



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

International Journal of Current Research
Vol. 15, Issue, 03, pp.24164-24169, March, 2023
DOI: <https://doi.org/10.24941/ijcr.44585.03.2023>

RESEARCH ARTICLE

DETERMINANTS OF SANITATION PRACTICES IN RURAL SETTLEMENTS OF TIGANIA EAST SUB-COUNTY, MERU COUNTY

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ARTICLE INFO

Article History:

Received 27th December, 2022
Received in revised form
09th January, 2023
Accepted 15th February, 2023
Published online 30th March, 2023

Key words:

Motivational Determinants, Ability Determinant, Opportunity Determinants, Sanitation Practices, Open Defecation.

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Citation: Mutiiria, Susan Muthoni, Rutto, Jane Jemeli, Muthuri, Grace Gakii and Kiogora Domenic. 2023. "Determinants of sanitation practices in rural settlements of tigania east sub-county, meru county.". *International Journal of Current Research*, 15, (03), 24164-24169.

INTRODUCTION

Sanitation refers to public health conditions related to clean drinking water and proper disposal of human excreta and sewage. Its aim is to protect human health by providing a clean environment that will stop the transmission of disease, like diarrhoea, especially through the fecal-oral routine. These diseases have diverse effects some of which cause stunted growth among children and malnutrition caused by diarrhoea. To prevent the spread of these diseases, there is a need to uphold good sanitation practices. Safe sanitation practices might include prevention of humans from getting contact with human faeces, always washing hands thoroughly before eating, before and after using toilets, taking shower at the end of the day and putting on clean clothes. Sanitation is one of the basic determinants of quality of life and human development index (Sheethal & Shashikantha, 2016). Good sanitation practices are important since they help the population maintain health, which increases people's life-span. Poor sanitation and hygiene practices are major causes of ill health and socio-economic problems, and portrays a major development barrier in most developing countries (Crow & Odaba, 2010).

ABSTRACT

Sanitation is one of the basic determinants of quality of life and human development index. Poor sanitation and hygiene practices are major causes of ill health and socio-economic problems, and portray a major development barrier in most developing countries. Meru County government loses 816 million KES each year due to poor sanitation, with pit latrine coverage of 60%. Diarrhoea and related illnesses account for 16% of deaths among the children below 5 years and stand second to pneumonia in Meru County. This study sought to assess the motivational determinants influencing sanitation practices in rural settlements of Tigania East Sub-County, in Meru County. A descriptive study design was used with a sample size of 150 households calculated using Fisher's formula. Cluster sampling technique was used in categorizing Tigania East Sub-County into its respective wards and simple random sampling technique employed in selection of households from the clusters. Data was analysed using Statistical Package for Social Sciences (SPSS) version 25 using descriptive and inferential statistics for quantitative, while qualitative data was presented thematically. Findings revealed that 70% of the respondents were not satisfied with using sanitation facilities in poor states. Absence of safety, privacy, poor design of the superstructure, inaccessibility of toilets, and cultural beliefs encouraged poor sanitation practices such as open defecation. Some of the residents believed that children faeces are safe and was disposed in the garden, bush and composite pit. This was influenced by behaviour of the people within the community due to lack of knowledge on effects on sanitation practices. The study recommends the need to address motivational determinants as they influence sanitation practices in rural areas through training to the residents. The study also recommends government collaboration with sanitation-related bodies coupled with health promotion activities by Public Health Officers to support the construction of improved toilets in the study area.

