*International Journal of TROPICAL DISEASE & Health*

***Volume 46, Issue 4, Page 64-83, 2025; Article no.IJTDH.132340***
***ISSN: 2278–1005, NLM ID: 101632866***

# Assessment of Knowledge, Attitudes, and Practices of Community Health Workers on Household Sanitation and Hygiene in Rural Tanzania

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Authors LPS, JM and NB were involved in the conception and design of the research idea, and author LPS collected and analyzed data. Author LPS drafted the initial manuscript. Author EM and MK did the statistical interpretation of the results. All authors read and approved the submission of the manuscript. All authors read and approved the final manuscript.*

***Article Information***

DOI: https://doi.org/10.9734/ijtdh/2025/v46i41645

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/132340

***Original Research Article***

***Received: 13/01/2025***
***Accepted: 15/03/2025***
***Published: 22/03/2025***

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***Cite as:*** *Samani, Lina Patrice, Joseph Mwanga, Namanya, Basinda, Evarist Msaki, and Michael Kadigi. 2025. "Assessment of Knowledge, Attitudes, and Practices of Community Health Workers on Household Sanitation and Hygiene in Rural Tanzania". International Journal of TROPICAL DISEASE & Health 46 (4):64-83. https://doi.org/10.9734/ijtdh/2025/v46i41645.*

## ABSTRACT

**Background:** Access to improved sanitation, adherence to good hygienic practices, and adequate supply of safe water are very crucial factors for the health and well-being of people within the household and the entire community. Household sanitation and hygiene promotion has largely been done by community health workers in most places in Tanzania and worldwide, especially in rural and marginalized areas. Despite the presence of community health workers in Tanzania as primary health providers, WASH-sensitive indicators such as diarrhea, stunted growth, and typhoid are still high. However, little has been done to assess their knowledge, attitude, and practices regarding household sanitation and hygiene.

**Aim:** This study aimed to assess knowledge, attitude and practices among community health workers on household sanitation and hygiene at Mbarali and Mbeya rural districts in Mbeya region, south-west highlands of Tanzania.

**Methods:** The study used a descriptive cross-sectional design. The sample size was estimated by using Yamane formula for calculating sample size. Data for the study were collected for one month, questionnaire guide and observation checklist were used as data collection methods. Data were entered in STATA version 15 databases by two research assistants, and then data were cleaned, validated and analyzed. Descriptive analyses included frequencies and percentages of socio-demographic characteristics such as age, sex, education, knowledge, attitude, and practice of hygiene and sanitation. To determine the association between socio-demographic characteristics and respondents 'KAP, a bivariate chi-square test was conducted. A threshold of 0.05 p-values was used for statistical significance.

**Results:** A total of 391CHWs were recruited. Out of 391CHWs, 184 (47.1%) had adequate knowledge regarding household sanitation and hygiene, while 207(52.9%) CHWs had inadequate knowledge. 74.4% of the CHWs had a positive attitude towards, whilst 25.6% of the participants had a negative attitude regarding household sanitation and hygiene. A total of 128 (33.0%) had good practices, while (67.1%) of the participants had poor practices regarding household sanitation and hygiene. High education level and the short period from the last training on sanitation and hygiene were found to be associated with adequate knowledge (p=0012) and (p=0.008) respectively. Female participants were found to have good practices (p=0.015) than their counterparts. The observation checklist revealed that, of the total 391CHWs, 206(52.7%) CHWs didn't receive the needed cooperation from the community members, though they had all the necessary equipment for home visits. On house-to-house visits, only 28 CHWs had all the necessary equipment. None of the CHWs had allowance at the end of the visit.

**Conclusion:** The findings of this study underscore the need to check CHW programs to match their needs as per their roles to strengthen the knowledge, attitude, and practices hence ensuring efficiency in their provision of primary health services and promotion of improvement in household sanitation and hygiene particularly in household sanitation and hygiene.


*Keywords: Household; knowledge; attitude; practices; community health workers; sanitation; hygiene.*

## 1. INTRODUCTION

Water, Sanitation and Hygiene (WASH) are human rights; they play an important role in achieving the highest standard of health for all and as an integral part of Infection Prevention Control (UNICEF, 2012; Kabote & Gudaga, 2018). Healthcare workers play an indispensable role in the functioning and maintenance of WASH in healthcare facilities (Parvez et al., 2018; Mukulukulu et al., 2020). It is a necessity to have sufficient knowledge and to perform correct practices. So, it is important to spread knowledge among healthcare workers at all levels (Balan et al., 2023; e Lima et al., 2018). Good health is comprised of physical, biological, and social factors interacting in a mutual way (Callahan, 1973). Sanitation and hygiene are closely linked to the availability of clean and safe water and have been the primary drivers of public health (Water & World Health Organization, 2004; Hunter et al., 2010; Tumwine et al., 2003; Berhe et al., 2020). Sustainable Development Goals (SDGs) 2030, goal number six, have clearly stated the importance of adequate sanitation, good hygiene, and safe water in contributing to good health by reducing the global disease burden and fostering social and economic

development. Access to clean and safe water, sanitation facilities, and adherence to hygienic practices is still a global challenge, especially in developing countries (Montgomery & Elimelech, 2007; Soboksa & Yimam, 2017). It is estimated that 2.1 billion (29%) people lacked safely managed drinking water services and 4.5 billion (61%) lacked safely managed sanitation services worldwide (Bain et al., 2018). Diseases caused by inadequate water and poor sanitation and hygiene result in 4.2 % of global deaths and 90% of that burden is born to children under five years of age (Bartram & Cairncross, 2010; Tumwine et al., 2002). Access to water, sanitation and hygiene is a major challenge in developing nations and more among rural population. Limited access to safe drinking water and poor sanitation can lead to under nutrition, water borne diseases including diarrhea and dysentery, vector borne diseases and neglected tropical diseases such as soil transmitted helminthiasis, schistosomiasis etc (Newborne & Liisanantti, 2017). Lack of access to suitable sanitation facilities is also a major cause of risks and anxiety, especially for women and girls (Gundry et al., 2004; Water, 2012). For all these reasons, sanitation that prevents disease and ensures privacy and dignity has been recognized as a basic human right (Wada et al., 2021; Gaude & Dessai, 2019; LeFevre et al., 2015)

Tanzania like many other developing countries is said to have high rates of chronic malnutrition and childhood stunting which is linked to poor WASH practices (Mshida, 2019). It is estimated that 40% of Tanzanians currently get their drinking water from unimproved sources as well as practising fixed-point defecation whereas 80% rely on basic unimproved sanitation facilities (Alexander et al., 2019). It has been documented that, actions to encourage hygiene practices like washing hands with soap can reduce the incidence of diarrhea by an estimated 47% while the use of proper sanitation can reduce cases of diarrhea by an estimated 36% (Prüss-Üstün & World Health Organization, 2008).

Household being the source of all other social relations and interactions, assurance for good health is inevitable (Mashoto et al., 2014). Adequate supply of safe water, improved sanitation, and adherence to good hygienic practices in households have significant contributions to household health and the entire community (Kamara et al., 2017; Bethony et al., 2006). Community health workers have been a vital link between community and health systems, especially in underserved and economically disadvantaged rural communities, serving a wide range of tasks in promoting health worldwide such as first aid and treatment of simple and common ailments, home visits, environmental sanitation and hygiene, maternal and child health as well as family planning promotion, health education (Love et al., 1997; Oliver et al., 2015; Ofosu-Amaah & World Health Organization, 1983). Despite the efforts of development agencies in providing infrastructural support to improve sanitation conditions in developing countries, nevertheless, there is a need for collateral personal hygiene and sanitary education to achieve improved outcomes (Kuberan et al., 2015; Crispin et al., 2012). Across countries, CHWs roles, names, training, and other related working conditions have been varying (World Health Organization, 1989). These variations might be linked to their differences in knowledge, attitude, and practices on their roles (Brunie et al., 2016; Baynes et al., 2017; McCollum et al., 2016; Urassa et al., 2015).

