and water availability within the facility at all times can help to keep the facility clean suggested by 32.1%. No latrine sharing was among the added reasons as reported by 36.3% of the respondents from Azimio, 22.7% from Mtoni, and 28% from Tandika. The respondents (72%) disposechild faeces by throwing it into the latrine, which was among the good sanitation practice. Other practices include thrown

faeces into the garbage (9.3%) and allowing the children above 5 years to use the toilet (10.7%). The overall knowledge on latrine quality and condition was 59%, based on the chosen criteria to measure knowledge, this was regarded as high.

3.3.3 Personal hygiene behaviours

As for personal hygiene behaviours, bathing (79.1%) and wearing clean clothes that is washing clothes (45%) were the major identified personal hygiene behaviours. Others cited tooth brushing (35.6%), and hand washing (20.5%) although they did not specify hand washing with soap or plain water (Figure 3). The overall perceived knowledge concerning personal hygiene activities was 36.4%, which is regarded as low knowledge.

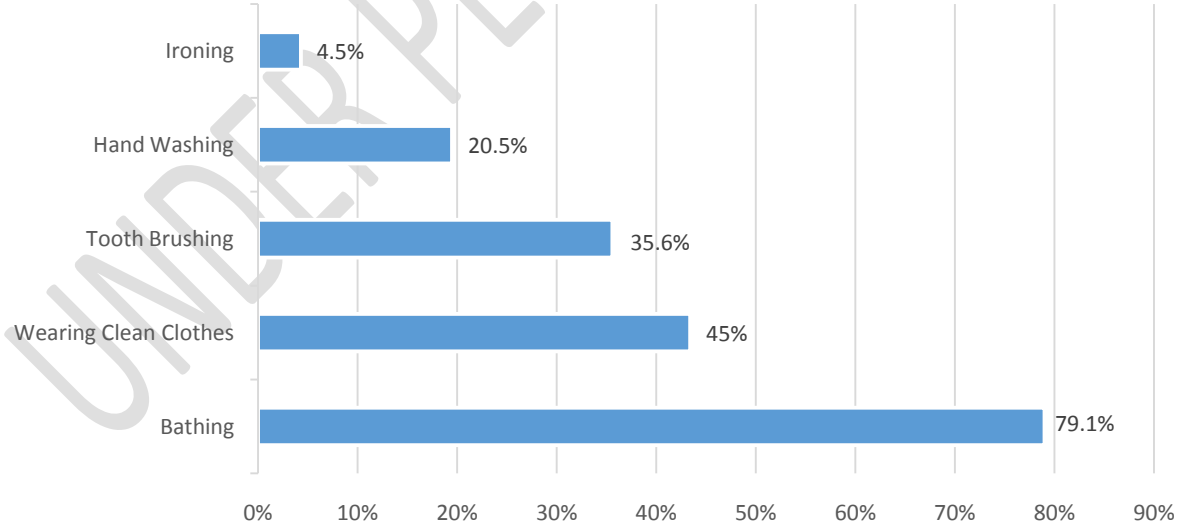

Figure 3: Respondents' awareness on personal hygiene activities

4.WASH-Related infections

Data on WASH-related infections among the under-five was based on self-reporting from mothers/ caregivers. Some of the interviewees agreed that their children have had diarrhoea in their lifetimes. Diarrhoea was the common infection reported accounting for 10.5% of all other infections followed by cholera 8.2%and the group that was mostly affected by these WASH related infections was the under-five children (14.5%). The majority of the mothers / caregivers interviewed reported to have some level of knowledge regarding waterborne diseases and their preventive measures. The respondents gave diverse responses as to the preventive measures against the mentioned infections, 77.3% mentioned environmental cleanliness, that is proper waste management mainly garbage waste. Moreover, 32.5, 22.7, and 17.3% of the respondents from Azimio, Mtoni, and Tandika respectively suggested self-cleanliness and food safety (from preparation to eating) as preventive measures against the mentioned infections (Table 5). Based on diverse responses given, the overall knowledge concerning WASH - related infections and their countermeasures is rather very low as only 11.8% mentioned hand-washing and 8.6% identified boiling water as preventive measures against diarrhoeal diseases.