In fact, around the world, over 800 children under the age of five die every day from preventable diarrhoea-related diseases caused by lack of access to safe water, sanitation and hygiene. Limited access to sanitation has become a worldwide problem that one in every four children suffers from stunted growth. This causes irreversible physical and cognitive damage. Since the outcome of poor sanitation as evidenced is not pleasing, there arises a serious concern of improvement to the standards of sanitation to curb the problem. However, prioritization and investments in improved sanitation facilities by individuals and governments in most developing countries are limited, creating imbalance between the population needs and available facilities. This leads to challenges in proper use and maintenance of the existing facilities (Kamara et al., 2008). As a matter of concern, diarrhoea and related illnesses account for 16% of deaths among the children below 5 years and stand second to pneumonia in Meru County (Achoki et al., 2019). A study by Bauza et al. (2018) in Odisha found that poor sanitation practices like unhygienic disposal of children faeces was associated with diarrhoea, infections from soil transmitted Helminths, stunted growth and environmental enteric infection.

The study in Odisha implied that behaviour change was key in improving the residents' livelihood. A report by MOH (2020) ranked diarrheal diseases as the third cause of outpatient illness among outpatient attendance in most health facilities in Tigania East Sub-County. Open defecation was a practice that determined increased diarrhoea cases in Tigania East as it contaminates the environment with diarrhoea-causing micro-organisms (Godana & Mengistie, 2017). As evidenced by the Meru County MOH reports of 2018, inadequate sanitation is common in many rural settings within the County despite numerous efforts to address the matter. In Kenya, there is no clarity to why latrine coverage remains low with 35% of households lacking latrines; 44% of them in the rural areas and 21% in the urban centres (Wangui, 2016). Sanitation is an important sustainable development goal that covers an important angle of human excreta management. The report by Wangui (2016) indicated that 39% of Kenyans use unimproved sanitation facilities where majority of these facilities are in poor state. Kenya, being one of the developing countries, experiences major sanitation challenges.

A study by Rah et al. (2020) revealed that in 2014, 4 out of 10 people had no access to improved sanitation globally with Africa and South East Asia being the most affected regions. The study further showed that 88% of diarrhoea-related deaths globally were caused by the consumption of unsafe water and poor sanitation. The same study highlighted that by 2008, 2.6 billion people (40% of the world's population) had no access to improved sanitation facilities. Poor sanitation issues were also reported in Ethiopia by Alemayehu et al. (2020) who pointed out that 1.5 million children died annually due to diarrhoea attributable to the combined impacts of inadequate sanitation and poor personal hygiene practices influenced by individual behaviour.

Access to safe water and improved sanitation is a challenge in Kenya. As many Kenyans living in rural areas still walk long distances for water, often collecting it from unsafe sources. These conditions have a profound effect on public health, causing under nutrition, illness and disease, particularly in children under the age of five. Prevention has always been better than cure. The resources spent to deal with the outcomes from poor or inadequate sanitation are much more than those that could have been used in its prevention. This therefore brings in the fact that poor sanitation does not only affect the health but also cuts across the well-being of individuals. Indeed, traditional approaches to improving sanitation, which are aimed at building facilities, have not resulted in significant and sustained sanitation coverage. This calls for a need to educate the residents on either means on adoption of more efficient methods of sanitation than the ones people are used to. More promising strategies have focused on creating demand for improved sanitation by changing behaviours. The WHO suggests that some practices should be maintained to uphold sanitation. The practices may include: cleaning latrines and surfaces soiled with faeces, handwashing after cleaning child's bottom, washing hands with soap and treated water after going to the toilet, burying faeces or covering it with soil, eradication of open defecation although if not prevented should be done 30 metres from sources of water, using latrines, chemical toilets, or other systems of sanitation. This study aimed at assessing the determinants of sanitation practices in Tigania east, Meru County.

MATERIALS AND METHODS

Study setting and Design: This study was done in rural settlements of Tigania East, one of nine Sub-Counties in Meru County bordering Tigania west, Igembe central and Buurisub-counties. It also borders Tharaka and Isiolo counties. It has a population of 72,549 with six wards which include Muthara, Karamakiguchwa, Thangatha, Mikinduri and special ward (Kenya National Bureau of Statistics, 2020). The main economic activity is farming and livestock keeping (GOK, 2019). Descriptive study design was used effectively to enable the researcher to collect data through observation and interview from relevant respondents where the target population household heads above 18 years from selected wards.