Due to rapid population growth which brought about a limited number of specialized health officers and healthcare care services hence poor performance of the health sector in Tanzania, In early 2010s The Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGEC) and the President's Office for Regional Administration and Local Government (PO-RALG) began planning the Community-based Health Program (CBHP) to address the lack of coordination, standardization, monitoring, supervision, and support across a range of community health programs operating at the local level (Kayombo, 2016; Leshargie et al., 2018). Through community-based health program centers, Therefore CHWs and the services that they deliver were first officially reorganized (Jonsson, 1986; Heggenhougen et al., 1987; Walt, 1988; Chanda et al., 2011).

Despite the presence of CHWs, still there is a challenge in access to sanitation services and the adoption of hygienic practices, WASH-sensitive indicators such as diarrhea, stunting, and typhoid still prevail (Billig et al., 1999). A cholera outbreak in 2015 is one of the indicators, whereby a total of 30,121 cholera cases and 466 deaths (equivalent to a case fatality rate of 1.5 percent) were reported.

## 2. MATERIALS AND METHODS

### 2.1 Study Design, Setting, and Population

A descriptive cross-sectional study was conducted for one month (November 2019), whereby all community health workers who meet the inclusion and exclusion criteria in Mbarali and Mbeya rural districts out of 7 districts situated in the Mbeya Region were involved in the study. The sample for this study was estimated by using the Yamane (1967) formula for calculating sample size. Data for this study was collected by the principal investigator and two research assistants. A questionnaire survey and observation checklist were used as data collection methods. Then data were entered into STATA version 15 databases by two research assistants, who were supervised by the principal investigator for cleaning and validation.

### 2.2 Data Analysis

For the questionnaire, there were three sections and 10 questions for each section. To define adequate knowledge, positive attitude, and good practice on household sanitation and hygiene, a score was generated and set cutoff points from a set of questions were constructed on the data collection tools. Sections 1 and 3which are knowledge and practice sections had multiple response questions with the highest score of 1 if answered correctly and 0" (zero) for wrong or don't know response. Knowledge and practice scores were classified as adequate knowledge and good practices if the score is (≥7/10) and inadequate knowledge and poor practices if (<7/10). For attitude which is section 2 we had Likert scale questions, whereby the responses for attitude questions were scored using 5 responses: strongly agree =1, agree =2, neutral=3, disagree =4, strongly disagree 5. A cut of point of 1 was used if the answer was given correctly and 0 if the answer given was wrong. Then a maximum score of 50 was used to define having a positive or negative attitude. A person with a score greater than 35 was defined as having a positive attitude and a person with a score less than 35 was described as having a negative attitude on household sanitation and hygiene. For the observation checklist, we had 5 questions for each of the two sections making a total of 10 questions, a score of 1 will be given if the answer is Yes and a score of 0 if the answer is No. A minimum score of 7 was considered as CHW practising and observing all recommended procedures for household sanitation and hygiene data collection and follow-up.

Continuous data was summarized using mean with standard deviation since data were normally distributed. Categorical data were summarized using proportions and percentages. Descriptive analyses included frequencies and percentages of socio-demographic characteristics such as age, sex, education, knowledge, attitude, and practice of hygiene and sanitation. To determine the association between socio-demographic characteristics and respondents 'KAP, We conducted a bivariate chi-square test. A threshold of 0.05 p-values was used for statistical significance.

## 3. RESULTS AND DISCUSSION

### 3.1 Social-Demographics Characteristics of the Study Participants

The mean age of the study participants was 43 years with a standard deviation of 9.2, with the age ranging from 20 to 65 years. The study revealed that the majority of the participants (35.3%, n=77) were in the age range of 41- 50 years. Most of the study participants (85.7%, n=204) had primary education, and other few (14.3%, n=30) completed secondary education. Also, the majority of them (91.3%, n=357) were subsistence farmers. A total of 386 participants resided in the study areas for more than three years. Other demographic characteristics are shown in Table 1.

### 3.2 Knowledge, Attitude and Practice (KAP) towards Household Sanitation and Hygiene

#### 3.2.1 Knowledge towards household sanitation and hygiene

The participants answered a total of 10 close-ended, multiple-choice questions about Knowledge regarding household Sanitation and Hygiene. Each correct response was given one mark with a total of 10 marks. The mean knowledge score for the participants was 6.6 out of possible 10 points (SD = 1.6). Distribution of knowledge of the participants on household Sanitation and Hygiene showed that (47.1%, n=184) of subjects had "Adequate knowledge" and (52.94%, n=207) had "Inadequate knowledge".

**Table 1. Social-demographics characteristics of the study participants**

| | Mbeya Rural | | Mbarali | | Total | |
|---|---|---|---|---|---|---|
| **Variables** | **Number(n)** | **Percent (%)** | **Number(n)** | **Percent (%)** | **Number(n)** | **Percent (%)** |
| **Age in years (Mean ± SD)** | 42.8 ± 9.7 | | 43.7 ± 8.5 | | 43.2 ± 9.2 | |
| **Age Group** | | | | | | |
| 20 – 30 | 30 | 12.8 | 9 | 5.73 | 39 | 10.0 |
| 31 – 40 | 74 | 31.6 | 52 | 33.1 | 126 | 32.2 |
| 41 – 50 | 77 | 32.9 | 61 | 38.9 | 138 | 35.3 |
| 51 – 60 | 43 | 18.4 | 31 | 19.8 | 74 | 18.9 |
| >60 | 10 | 4.3 | 4 | 2.6 | 14 | 3.6 |
| **Sex** | | | | | | |
| Male | 117 | 50.0 | 78 | 49.7 | 195 | 49.9 |
| Female | 117 | 50.0 | 79 | 50.3 | 196 | 50.1 |
| **Education Level** | | | | | | |
| Primary | 204 | 87.2 | 131 | 83.4 | 335 | 85.7 |
| Secondary | 30 | 12.8 | 26 | 16.6 | 56 | 14.3 |
| **Marital Status** | | | | | | |
| Single | 43 | 18.4 | 7 | 4.5 | 50 | 12.8 |
| Married | 181 | 77.4 | 143 | 91.1 | 34 | 82.7 |
| Divorced | 10 | 4.3 | 5 | 3.2 | 10 | 3.8 |
| Separated | 0 | 0.0 | 1 | 0.6 | 0 | 0.3 |
| Widow/Widower | 0 | 0.0 | 1 | 0.6 | 0 | 0.3 |
| **Occupation** | | | | | | |
| Peasantry | 212 | 90.6 | 145 | 92.4 | 357 | 91.3 |
| Business | 22 | 9.4 | 12 | 7.6 | 34 | 8.7 |
| **Duration of Residence in the Community** | | | | | | |
| <1yrs | 4 | 1.7 | 0 | 0.0 | 4 | 1.0 |
| BTWN 1 to 3 yrs | 0 | 0.0 | 1 | 0.6 | 1 | 0.3 |
| > 3 yrs | 230 | 98.3 | 156 | 99.4 | 386 | 98.7 |
| **Duration Working as a CHW** | | | | | | |
| < 1 yrs | 4 | 1.7 | 0 | 0.0 | 4 | 1.0 |
| BTW 1 to 3 yrs | 0 | 0.0 | 2 | 1.3 | 2 | 0.5 |
| > 3 yrs | 230 | 98.3 | 155 | 98.7 | 385 | 98.5 |