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

Table 5a: Common WASH-relatedIncidences (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 PreventionMeasures (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**

4.1 Factors associated with diarrhoea incidence

The results of the binary logistic regression model on the key factors associated with respondents contacting diarrhoea are presented in Table 6. The Overall Wald statistics was significant ($p = 0.000$ i.e. $p < 0.05$); the overall model was well predicting the outcome. The chi-square for the Omnibus Tests of Model Coefficients was not significant ($p = 0.215$, i.e. $p > 0.05$); the overall model was not well predicting the outcome. The chi-square for the Hosmer and Lemeshow Test was not significant ($p = 0.433$, i.e. $p > 0.05$). The Nagelkerke R^2that was 0.082 shows that the independent variables entered in the model were able to predict only about 8.2% (i.e. 0.082 x 100) of the variance of the dependent variable. Out of eight independent variables entered into the binary logistic regression model, only one i.e. hand washing with soap before meals ($p \leq 0.05$) was significantly associated with respondents' contacting diarrhoea.

Hand washing with soap before meals had a positive effect and greatest effect on the chances of the respondents getting diarrhoea as it has the greatest Wald statistic. Age, marital status, income sources and hand washing with soap after meals were not significantly associated with respondents contacting diarrhoea and they had negative B-values. Variables like water sources, water safety measures, educational level were not significantly associated with respondents' contacting diarrhoea though they had positive B-values, albeit their Exp(B) values were above 1.0 which means the variables increases the odds of respondents getting diarrhoea.

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 $P \leq 0.05$.

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%.

5. Discussion

The study found that the majority (76.9%) depend on public water sources as their main 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 (Mbwette 2010; Bossman, 2011) 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. Similar findings are reported in a study done in Goba, Dar es Salaam that residents in low-income areas depend on other water sources such as boreholes as the government has failed to provide water services to cope with the rapid increase of population (Sakijege, 2019). Scarcity of water in the city together with a rapid increase in population increases the room for more private water suppliers, as they are safe and reliable though the cost is higher compared with the official rates charged by DAWASCO. The quality of water supplied by private proprietors and the related health risks are still questionable as no traceable studies examined the risks of the use of groundwater (Kombe *et al.,* 2015; Sakijege, 2019). Daily water consumption by households in both dry and wet seasons was reported to be 20 - 200 litres based on varying prices depending on the source. The study findings indicate that the rapid population increase in the city continues to increase water demand and based on the fact that water has no substitute (UNICEF and WHO, 2012), people will go for whatever source of water available regardless how much it costs. Similar findings are reported in a study done in the informal settlements of Dar es Salaam that households served with private water suppliers spend more money in purchasing water compared to those served with public water supply company

(Dakyaga*et al.,* 2018). Given that more than half of informal settlement dwellers fall under low-income category, the cost challenge interferes with their daily water consumption needs. In addition, it is evident that there is water scarcity in the households' premises that are being supplied by the public company 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 is being supplied with water from the Ruvu basin through a constructed pipe from the basin up to the city. However, there are some issues with the pipe that water is not available all day for more than a week so some people decided to dig their well near their premises to keep up with their daily water need. For those with private wells, they also sell water to those in need and the price varies depending on the storage container used i.e. 20 litre bucket is sold at 100 TZS, 10 litre bucket for 50 TZS..."* (Key informant respondent from Tandika ward on 6th April 2019).

The study found that 16% of the households, which was very low percentage, treat their drinking water by boiling. It is possible that, there is limited understanding of the risks associated with drinking untreated water as users rely upon their senses or they cannot afford the cost of boiling water everyday. Furthermore, the quality of water provided by private proprietors is neglected as long as water is safely and constantly

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 (Ngasala*et al.,* 2020). These differences might be attributed to variations in socio-economic status and the selected sample size. However, this practice of reducing diarrhoea infections at household level has been poorly 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.,* (2019), in a peri-urban neighbourhood of Dar es Salaam who demonstrated the importance of careful storage of water following treatment for preventing re-contamination. From study findings, the majority do not apply any treatment methods for drinking water, as they believe that, the water sold by private water suppliers is safe for drinking. Similar findings are reported in a study in rural Tanzanian community, which indicated that Escherichia coli was found in the water samples from homes in 80% of the cases (Ngasala*et al.,* 2020). In addition, the practice of the respondents treating their drinking water as observed from the study was very low. This implies that the fight against the outbreak and spread of communicable diseases is still low as the primary preventive measure of some of the communicable diseases is through treating drinking water, which ensures that drinking water is free from contamination of pathogens.