Sample Size and Sampling Procedure: Sample size was calculated by use of Fisher's formula to get the number of household heads to be interviewed in the study (Kasiulevičius et al., 2006).

$$n = \frac{Z^2 P(1 - P)}{I^2}$$

Where;

n is sample size of where the population is more 10000.
Z = normal deviation at the desired confidence interval. In this case 95% was taken:

Z-score value at 92% was 1.96.

P = proportion of the population with the desired characteristics.

I = degree of precision, was taken 8%.

Since the proportion of the population with characteristics was not known, then 50% was used.

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{0.08^2} = 150 \text{ participants}$$

Cluster sampling technique was employed in categorizing Tigania East Sub-County into its three corresponding wards, namely; Karama ward, Muthara ward and Special ward. To select participants (household heads) from the three clusters, simple random sampling technique was used as it presented an equal chance for every household to be selected. The number of participants in each ward was calculated as the percentage of the total households in each ward against the intended sample size of 150 as illustrated in the formula below:

$$\frac{\text{Number in ward} \times \text{Intended Sample}}{\text{Total households}}$$

Representative samples from each ward are as shown in Table 1

Data Collection: Data collection was done through the data assistants who were trained on the tools for data collection.

Table 1. Number of households selected from each ward

Ward	Number of households	Percentage of the total heads
1 Karama	6,200	40.7%
2 Muthara	5,332	35.0%
3 Special ward	3,697	24.3%
Total household	15,229	100

The questionnaire was pre-tested in 15 households in Tigania West, Akithi ward which borders Tigania East Sub-County. The instruments were tested for reliability yielding a Cronbach's alpha of 0.75 and therefore considered reliable. Structured questionnaires were given to capture relevant information on the study area. The questionnaires were administered at the household level to heads of the households aged above 18 years.

Through focus discussion, qualitative data collection was done from ten purposively selected participants who included 2 chiefs, 3 leaders of various groups and 3 Community Health Volunteers, and 2 church leaders. An interview guide with open-ended questions for the focus group guided the study. Notes-taking and recording using a mobile phone were the approaches of collecting information from the focus group respondents. The audios were further transcribed into written texts. An observation checklist was used to collect data during household survey where information was recorded about the sanitation status of the area. Household Survey method was used to collect data where respondents gave consent, to researcher through signing the letter of acceptance.

Statistical Analysis: The study used both quantitative and qualitative method of data analysis. Quantitative data was organized and analysed using Statistical Package for Social Sciences (SPSS) version 25. Data was presented by use of frequency distribution tables and

graphs to illustrate the findings of the study. The qualitative data was presented thematically and reported in a narrative way.

Ethical Consideration: The researcher received ethical approval from Meru University Institutional Research Ethics Review Committee (MU/1/39/28 vol.2 (390, Date: 17/02/1022). The researcher also got approval from the local administration in Tigania East of Meru County before conducting the study. Confidentiality in terms of disclosure of confidential information about the respondents was maintained.

RESULTS

Motivation Determinants Influencing Sanitation Practices: Emotional, Social and Physical Drivers Determining Latrine Adoption. It is shown in table 3. That majority (85%) of respondents agreed that safety influences sanitation adoption, 5% were neutral and the rest, 5%, disagreed. The research finding clearly confirmed that cleanliness of toilet had great influence on toilet adoption where majority (95%) of respondents agreed, then a mere 2% were neutral and finally 3% disagreed to the statement. Further the research finding clearly confirmed that privacy of toilet had great influence on toilet adoption where majority (82%) of respondents agreed, then a mere 8% were neutral and finally 10% disagreed to the statement. In addition, research finding clearly confirmed that status of toilet had great influence on toilet adoption where most 57% of respondents agreed, then 13% were neutral and finally 30% disagreed to the statement. Then finally research finding clearly confirmed that pride and self-esteem of toilet had great influence on toilet adoption where majority (67%) of respondents agreed, then a small number of 13% were neutral and finally whooping 20% disagreed to the statement.