**Table 2. Knowledge towards household sanitation and hygiene**

| Knowledge Questions | Number(n) | Percent (%) |
|---|---|---|
| 1. What are the people's hygienic behaviors that you think can prevent to transmission of unhygienic-related diseases | 225 | 57.5 |
| 2. What are the critical moments when people are advised to wash their hands using clean water and soap? | 259 | 66.2 |
| 3.Mention unhygienic-related diseases that you know | 201 | 43.9 |
| 4. How many meters a latrine can be constructed from a household | 172 | 41.2 |
| 5. Is it necessary to have a household utensil rack? | 349 | 89.3 |
| 6.Whyisitimportanttoputcookingutensilsonutensilrackafter cleaning them | 285 | 72.9 |
| 7. Mention types of latrines that you know? | 248 | 63.4 |
| 8. What do you consider to know it is improved latrine? | 277 | 70.8 |
| 9.How can one get infected with cholera | 222 | 56.8 |
| 10.Whenyou perceive a person suffers from cholera disease what step will you take | 348 | 89.0 |

**Table 3. Attitude towards household sanitation and hygiene**

| Attitude questions | Strong Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| | n (%) | n (%) | n (%) | n (%) | n(%) |
| Witchcraft is one of the causes of cholera | 44(11.3) | 43(11.0) | 28(7.2) | 148(37.8) | 128(32.7) |
| Children's feces can transmit unhygienic-related diseases | 150(38.4) | 133(34.0) | 46(11.8) | 32(8.2) | 30(7.7) |
| People can get contaminated if the water source for domestic use is very close to the latrine | 182(46.5) | 102(26.1) | 44(11.3) | 32(8.2) | 31(7.9) |
| Water guards have adverse effects on men's fertility and reproductive system | 51(13.0) | 37(9.5) | 37(9.5) | 150(38.4) | 116(29.7) |
| Only women are responsible for household cleanliness and hygienic practices. | 41(10.5) | 33(8.4) | 29(7.4) | 161(41.2) | 127(32.5) |
| Construction of a household latrine is men's responsibility? | 39(9.9) | 36(9.2) | 30(7.7) | 159(40.7) | 127(32.5) |
| HouseholdsanitationandhygienesituationisamongCHW'sresponsibility | 43(11.0) | 34(8.7) | 30(7.7) | 122(31.2) | 162(41.4) |
| Typhoid is among sexual-related diseases | 49(12.5) | 35(8.9) | 33(8.4) | 170(43.5) | 104(26.6) |
| If a person defecates far away from people's residence in the bushes it is not possible for the feaces to comeback and contaminate water sources | 49(12.5) | 37(9.5) | 38(9.7) | 152(38.9) | 115(29.4) |
| Rain water even if not boiled is safe to be used as drinking water | 49(12.5) | 42(10.7) | 44(11.3) | 130(33.3) | 126(32.2) |

**Table 4. Practices towards household sanitation and hygiene**

| Practice questions | Number(n) | Percent (%) |
|---|---|---|
| 1. Do you conduct house to house visit (follow-ups) to assess and promote improvement in sanitation and hygiene status in your village? | 293 | 74.94 |
| 2. How frequently do you conduct follow – up to asses and promote improvement in sanitation and hygiene status in your village? | 261 | 66.75 |
| 3. Do you conduct sanitation and hygiene promotion in your village? | 237 | 60.61 |
| 4. How frequently do you conduct sanitation and hygiene promotion in your village | 235 | 60.10 |
| 5. Do you conduct household sanitation and hygiene data Collection in your village? | 252 | 64.45 |
| 6. Please tell me your reasons for not conducting household sanitation and hygiene data collection in your village. | 242 | 65.47 |
| 7. How often do you conduct household sanitation and hygiene data collection per year? | 256 | 95.65 |
| 8. What do you use as a tool for household sanitation and hygiene Data collection? | 243 | 62.15 |
| 9. Have you obtained any training to enhance your practices on household sanitation and hygiene | 254 | 64.96 |
| 10. When was the last time you obtained any training to enhance your practices on household sanitation and hygiene? | 188 | 48.08 |

**Table 5. Association of KAP between Districts (Mbeya Rural and Mbarali) and social demographic characteristics of study participants**

| Variable | Mbeya Rural n (%) | Mbarali n (%) | P-value |
|---|---|---|---|
| **Knowledge** | | | |
| Adequate | 10(58) | 76(41.3) | |
| Inadequate | 126(60.9) | 81(39.1) | 0.662 |
| **Attitude** | | | |
| Positive | 183(62.9) | 108(37.1) | |
| Negative | 51(51.0) | 49(49.0) | **0.036** |
| **Practice** | | | |
| Good | 60(46.5) | 69(53.5) | |
| Poor | 174(66.4) | 88(33.6) | **<0.001** |
| **Age group** | | | |
| 20 - 30 | 30(12.8) | 9(5.73) | |
| 31 - 40 | 74(31.6) | 52(33.1) | |
| 41 - 50 | 77(32.9) | 61(38.9) | |
| 51 - 60 | 43(18.4) | 31(19.8) | |
| >60 | 10(4.3) | 4(2.6) | 0.158 |

| Variable | Mbeya Rural n (%) | Mbarali n (%) | P-value |
|---|---|---|---|
| **Sex** | | | |
| Male | 117(50) | 78(49.7) | |
| Female | 117(50) | 79(50.3) | 0.951 |
| **Education Level** | | | |
| Primary | 204(87.2) | 131(83.4) | |
| Secondary | 30(12.8) | 26(16.6) | 0.301 |
| **Marital status** | | | |
| Single | 43(18.4) | 7(4.5) | |
| Married | 181(77.4) | 143(91.1) | |
| Divorced | 10(4.3) | 5(3.2) | |
| Separated | 0(0) | 1(0.6) | |
| Widow/Widower | 0(0) | 1(0.6) | **0.001** |
| **Occupation** | | | |
| Peasantry | 212(90.6) | 145(92.4) | |
| Business | 22(9.4) | 12(7.6) | 0.545 |
| **Duration of Residence in the community** | | | |
| <1yrs | 4(1.7) | 0(0) | |
| BTWN 1 to 3 yrs | 0(0) | 1(0.6) | |
| > 3 yrs | 230(98.3) | 156(99.4) | 0.077 |
| **Duration working as a CHW** | | | |
| < 1 yrs | 4(1.7) | 0(0) | |
| BTW 1 to 3 yrs | 0(0) | 2(1.3) | |
| > 3 yrs | 230(98.3) | 155(98.7) | **0.046** |

The responses to the 10 knowledge questions are summarized in Table 2. Around (89%, n=349), of the study participants knew that it is necessary to have a household utensil rack and what step to take when you perceive a person suffers from cholera. The questions with the least number of correct answers were (41.2%, n=172), and (43.9%, n=201), of the respondents reported knowledge regarding household Sanitation and Hygiene (questions 4 and 3).

#### 3.2.2 Attitude towards household sanitation and hygiene

The participants answered a total of 10 close-ended, multiple-choice questions about attitudes regarding household Sanitation and Hygiene. Each correct response was given one mark with a total of 10 marks. The mean attitude score for the study participants was 7.1 out of possible 10 points (SD = 1.7). Distribution of attitude of the participants on household Sanitation and Hygiene showed that (74.4%, n=291) of subjects had a “Positive attitude” and (25.6%, n=100) had a “Negative attitude”. The responses to the 10 attitude questions are summarized in Table 4. Around (73%, n=288), of the participants had a positive attitude regarding question number 5 which asked if Only women are responsible for household cleanness and hygienic practices. The question with the least number of correct answers was (65.5%, n=256) of the participants who reported on their attitude regarding household Sanitation and Hygiene (question 10).