Asfor Hand washing during critical times such as after visiting the toilet, the findings of the present study revealed that respondents acknowledge the importance of the

practice in fighting against disease transmission. Similar study in Iringa, reported that respondents acknowledge the importance of washing hands during critical times such as after using the toilet, and before having a meal and after feeding a child (Lufingo, 2019). This indicates that the respondents prevent themselves from contacting infections related to faecal contamination such as Escherichia coli and hepatitis. It is a common practice for people to wash hands after visiting the toilet but few understand the health importance of the practice. Hand washing with soap before and after meals shows some distinction with the majority doing so after meals. This implies that the majority of the respondents perceive hand cleanliness as the removal of food remains instead of microorganisms implying that most times their hands are contaminated with pathogens and other dangerous microorganisms. This finding concur with the findings from a study in Manyara region that 66% of the respondents reported to wash their hands after meals and this practice can be protective against risk of diarrheal incidence (Mshida*et al.,* 2020). The overall perception of respondents towards hand washing seems to rely on the common nature of the practice that is everyone is doing 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 present study, respondents acknowledge the importance of having a properly designed and well-managed 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 Pantaleo*et al.* (2019). The findings from the present study concur with the findings in a study by Weststrate*et al.* (2019) that poorly managed sanitation facilities can infiltrate water wells causing groundwater pollution and disease outbreaks suggesting that pit latrines should be properly constructed and well-managed. The respondents agreed to have a well-designed latrine facility because the nature and design of sanitation facilities around the areas were of low quality with multiple damages caused by the facility being too old, lack of repair, and shared by many households. Respondents' knowledge on proper latrine utilization was high; this can be confirmed by a key informant from Mtoni ward, who said,

> *"... 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).

The majority dispose child's faeces collected from baby diapers and rinse them in their toilets or septic tanks while others throw them into the garbage. This implies that the safe disposal of child's faeces as perceived by majority of the respondents was through throwing them into the latrine or septic tank, which indicates poor

management practice of sanitation facilities in particular, septic tanks. Similar findings are reported in a study in Ethiopia that majority dispose child faeces into the toilet as they use open pits toilets (Abera *et al.*, 2018). This is because of the nature of latrine facilities used in the area, which were pit latrines making it easy for them to throw the faeces unlike those with flush toilets, which forced 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 further implies that the under-five children are more vulnerable to communicable diseases considering the low understanding of safe sanitation practices of their caregivers and their playing grounds which might be contaminated with pathogens and other harmful micro-organisms.

Concerning personal hygiene, bathing, and washing clothes were highly reported by majority of the households. These findings imply that the respondents are more concerned with some hygiene practices that are considered important. This might be caused by low understanding of behaviours related to personal hygiene, scarcity of water and availability of few hand washing points with all the required essentials. A similar study in Bangladesh found that respondents ration and re-use their water supply for cooking and drinking due to water scarcity hence reporting poor personal hygiene behaviours such as bathing and washing clothes (Farah *et al.*, 2016). This

difference might be attributed by the nature of the study areas and the selected sample. Knowledge concerning personal hygiene activities was observed to be very poor among study participants. This implies that, among other factors, personal hygiene activities practiced among the under-fives might be contributing factors for diarrheal incidence among that age group.

The most common WASH-related infection was diarrhoea, which mostly affected the under-five children. 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 Figure 3 that, respondents' overall perception towards hand washing was very poor as the majority were only used to the practice. Similarly, a study in Cameroon reported that respondents were knowledgeable on the occurrence of waterborne diseases, vulnerable groups and the complications associated with such infections (Fonyuy, 2014). The respondents acknowledged the root causes of diarrhoea infection being drinking contaminated water, poor hygienic measures, poor sanitation, and the general environment. A similar study in Rwanda (Nahimana *et al.*, 2017) and Ethiopia (Abera *et al.,* 2018) revealed that respondents were aware of the factors associated with waterborne diseases and their preventive measures. Knowledge concerning WASH-related infections and associated risks was high as it was also explained by a participant from Tandika ward, who said,

"...Nowadays people are aware of the waterborne diseases caused by the use of contaminated water and poor sanitary conditions. Some are taking precautions by treating their drinking through boiling and use of chemicals, keeping their environment clean around the house and their toilets..." (Key informant from Tandika ward on 6th April 2019).