From the focus group discussion, the residents said that, *“sometimes we do not use toilets even when it is provided due to inaccessibility and lack of safety, where women fear getting attacked by evil people and wild animals, and some fear also being raped. Poor structures and unhygienic toilet conditions which have flies and are smelly have huge apertures where children fear to fall while, may be avoided and some people fear using the toilets that are full due to bad smell”*.

Table 3. Emotional, social and physical drivers determining latrine adoption (N=150)

	Agree	Neutral	Disagree
Safety	85	5	5
Cleanliness	95	2	3
Privacy	82	8	10
Status	57	13	30
Pride and self esteem	67	13	20

Frequency of Availability of Water for Toilet Cleaning: As evidenced in table 4, majority (53%) of respondents agreed that water was available on daily basis for toilet cleaning, 29% stated that water was available on weekly basis and 18% agreed that it was provided after two weeks.

Table 4. Frequency of Availability of Water for Toilet Cleaning (N=150)

	Frequency	Percent	Valid Percent
Daily	79	53	53
Weekly	43	29	29
After two weeks	28	18	18
Total	150	100	100

Beliefs on latrine adoption and faeces disposal: Findings showed that majority (72.7%) of the participants believed that beliefs would determine sanitation practices while 27.3% denied the existence of beliefs determining the sanitation practices.

Table 3. Beliefs on Latrine Adoption and Faeces Disposal (N=150)

	Responses	Frequency	Percent	Valid Percent
Beliefs and attitude have influence on sanitation use. Are there some people who do not use toilets even when provided?	Yes	109	72.7	72.7
	No	41	27.3	27.3
Adult faeces is disposed differently from children faeces	Yes	109	75.3	75.3
	No	41	24.7	24.7
Adult faeces is disposed differently from children faeces	Yes	37	24.7	24.7
	No	113	75.3	75.3

This study noted that 75.3 % of respondent reported that they practiced open defecation even in the presence of toilets but 24.7% of respondent said that they did not practice open defecation besides the availability of latrines. Majority (75.3%) of respondent also confessed that adult faeces were not disposed differently from children's faeces while, 24.7% of the respondents reported that faeces were disposed differently. From the focused group discussion, it was noted that beliefs on sanitation practices would result in low sanitation coverage. Members complained that, *“Some of our residents do not use toilets even when they are provided because they believe that circumcised men do not go to help themselves and yet they defecate in the bush especially very early in the morning or at night”*. The group was also asked reasons for disposing adult faeces differently from children and the replied, *“it is a taboo to mix adult and children faeces because children will get sick”*.

Disposal of Adult and Children Faeces: Figure 1 indicates that majority of faeces were deposited in latrine, with 68% for adult and 50% for children, 20 % for adult and 15 % for children faeces were done in bushes, 6% of adult and 15% of children faeces were done in garden, 4% of adult and 17% of children faeces were fed to animals and finally 2% of adult and 3% of children faecal matter was thrown into compost pit. Findings from focused group discussion deduced that, *“Children's faeces are safe hence can be fed to dogs, or thrown to garden or composite pits”*. Respondents also said that, *“Some adult may prefer not use latrine because of fear to fall on poorly constructed slab, with holes on the floor”*.

Correlation

Correlation on Physical Attributes and Sanitation Facilities: A strong positive correlation (+1) between the fullness of toilets and open defecation was depicted from the collected data. This indicates that many people with full toilets are likely to engage in open defecation, which negatively affects their health. The lack of privacy, presence of roof, toilet slab, and toilet accessibility does not guarantee open defecation since they are strongly negatively correlated with a correlation coefficient of -1. The structuring of the toilets differs and therefore lead to the differences in the opinions held by individuals on the physical attributes of the sanitation facilities. The differences in knowledge and skills amongst the people are the root causes of differences in the sanitation facilities possessed, as shown in Table 4.