#### 3.2.3 Practices towards household sanitation and hygiene

The participants answered a total of 10 close-ended, multiple-choice questions about practices regarding household Sanitation and Hygiene. Each correct response was given one mark with a total of 10 marks. The mean practice score for the study participants was 6.3 out of possible 10 points (SD = 1.8). Distribution of practice of the participants on household Sanitation and Hygiene showed that (32.9%, n=129) of subjects had “Good practice” and (67.0%, n=262) had “Poor practice”.

The responses to the 10 practice questions are summarized in Table 4. A total of 256 (95.7%) participants have been conducting household sanitation and hygiene data collection exercises every month (once after every four weeks) or once every three months. In contrast, a Total number of 243 (62.2%) participants have been using the piece of paper to write the information of the household. Also, they used to promote improvement in sanitation and hygiene status in their villages. Fewer participants had received on-the-job training that could enhance their practices on household sanitation and hygiene (n=188 (48.1%).

### 3.3 Association of KAP between Districts (Mbeya Rural and Mbarali) and Social Demographic Characteristics of Study Participants

The study identified a significant association between the districts (Mbeya Rural and Mbarali) and key Knowledge, Attitude, and Practice (KAP) components, as well as socio-demographic characteristics of the study participants. Specifically, statistically significant differences were observed in attitude ($p = 0.036$), practice ($p < 0.001$), marital status ($p = 0.001$), and duration of working as a Community Health Worker (CHW) ($p = 0.046$) (Table 5). The significant association between districts and attitude ($p = 0.036$) suggests that community health workers (CHWs) in the two districts hold different perceptions or beliefs regarding health interventions. This could be influenced by variations in local policies, cultural beliefs, or exposure to training programs across the two districts. Mbeya Rural, for instance, may have a more entrenched traditional perspective on healthcare compared to Mbarali, where there might be a greater influence of structured public health programs.

The highly significant difference in practice ($p < 0.001$) indicates that CHWs in the two districts engage in different levels of health-related activities. Factors such as resource availability, institutional support, and accessibility of healthcare infrastructure might contribute to these differences. If CHWs in Mbarali have better access to healthcare facilities and training programs, they may be more likely to implement health practices effectively compared to their counterparts in Mbeya Rural.

The strong association between marital status and district ($p = 0.001$) suggests that social structures and family responsibilities may influence CHWs' engagement and effectiveness in their roles. Married individuals may have greater stability and social support, which could affect their ability to perform their duties efficiently. Conversely, unmarried CHWs might

have more flexibility in mobility and time allocation for healthcare activities.

The association between district and duration of working as a CHW (p = 0.046) highlights potential disparities in workforce experience. If CHWs in one district have, on average, longer work experience than those in the other, this could impact health service delivery. More experienced CHWs are likely to be better equipped with knowledge and practical skills, leading to more effective implementation of health interventions. Targeted training, policy support, family-friendly programs, and retention strategies are essential to enhance CHW performance and ensure equitable healthcare delivery across districts.

### 3.4 Association of Socio-Demographic Variables with Sanitation and Hygiene Knowledge, Attitudes, and Practices (KAP)

The study's findings reveal that certain socio-demographic factors, specifically education level and training duration, significantly influence sanitation and hygiene knowledge (Table 6). Conversely, variables such as age, sex, marital status, occupation, and duration of residence or tenure as a Community Health Worker (CHW) did not show a significant association.

Participants possessing a secondary education demonstrated higher levels of sanitation and hygiene knowledge compared to those with only primary education (p = 0.012). This correlation between higher educational attainment and improved hygiene knowledge is well-documented in the literature. For instance, a study conducted among university students in Bangladesh found that despite high awareness levels, actual sanitation and hygiene practices were influenced by individual factors, including education (Kabir et al., 2021). Similarly, research by Mohd & Malik (2017) in Bangalore, India, highlighted that sanitation and hygiene practices are heavily influenced by people's knowledge and attitudes, which are often shaped by their educational background.

Interestingly, the study observed that participants who received hygiene and sanitation training for less than 12 months exhibited higher knowledge levels than those trained for longer periods (p = 0.008). This finding suggests that shorter, more focused training programs might be more effective in imparting essential knowledge. While specific studies directly comparing training durations are limited, the importance of targeted and context-specific training is emphasized in various contexts. For example, research by Berhe et al. (2020) in Ethiopia underscores the need for effective training programs to enhance water, sanitation, and hygiene (WASH) knowledge among rural residents. The findings highlight the need for education-sensitive sanitation programs, emphasizing interactive and visual learning for individuals with lower formal education. Short, intensive training sessions should be prioritized over prolonged ones to enhance retention and effectiveness. Additionally, contextual factors such as infrastructure and resource availability must be addressed to reinforce knowledge and promote sustained hygiene practices.

The findings presented in Table 7 indicate that socio-demographic factors such as gender, education level, and training duration do not have a statistically significant influence on sanitation and hygiene attitudes. While there may be observable trends—such as a higher proportion of females exhibiting positive attitudes or individuals with secondary education showing slightly better attitudes than those with primary education—the differences are not strong enough to be considered statistically meaningful.

Although the results show that females had more positive attitudes towards sanitation and hygiene than males, the lack of statistical significance (p = 0.098) implies that gender alone may not be a strong determinant of hygiene attitudes. This finding aligns with some literature suggesting that while women are often more involved in household hygiene practices, broader socio-cultural and environmental factors may influence attitudes more than gender alone. Respondents with secondary education demonstrated slightly more positive sanitation and hygiene attitudes compared to those with primary education, but again, the difference was not statistically significant (p = 0.272). This suggests that formal education alone may not be sufficient to drive attitude changes in sanitation and hygiene. Other factors, such as community norms, personal experiences, or targeted interventions, might play a more critical role.

The findings of this study (Table 8) reveal significant associations between gender and self-reported sanitation and hygiene practices, with females reporting better practices than males (p = 0.015). Additionally, a significant correlation

was observed between self-reported hygiene practices and those assessed through a checklist (p = 0.017). However, variables such as age, education level, marital status, occupation, and training duration did not exhibit significant associations with sanitation and hygiene practices.

The observed gender disparity aligns with existing literature indicating that women often engage in more hygienic behaviors than men. For instance, a study by Odonkor et al., (2019) in Ghana found that personal hygiene practices were influenced by cultural factors, with certain ethnic groups placing a strong emphasis on hygiene and community cleanliness. Similarly, research conducted by Kayser et al., (2019) in Ethiopia and other countries has documented that women and girls face unique challenges related to water, sanitation, and hygiene, including physical and sexual harassment when accessing shared facilities. These challenges may motivate women to adopt better hygiene practices to ensure safety and well-being.

The significant correlation between self-reported and observed hygiene practices suggests that individuals' perceptions of their hygiene behaviors align with actual practices. This finding is consistent with studies indicating that self-reported hygiene behaviors can be reliable indicators of actual practices. For example, Diefenbacher et al., (2020) on hand hygiene behavior found that self-reported data correlated with observed behaviors, highlighting the validity of self-assessment in hygiene practices.