The high level knowledge about causes of diarrhoea may be explained by diffusion of information related to diarrhoea and high rate of seeking care from health care facilities available in the area. This implies that diarrhoea is still prevalent in the informal settlements of Dar es Salaam and increasing access to water supply alone will not solve this particular problem unless sanitation and hygiene practices and their health impacts are also taken into account.

Hand washing with soap before meals ($p \leq 0.05$) was significantly associated with respondents' getting into contact with diarrhoea with an Exp(B) of 2.641 implying that respondents were two times more likely to get diarrhoea if they did not wash their hands with soap before meals compared to chances that they were not. This may be so because, before taking a meal your hands might have been exposed to various types of infections through contaminated food and water. Those are the primary transmission routes of infectious diseases hence, increases the chances of getting into contact with diarrhoea infection if hand washing practices is poorly understood. Only this study can confirm findings of Eshete *et al.* (2015) and Abuzerr *et al,* (2019), who found that

hand washing practices such before eating was significantly associated with the risk of diarrheal disease incidence. Hand washing practices being the factor associated with diarrheal incidence indicates a significant increase in people's awareness towards WASH-related infections and their preventive measures. In the present study, educational level of mothers had a positive association with getting 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. Similar to a study in India by Paul (2020), mothers with at least secondary education are more likely to be aware of transmission and prevention methods of diarrheal disease compared to those with no formal education. Water sources and water safety measures also had a positive association with diarrhoea incidence, similar to a study in Ethiopia (Workie *et al.*, 2019) and in Afghanistan (Nasir *et al.*, 2020), that tube wells, public taps or standpipes, springs were sources with higher chances of diarrheal morbidity among under-five children than piped water.

6. Conclusion and Recommendations

Based on the study findings we can conclude that generally, water is still scarce among households and treatment methods for drinking water were very disappointing. Whereas hand washing practices with soap during critical times and personal hygiene practices were low. There exists high knowledge on proper latrine utilization, WASH-related infections, and practical measures employed in the prevention of their

occurrence based on the diverse responses provided. From the study, the on-going WASH-related infections in the area were positively associated with factors such as poor hand washing practices at critical times, poor treatment methods of drinking water, and the educational level of mothers. This implies that, all those factors had the potential to accelerate the infections if not taken into account. From study findings, mothers and caregivers had reasonable knowledge on causes of, and preventive measures against diarrhoea but their practices in such aspects is still questionable. Mothers and caregivers' understanding of sanitation and hygiene, water safety measures, WASH-related infections, and their prevention were not based on the level of education but on how much information they got via public health education concerning sanitation and hygiene. The study shows significant distinction between respondents' knowledge and what they actually practice as majority are equipped with the knowledge of the things they do not practice. 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 study recommends 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 should be treated in separate sectors and dealt with accordingly if we are to achieve the SDG 6 of ensuring availability and sustainable management of water and sanitation for all. The integration of sanitation

and hygiene behavioural change with improved access to water supply and construction of latrines is essential.Policy frameworks and investments should be put in place in all the sectors as insurance of people's health and better living conditions.The outbreak of waterborne diseases and mortality rates will continue to rise until the situation is well controlled; first people need to be aware of the importance of sanitation and hygiene before increasing access to the services.

Based on the study findings, attention must be given to expanding the availability of water in households' premises by the public water supply company accompanied with proper treatment methods before final consumption by households.

The government under the Ministry of Health and Social Welfare and Ministry of Water and Irrigation should prepare separate budgets for Water, Sanitation, and Hygiene. In addition, other private sectors should be encouraged to engage in the provision of water and sanitation services to the people as it is with health and education, which would help to cover many areas within a reasonable time.

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