Correlation of the opportunity determinants, motivational determinants and ability determinants affecting sanitation practice in Tigania East sub-county: Correlation was determined in order to test the relationship between the independent variables. The test was important as it gave an overview of how the independent variables relate to each other. The study evaluated whether there existed a correlation between the independent variables (Opportunity determinants, ability determinants and Motivational determinants) and the dependent variable (sanitation practices), and whether the correlation was significant. Pearson correlation was computed to evaluate the bivariate relationship, as presented in Table 5. As illustrated in Table 5, there exist a moderate positive correlation between opportunity determinants and sanitation practices – desired behaviour ($r = 0.383, p_{value} = .000$), and the moderate positive correlation was significant. In terms of ability determinants and sanitation practices – desired behaviour, a positive significant correlation was evident ($r = 0.695, p_{value} = .000$).

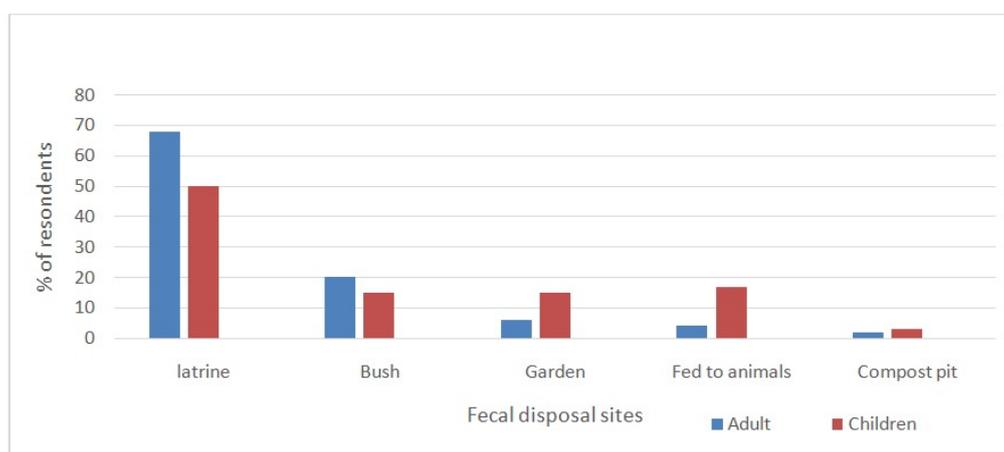


Figure 1. Waste Disposal Site for adult and children

Table 4. Correlation on physical attributes and Sanitation practices

	Toilet maintenance	Open defecation	Privacy	Presence of roof	Toilet availability	Toilet accessibility	Aperture child friendly	Toilet full
Toilet maintenance	1							
Open defecation	1	1						
Privacy	1	-1	1					
Presence of roof	1	-1	1	1				
Toilet availability	1	-1	1	1	1			
Toilet accessibility	1	-1	1	1	1	1		
Aperture child friendly	-1	1	-1	-1	-1	-1	1	
Toilet full	-1	1	-1	-1	-1	-1	1	1

Table 5. Correlation of sanitation determinants and desired behavior

Correlations		Composite index for Opportunity determinants	Composite index for Ability determinants	Composite index for Motivational determinants	Composite Index for Desired Behaviour
Composite index for Opportunity determinants	Pearson Correlation	1	.432**	.442**	.383**
	Sig. (2-tailed)		.000	.000	.000
	N	150	150	150	150
Composite index for Ability determinants	Pearson Correlation	.432**	1	.661**	.695**
	Sig. (2-tailed)	.000		.000	.000
	N	150	150	150	150
Composite index for Motivational determinants	Pearson Correlation	.442**	.661**	1	.658**
	Sig. (2-tailed)	.000	.000		.000
	N	150	150	150	150
Composite Index for Desired Behaviour	Pearson Correlation	.383**	.695**	.658**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	150	150	150	150