**Table 6. Association of socio-demographic variables with sanitation and hygiene Knowledge**

| Variables | Adequate | Inadequate | P-value |
|---|---|---|---|
| **Age group** | n (%) | n (%) | |
| 20 - 30 | 12(30.8) | 27(69.2) | |
| 31 - 40 | 65(51.6) | 61(48.4) | |
| 41 - 50 | 59(42.8) | 79(57.3) | |
| 51 - 60 | 40(54.1) | 34(45.9) | |
| >60 | 8 (57.1) | 6(42.9) | 0.133 |
| **Sex** | | | |
| Male | 86(44.1) | 109(55.9) | |
| Female | 98(50.0) | 98(50.0) | 0.073 |
| **Education Level** | | | |
| Primary | 149(44.5) | 186(55.5) | |
| Secondary | 35(62.5) | 21(37.5) | **0.012** |
| **Marital status** | | | |
| Single | 27(54.0) | 23(46.0) | |
| Married | 148(45.7) | 176(54.3) | |
| Divorced | 8(53.3) | 7(46.7) | |
| Separated | 0(0.0) | 1(100.0) | |
| Widow/Widower | 1(100.0) | 0(0.0) | 0.459 |
| **Occupation** | | | |
| Peasantry | 164(45.9) | 193(54.1) | |
| Business | 20(58.8) | 14(41.2) | 0.937 |
| **Duration of Residence in the Community** | | | |
| < 1 yrs | 2(50.0) | 2(50.0) | |
| BTWN 1 to 3 yrs | 0(0.0) | 1(100.0) | |
| > 3 yrs | 182(47.2) | 204(52.8) | 0.794 |
| **Duration working as a CHW** | | | |
| < 1 yrs | 2(50.0) | 2(50.0) | |
| BTW 1 to 3 yrs | 1(50.0) | 1(50.0) | |
| > 3 yrs | 181(47.0) | 204(53.0) | 0.821 |
| **Training duration on Hygiene and Sanitation** | | | |
| Less than12 months | 111(53.4) | 97(46.6) | |
| More than 12 months | 73(39.9) | 110(60.1) | **0.008** |

**Table 7. Association of socio-demographic variables with sanitation and hygiene attitude**

| Variables | Positive | Negative | P-value |
|---|---|---|---|
| **Age group** | n (%) | n (%) | |
| 20 – 30 | 28(71.8) | 11(28.2) | |
| 31 – 40 | 101(80.2) | 25(19.8) | |
| 41 – 50 | 98(71.0) | 40(29.0) | |
| 51 - 60 | 53(71.6) | 21(28.4) | |
| >60 | 11(78.6) | 3(21.4) | 0.448 |
| **Sex** | | | |
| Male | 138(70.8) | 57(29.2) | |
| Female | 153(78.1) | 43(21.9) | 0.098 |
| **Education Level** | | | |
| Primary | 246(73.4) | 89(26.6) | |
| Secondary | 45(80.4) | 11(19.6) | 0.272 |
| **Marital status** | | | |
| Single | 39(78.0) | 11(22.0) | |
| Married | 240(74.1) | 84(25.9) | |
| Divorced | 11(73.3) | 4(26.7) | |
| Separated | 0(0.0) | 1(100.0) | |
| Widow/Widower | 1(100.0) | 0(0.0) | 0.534 |
| **Occupation** | | | |
| Peasantry | 266(74.5) | 91(25.5) | |
| Business | 25(73.5) | 9(26.5) | 0.900 |
| **Duration of Residence in the Community** | | | |
| < 1 yrs | 3(75.0) | 1(25.0) | |
| BTWN 1 to 3 yrs | 1(100.0) | 0(0.0) | |
| > 3 yrs | 287(74.4) | 99(25.6) | 0.841 |
| **Duration working as a CHW** | | | |
| < 1 yrs | 3(75.0) | 1(25.0) | |
| BTW 1 to 3 yrs | 2(100.0) | 0(0.0) | |
| > 3 yrs | 286(74.3) | 99(25.7) | 0.708 |
| **Training on Hygiene and Sanitation** | | | |
| Less than12 months | 150(72.1) | 58(27.9) | |
| More than 12 months | 141(77.1) | 42(22.9) | 0.265 |

## 3.5 Practices among CHWs Based on the Observational Checklist

A checklist was prepared to observe the actual practices among the study participants. This was done to rule out the information bias that could occur during the filling of the self-administered questionnaire. It was observed that, out of 391 participants, 380 participants (97.2%) had a national sanitation register as a tool for data collection exercise, 173 participants (44.2%) were familiar with all types of latrines and capable of filling all other parameters in the sanitation register, 201(51.4%) of participants were provided with all necessary tools like pencils, sharpeners, and rubbers to use during data collection exercise to enhance their efficiency. A total of 185(47.3%) participants didn't receive the needed cooperation from the community during the exercise of data collection. None of the study participants was given any allowance or motivation after the completion of the data collection exercise.

However, during the house-to-house visit, it was observed that 375(95.9%) participants had checklist/ guideline they used during the activity of household visit. Only 19(4.9%) of study participants received cooperation from the community members during the exercise of household visits. Of the 391 study participants, 373 used by-laws for households with poor sanitation and hygiene situations during the visit. A total of 156(39.9%) participants had all sanitation and hygiene facilities, i.e. Hand washing facilities, refusal pit, utensil rack, and latrine checked by the study participant during the visit. The majority of study participants 381(97.4%) received cooperation from local authority personnel e.g.; VEO, DHO, any other health officer, Village Chair Person, and sub-village leaders, among others during follow-up visits.

**Table 8. Association of socio-demographic variables with sanitation and hygiene practices**

| Variables | Good | Poor | P-value |
|---|---|---|---|
| **Age group** | n (%) | n (%) | |
| 20 - 30 | 13(33.3) | 26(66.7) | |
| 31 - 40 | 41(32.5) | 85(67.5) | |
| 41 - 50 | 44(31.9) | 94(68.1) | |
| 51 - 60 | 29(39.2) | 45(60.8) | |
| >60 | 2(14.3) | 12(55.7) | 0.777 |
| **Sex** | | | |
| Male | 53(27.2) | 142(72.8) | |
| Female | 76(38.8) | 120(61.2) | **0.015** |
| **Education Level** | | | |
| Primary | 113(33.7) | 222(66.3) | |
| Secondary | 16(28.6) | 40(71.4) | 0.587 |
| **Marital status** | | | |
| Single | 13(26.0) | 37(74.0) | |
| Married | 111(34.3) | 213(65.7) | |
| Divorced | 4(26.7) | 11(73.3) | |
| Separated | 1(100.0) | 0(0.0) | |
| Widow/Widower | 0(0.0) | 1(100.0) | 0.797 |
| **Occupation** | | | |
| Peasantry | 115(32.2) | 242(67.8) | |
| Business | 14(41.2) | 20(58.8) | 0.516 |
| **Duration of Residence in the community** | | | |
| < 1 yrs | 1(25.0) | 3(75.0) | |
| BTWN 1 to 3 yrs | 0(0.0) | 1(100.0) | |
| > 3 yrs | 128(33.2) | 258(66.8) | 0.759 |
| **Duration working as a CHW** | | | |
| < 1 yrs | 1(25.0) | 3(75.0) | |
| BTW 1 to 3 yrs | 0(0.0) | 2(100.0) | |
| > 3 yrs | 128(33.3) | 257(66.7) | 0.523 |
| **Practices based on Observation Checklist** | | | |
| Good | 66(51.2) | 167(63.7) | |
| Poor | 63(48.8) | 95(36.3) | **0.017** |

**Table 9. Practices among CHWs based on the observational checklist**

| No | Observation | Frequency(n) | Percent (%) |
|---|---|---|---|
| | **Part A** | | |
| 1. | Is national sanitation register a tool that is used by CHW during data collection exercise? | | |
| | Yes | 380 | 97.2 |
| | No | 11 | 2.8 |
| 2. | Is the CHW familiar with all types of latrines and capable of filling all other parameters in the sanitation register? | | |
| | Yes | 173 | 44.2 |
| | No | 218 | 55.8 |
| 3. | Is the CHW given all necessary tools like pencils, sharpeners, and rubbers to use during data collection exercise so as to enhance their efficiency? | | |
| | Yes | 201 | 51.4 |
| | No | 190 | 48.9 |
| 4. | Is the CHW given the needed cooperation from the community during the exercise of data collection? | | |
| | Yes | 185 | 47.3 |
| | No | 206 | 52.7 |
| 5. | Are the CHW given any allowance or motivation after completion of data collection exercise? | | |
| | Yes | 0 | 0.0 |
| | No | 391 | 100.0 |
| | **Part B** | | |
| 1. | Are there Any checklist / guideline that CHW use during the activity of household visit? | | |
| | Yes | 375 | 95.9 |
| | No | 16 | 4.1 |
| 2. | Is there Cooperation from the community members to CHWs during the exercise of household visit? | | |
| | Yes | 19 | 4.9 |
| | No | 372 | 95.1 |
| 3. | Are there any measures that are taken for households with poor sanitation and hygiene situation during the visit? | | |
| | Yes | 373 | 95.4 |
| | No | 18 | 4.6 |
| 4. | Does all household sanitation and hygiene facilities, i.e. Hand washing facilities, Refusal pit, utensil rack, and latrine checked by CHW during the visit? | | |
| | Yes | 156 | 39.9 |
| | No | 235 | 60.1 |
| 5. | Is there Participation of any local authority personnel eg; VEO, DHO, any other health officer, Village Chair Person, sub-village leaders, etc, during the follow-up visit? | | |
| | Yes | 381 | 97.4 |
| | No | 10 | 2.6 |

## 4. DISCUSSION

### 4.1 General Overview of Study Participants

This study aimed to assess knowledge, attitudes and practices among CHWs on household sanitation and hygiene. Despite the fact that CHWs have been playing significant roles in household and environmental sanitation and hygiene, ranging from promotion, house to house follow up and primary health care provision Callahan, (1973) there is a limited number of literature about CHWs on environmental and household sanitation and hygiene. (Water & World Health Organization, 2004) However this study have found social-demographic characteristics of CHWs are more likely similar to the social – demographic characteristics of CHWs in other places.

From the study findings, the mean age of CHWs was 42 and 43 at Mbeya rural and Mbarali District respectively, whereby the majority ranged from 41-50 years old. These results were consistent with findings from the study which was conducted in Morogoro, Tanzania on the Influence of age on CHWs knowledge and service provision for maternal, newborn, and child health (Hunter et al., 2010). These findings are also consistent with the findings of the study on the effectiveness of an action-oriented educational intervention in ensuring long-term improvement of knowledge, attitudes and practices of community health workers in maternal and infant health (Hunter et al., 2010; Bain et al., 2018). The current study found majority of CHWs have acquired primary education, these findings are contrary with the findings of the study which was conducted in Kenya on the effects of selected social-demographic characteristics of CHWs on the performance of home visit during pregnancy whereby the majority of CHWs (67.7%) had completed secondary education, and only (30.2%) CHWs had completed primary level of education. This study also found that the majority of CHWs are married, these findings are also similar to the findings of the above study in Kenya. This similarity was also found in the rest of social demographic characteristics in this study (Bartram & Cairncross, 2010).

### 4.2 Knowledge of Community Health Workers on Household Sanitation and Hygiene

From the findings of this study majority of CHWs were found to have inadequate knowledge on household sanitation and hygiene, whereby high education level and length of time from the last training were found to be associated with knowledge of the community health worker. This is consistent with a study which was conducted in democratic republic of Congo, on improving demand for health services with the involvement of CHWs, whereby high education level was found a significant factor for CHWs' knowledge by increasing the chances that CHWs can improve health indicators for more than 85% (Tumwine et al., 2002). Another study which was conducted in Morogoro Tanzania on the Profile, knowledge, and work patterns of a cadre of maternal, newborn, and child health CHWs focusing on preventive and promotive services, found the overall mean knowledge scores for MNCH- -CHWs to be poor for 8 of 10 MNCH domains assessed whereby a high level of education of a CHW was found to be an influencing factor for adequate knowledge and better performance (Kuberan et al., 2015). The study also found the length of the time from the last training on Sanitation and hygiene to be a significant factor in CHW's knowledge of sanitation and hygiene. This is supported by a study which was conducted in Brazil on the effectiveness of an action-oriented educational intervention in ensuring long-term improvement of knowledge, attitudes, and practices of community health workers in maternal and infant health. In this study it was found that at 1 year from training, the intervention group had a higher overall KAP score compared to the control group, additionally, the intervention group maintained significant improvements in overall KAP score than their counterparts (Bain et al., 2018).

### 4.3 Attitude of Community Health Workers on Household Sanitation and Hygiene

The current study found that the majority of CHWs have positive attitudes towards household sanitation and hygiene. These findings go in line with the findings of the study which was conducted in Rwanda on CHWs' knowledge, attitude, and practices about Malaria prevention, whereby positive attitude was found among study participants (Habimana et al., 2016). However, these findings are contrary with the findings of the study which was conducted in Mahama refugee camp, Burundi whereby there was negative attitude among study participants, about sanitation and hygiene which was linked to poor health information from CHWs (Nahimana et al., 2017).

### 4.4 Practices of Community Health Workers on Household Sanitation and Hygiene

The current study revealed poor practice for the majority of CHWs, whereby sex was found to be one of the factors that contribute to the practices of CHWs. Female CHWs were found to have good practices as compared to male, however, these findings goes contrary to the study which was conducted in Kenya on the effects of selected social-demographic characteristics of CHWs on the performance of home visits during pregnancy whereby male CHWs were found to have (Gilmore & McAuliffe, 2013). Contrary to the structured questionnaire, the Practices of CHWs in the observation checklist were found to be statistically significant. Even though CHWs have gained national recognition for their role in addressing health disparities and are increasingly integrated into the healthcare delivery systems (Ingram et al., 2012), still there is a challenge in recognition and respect from the community including other health workers hence poor cooperation (Kahssay et al., 1998). The current study observation checklist revealed that poor practices by the CHWs were found to be attributed to poor cooperation provided by the community members during the implementation of their role which included house-to-house follow-up and data collection. Similarly, a study on sources of CHW motivation, which was conducted in Morogoro, Tanzania, found poor cooperation from community members including poor recognition and respect from community members. This poor cooperation from community members might also be attributed to poor engagement of the community in the selection, training, and support (Perry & Zulliger, 2012).

Observation revealed that lack of daily allowance and promotion made CHWs fail to make home visits as required. This is supported by findings from a study on delivery of public health services by CHWs which was conducted in China (Huang et al., 2018). Inadequate on-the-job training also was seen as one of the contributing factors to poor practices. These findings are in line with the findings of the study which was conducted in Morogoro, Tanzania on sources of CHW motivation (Greenspan et al., 2013).

### 4.5 Association of KAP between Districts (Mbeya Rural and Mbarali) and Social Demographic Characteristics of Study Participants

Based on the association that was done among CHWs in Mbarali and Mbeya rural districts as far as their social demographic characteristics are concerned, attitude, practices, marital status, and duration of working as CHWs were found significant. Long duration of working as CHWs was found to be associated with KAP between Mbarali and Mbeya rural districts this is supported by a study which was conducted in Nyanza province, Kenya on Individual and contextual factors associated with CHWs performance (Kawakatsu et al., 2015). In the current study, marital status was found to be associated with the KAP of CHWs, similarly, the study on Individual and contextual factors associated with CHWs performance in Nyanza province supports the subject, and another study on job satisfaction among primary health workers in South-West Nigeria found marital status was found to be associated with job satisfaction of CHWs (Kawakatsu et al., 2015; Amoran et al., 2005).

## 5. CONCLUSION

The findings of this study underline the need to check CHW programs to match their needs as per their roles to strengthen the knowledge, attitude, and practices hence ensuring efficiency in their provision of primary health services and promotion of improvement in household sanitation and hygiene particularly in household sanitation and hygiene. Therefore, this implies that, there is needed actions to be taken by the government (MOHSW, CHMT, RHMT) and development stakeholders such as donor/ funding organizations like UNICEF, CRS, USAID to improve knowledge hence practices of CHWs. However, the findings of this study cannot be generalized since the sample covered a small portion of Mbeya region and the participant's characteristics may differ from one geographical area to another therefore cannot be generalizable for the entire Tanzania or worldwide. Also, this was a cross-sectional study and obtained information on the knowledge, attitudes and practices on household sanitation and hygiene among CHWs once, at a particular point in time (snapshot picture of a situation) and in that case would not show the change (trend) over time. Furthermore, the direct observation

method employed by this study was limited, since; CHWs might have modified their work routines in response to the presence of the researcher.

## CONSENT AND ETHICAL APPROVAL

It is not applicable.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during the writing or editing of this manuscript.

## ACKNOWLEDGEMENTS

We sincerely thank the Community Health Workers (CHWs) in Mbarali and Mbeya rural districts for their participation and insights. Our gratitude extends to CUHAS, SUA, and Bugando Medical Centre for their institutional support. We appreciate the research assistants for their dedication to data collection and validation. Special thanks to the local government authorities and communities for their cooperation.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

Alexander, C. C., Shrestha, S., Tounkara, M. D., Cooper, S., Hunt, L., Hoj, T. H., & Davis, J. (2019). Media access is associated with knowledge of optimal water, sanitation and hygiene practices in Tanzania. *International Journal of Environmental Research and Public Health*, *16*(11), 1963.

Amoran, O., Omokhodion, F., Dairo, M., & Adebayo, A. (2005). Job satisfaction among primary health care workers in three selected local government areas in southwest Nigeria. *Nigerian Journal of Medicine: Journal of the National Association of Resident Doctors of Nigeria, 14*(2), 195-199.

Bain, R., Johnston, R., Mitis, F., Chatterley, C., & Slaymaker, T. (2018). Establishing sustainable development goal baselines for household drinking water, sanitation and hygiene services. *Water*, *10*(12), 1711.

Balan, V. G. M., Galhotra, A., & Shukla, A. K. (2023). Knowledge, attitude and practice of healthcare workers about water, sanitation, and hygiene in healthcare facilities in a district of central India. *Journal of Pharmaceutical Negative Results, 14.*

Bartram, J., & Cairncross, S. (2010). Hygiene, sanitation, and water: Forgotten foundations of health. *PLOS Medicine*, *7*(11), e1000367.

Baynes, C., Semu, H., Baraka, J., Mushi, H., Ramsey, K., Kante, A. M., et al. (2017). An exploration of the feasibility, acceptability, and effectiveness of professional, multitasked community health workers in Tanzania. *Global Public Health, 12*(8), 1018-1032.

Berhe, A. A., Aregay, A. D., Abreha, A. A., Aregay, A. B., Gebretsadik, A. W., Negash, D. Z., et al. (2020). Knowledge, attitude, and practices on water, sanitation, and hygiene among rural residents in Tigray Region, Northern Ethiopia. *Journal of Environmental and Public Health, 2020*.

Berhe, A. A., Aregay, A. D., Abreha, A. A., Aregay, A. B., Gebretsadik, A. W., Negash, D. Z., ... & Mamo, N. B. (2020). Knowledge, attitude, and practices on water, sanitation, and hygiene among rural residents in Tigray Region, Northern Ethiopia. *Journal of Environmental and Public Health, 2020*(1), 5460168.

Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., et al. (2006). Soil-transmitted helminth infections: *Ascariasis, trichuriasis,* and *hookworm*. *The Lancet, 367*(9521), 1521-1532.

Billig, P., Bendahmane, D., & Swindale, A. (1999). *Water and sanitation indicators measurement guide*. Food and Nutrition Technical Assistance Project.

Brunie, A., Chen, M., & Akol, A. (2016). Qualitative assessment of the application of a discrete choice experiment with community health workers in Uganda: Aligning incentives with preferences. *Global Health: Science and Practice, 4*(4), 684-693.

Callahan, D. (1973). The WHO definition of 'health'. *Hastings Center Studies*, *1*(3), 77–87.

Chanda, P., Hamainza, B., Moonga, H. B., Chalwe, V., & Pagnoni, F. (2011). Community case management of malaria using ACT and RDT in two districts in Zambia: Achieving high adherence to test

results using community health workers. *Malaria Journal*, *10*(1), 158.

Crispin, N., Wamae, A., Ndirangu, M., Wamalwa, D., Wangalwa, G., Watako, P., et al. (2012). Effects of selected socio-demographic characteristics of community health workers on performance of home visits during pregnancy: A cross-sectional study in Busia District, Kenya. *Global Journal of Health Science, 4*(5), 78.

Diefenbacher, S., Pfattheicher, S., & Keller, J. (2020). On the role of habit in self-reported and observed hand hygiene behavior. *Applied Psychology: Health and Well-Being, 12*(1), 125-143.

e Lima, T. R. d. M., de Mascena Diniz, P. F. C., Valente, E. P., Vezzini, F., & Tamburlini, G. (2018). Effectiveness of an action-oriented educational intervention in ensuring long-term improvement of knowledge, attitudes, and practices of community health workers in maternal and infant health: A randomized controlled study. *BMC Medical Education, 18*(1), 224.

Gaude, N., & Dessai, A. (2019). Water, sanitation and hygiene practices in rural area of Goa: A cross-sectional study. *Asian Journal of Medicine and Health, 14*(2), 1-6. https://doi.org/10.9734/ajmah/2019/v14i230095

Gilmore, B., & McAuliffe, E. (2013). Effectiveness of community health workers delivering preventive interventions for maternal and child health in low- and middle-income countries: A systematic review. *BMC Public Health, 13*(1), 847.

Greenspan, J. A., McMahon, S. A., Chebet, J. J., Mpunga, M., Urassa, D. P., & Winch, P. J. (2013). Sources of community health worker motivation: A qualitative study in Morogoro Region, Tanzania. *Human Resources for Health, 11*(1), 52.

Gundry, S., Wright, J., & Conroy, R. (2004). A systematic review of the health outcomes related to household water quality in developing countries. *Journal of Water and Health*, *2*(1), 1–13.

Habimana, A., Harerimana, A., Asingizwe, D., Nyandwi, T., & Njunwa, K. J. (2016). Community health workers' knowledge, attitudes and practices about malaria prevention in Gicumbi District, Rwanda. *Rwanda Journal, 3*(1), 27-35.

Heggenhougen, K., Vaughan, P., Muhondwa, E. P., & Rutabanzibwa Ngaiza, J. (1987). *Community health workers: The Tanzanian experience*. Oxford University Press.

Huang, W., Long, H., Li, J., Tao, S., Zheng, P., & Tang, S., et al. (2018). Delivery of public health services by community health workers (CHWs) in primary health care settings in China: A systematic review (1996–2016). *Global Health Research and Policy, 3*(1), 18.

Hunter, P. R., MacDonald, A. M., & Carter, R. C. (2010). Water supply and health. *PLOS Medicine*, *7*(11), e1000361.

Ingram, M., Reinschmidt, K. M., Schachter, K. A., Davidson, C. L., Sabo, S. J., De Zapien, J. G., et al. (2012). Establishing a professional profile of community health workers: Results from a national study of roles, activities and training. *Journal of Community Health, 37*(2), 529–537.

Jonsson, U. (1986). Ideological framework and health development in Tanzania 1961–2000. *Social Science & Medicine*, *22*(7), 745–753.

Kabir, A., Roy, S., Begum, K., Kabir, A. H., & Miah, M. S. (2021). Factors influencing sanitation and hygiene practices among students in a public university in Bangladesh. *PLOS One, 16*(9), e0257663.

Kabote, S. J., & Gudaga, J. L. (2018). *Groundwater conflicts or disputes? Experience from Mbarali District in Tanzania*.

Kahssay, H. M., Taylor, M. E., Berman, P., & World Health Organization. (1998). *Community health workers: The way forward*. World Health Organization.

Kamara, J. K., Galukande, M., Maeda, F., Luboga, S., & Renzaho, A. (2017). Understanding the challenges of improving sanitation and hygiene outcomes in a community-based intervention: A cross-sectional study in rural Tanzania. *International Journal of Environmental Research and Public Health, 14*(6), 602.

Kawakatsu, Y., Sugishita, T., Tsutsui, J., Oruenjo, K., Wakhule, S., Kibosia, K., et al. (2015). Individual and contextual factors associated with community health workers' performance in Nyanza Province, Kenya: A multilevel analysis. *BMC Health Services Research, 15*(1), 1-10.

Kayombo, W. (2016). Assessing meteorological data for reference evapotranspiration in Kyela and Mbarali district. *Journal of Environment and Earth Science, 6*(4), 1-7.

Kayser, G. L., Rao, N., Jose, R., & Raj, A. (2019). Water, sanitation and hygiene: Measuring gender equality and

empowerment. *Bulletin of the World Health Organization, 97*(6), 438.

Kuberan, A., Singh, A. K., Kasav, J. B., Prasad, S., Surapaneni, K. M., Upadhyay, V., & Joshi, A. (2015). Water and sanitation hygiene knowledge, attitude, and practices among household members living in rural settings of India. *Journal of Natural Science, Biology, and Medicine*, *6*(Suppl 1), S69.

LeFevre, A. E., Mpembeni, R., Chitama, D., George, A. S., Mohan, D., Urassa, D. P., et al. (2015). Profile, knowledge, and work patterns of a cadre of maternal, newborn, and child health CHWs focusing on preventive and promotive services in Morogoro Region, Tanzania. *Human Resources for Health, 13*(1), 98.

Leshargie, C. T., Alebel, A., Negesse, A., Mengistu, G., Wondemagegn, A. T., Mulugeta, H., et al. (2018). Household latrine utilization and its association with educational status of household heads in Ethiopia: A systematic review and meta-analysis. *BMC Public Health, 18*(1), 901.

Love, M. B., Gardner, K., & Legion, V. (1997). Community health workers: Who they are and what they do. *Health Education & Behavior*, *24*(4), 510–522.

Mashoto, K. O., Malebo, H. M., Msisiri, E., & Peter, E. (2014). Prevalence, one-week incidence and knowledge on causes of diarrhea: Household survey of under-fives and adults in Mkuranga district, Tanzania. *BMC Public Health*, *14*(1), 985.

McCollum, R., Gomez, W., Theobald, S., & Taegtmeyer, M. (2016). How equitable are community health worker programmes and which programme features influence equity of community health worker services? A systematic review. *BMC Public Health, 16*(1), 419.

Mohd, R., & Malik, I. (2017). Sanitation and hygiene knowledge, attitude and practices in urban setting of Bangalore: A cross-sectional study. *Journal of Community Medicine & Health Education, 7*(4), 2-6.

Montgomery, M. A., & Elimelech, M. (2007). Water and sanitation in developing countries: Including health in the equation. *Environmental Science & Technology*, *41*(1), 17–24.

Mshida, H. A. (2019). *Influence of water, sanitation and hygiene interventions on common infections and nutritional status among under-five children in semi-pastoral communities, Arusha* [Master's thesis, Nelson Mandela African Institute of Science and Technology].

Mukulukulu, J. E., Ngo-Bebe, D., Mabanza, N. K., & Kwilu, F. N. (2020). Improving demand for health services with the involvement of community health workers: A case study of community dynamics at Mosango Rural Health Zone in the Democratic Republic of Congo. *Open Journal of Epidemiology, 10*(3), 265.

Nahimana, M.-R., Ngoc, C. T., Olu, O., Nyamusore, J., Isiaka, A., Ndahindwa, V., et al. (2017). Knowledge, attitude, and practice of hygiene and sanitation in a Burundian refugee camp: Implications for control of a *Salmonella typhi* outbreak. *Pan African Medical Journal, 28*(1).

Newborne, P., & Liisanantti, A. (2017). Sanitation and hygiene promotion in rural communities: The Health Extension Programme. *Achieving Water Security*, 89.

Odonkor, S. T., Kitcher, J., Okyere, M., & Mahami, T. (2019). Self-assessment of hygiene practices towards predictive and preventive medicine intervention: A case study of university students in Ghana. *BioMed Research International, 2019*(1), 3868537.

Ofosu-Amaah, V., & World Health Organization. (1983). National experience in the use of community health workers*: A review of current issues and problems*. World Health Organization.

Oliver, M., Geniets, A., Winters, N., Rega, I., & Mbae, S. M. (2015). What do community health workers have to say about their work, and how can this inform improved programme design? A case study with CHWs within Kenya. *Global Health Action*, *8*(1), 27168.

Parvez, S. M., Azad, R., Rahman, M., Unicomb, L., Ram, P. K., Naser, A. M., & Luby, S. P. (2018). Achieving optimal technology and behavioral uptake of single and combined interventions of water, sanitation hygiene and nutrition, in an efficacy trial (WASH benefits) in rural Bangladesh. *Trials*, *19*(1), 358.

Perry, H., & Zulliger, R. (2012). *How effective are community health workers*.

Prüss-Üstün, A., & World Health Organization. (2008). *Safer water, better health: Costs, benefits and sustainability of interventions to protect and promote health*. World Health Organization.

Soboksa, N. E., & Yimam, G. N. (2017). Assessment of household level sanitation

practice of mothers and associated factors in Gedeo Zone, South Ethiopia. *American Journal of Public Health Research, 5*(2), 43-49.

Tumwine, J. K., Thompson, J., Katua-Katua, M., Mujwajuzi, M., Johnstone, N., Wood, E., & Porras, I. (2002). Diarrhea and effects of different water sources, sanitation and hygiene behavior in East Africa. *Tropical Medicine & International Health*, *7*(9), 750–756.

Tumwine, J., Thompson, J., Katui-Katua, M., Mujwahuzi, M., Johnstone, N., & Porras, I. (2003). Sanitation and hygiene in urban and rural households in East Africa. *International Journal of Environmental Health Research*, *13*(2), 107–115.

UNICEF. (2012). *Sanitation and hygiene advocacy and communication strategy framework*. https://www.unicef.org/wash/files/Sanitation_Hygiene_Advocacy_Communication_Strategy_Framework.pdf

Urassa, D. P., LeFevre, A., George, A., Frumence, G., Mpembeni, R., Chitama, D., et al. (2015). Influence of age on community health workers' knowledge and service provision for maternal, newborn, and child health in Morogoro region, Tanzania. *East African Journal of Public Health, 12*(1), 964-974.

Wada, O. Z., Olawade, D. B., Asogbon, O., Makinde, F. T., & Adebayo, I. (2021). Evaluation of household water, sanitation, and hygiene management in a Nigerian rural community. *International Journal of Tropical Disease & Health, 42*(5), 21-33. https://doi.org/10.9734/ijtdh/2021/v42i530455

Walt, G. (1988). CHWs: Are national programmes in crisis? *Health Policy and Planning*, *3*(1), 1–21.

Water, S., & World Health Organization. (2004). *Water, sanitation and hygiene links to health: Facts and figures*. World Health Organization.

Water, U. (2012). *Sanitation drive to 2015 planners' guide*. Geneva.

World Health Organization. (1989). *Strengthening the performance of community health workers in primary health care: Report of a WHO Study Group (meeting held in Geneva from 2 to 9 December 1987)*. World Health Organization.



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