** . Correlation is significant at the 0.05 level (2-tailed).

In addition, motivational determinants were weakly but positively correlated to sanitation practices – desired behaviour, and the weak positive correlation was significant ($r = 0.658, p_{value} = .000$). Overly, all the independent variables (Opportunity determinants, ability determinants and Motivational determinants) were positively correlated to the dependent variable (sanitation practices) and the correlations were significant.

DISCUSSION

Motivational determinants for sanitation practices: This study assessed motivation determinants of sanitation practices in rural settlements of Tigania East Sub-County, Meru County. Based on the sample considered in this study, there was an unequal belief on sanitation with the majority standing at 72.7% who believed that beliefs determined sanitation practices. This was supported by findings in qualitative studies where Members complained that some members like circumcised men avoided using sanitation facilities even in their presence because it was believed that they were not supposed to go for defecation and that are the people who defecated in the open especially in the morning hours.

The other remaining proportions had a strong belief that beliefs did not affect sanitation practices in any way. There were differences on the way the faeces were disposed considering the age of them that formed the sample. While a greater proportion of the sample 75.3% believed that faeces were exposed on the same ways regardless of the participant's age in the study sample. Age however was defined as either adult or children specifically in this case. The study indicated that, some individuals were exposed to toilets (latrines) with 100% availability, but showed low utilization due to reasons better known by such individuals. These reasons that made them prefer open defecation were recorded as, lack of privacy, safety of the latrines and uncleanness. Similar studies done by Mwirigiet al. (2020) indicated that lack of privacy, safety, and uncleanness of latrines promote low utilization. These reasons brought low self-esteem making people to consider other unsafe methods of faecal disposal. Due to low economic status, poorly constructed structures were seen in the area which had no privacy, poor slabs, and lacked security. This had a great influence on latrine adoption to the residents. Busienei *et al.* (2019) also indicated that poor structural designs act as a motivational determinant limiting latrine usage, due to lack of privacy and security to the users.

The researcher found that open defecation was practiced by both adult and children due to cultural belief among the community members. As revealed in the focus group discussion, it was seen a taboo for mixing children faeces with adults' because children would get sick. These findings conquer with a research by Okurut et al. (2015) who reported that communities choose different excreta disposal practices based on traditional beliefs and are unlikely to use systems that conflict with culture as it demotivates them from practising good sanitation practices. In terms of correlation between the factors considered such as safety, cleanliness, privacy, status, pride and self-esteem, the factors were found to have a strong positive correlation. This meant that with an increase in either one of the factors, there would be an increase in negative sanitation practices. The manner to which the latrines were structured depended on the levels of skills, economic status and knowledge by the individuals as revealed in this study. The toilets that were full, had strong negative correlation (-1) with sanitation practices held by the individuals. They had a perfect negative correlation where the proportion at which one increased would lead to the same proportion of decrease in the other variable. Some annoyance practices were also revealed in this study where children faeces were dumped in the garden where they were fed by animals. It was also found from the focused group discussion that children's faeces are harmless to the environment and could be used as food for dogs and chicken or thrown to the garden. This disagreed with findings by Bauza et al. (2018), who indicated that, disposing faeces anyhow regardless of the age was unhygienic and it prompted diarrhoea and many infections such as soil transmitted helminthes infection, stunted growth and environmental enteric infection. This implies that diarrhoea diseases could be associated with poor disposal of children faeces among the residents of Tigania East. It is important for the residents to be empowered with knowledge about the effects of open defecations for behaviour change. Women have major role on positive sanitation practices because they are at home most of the time and can ensure proper disposal of children faeces to reduce open defecation.

CONCLUSION

There was a positive correlation between the determinants for sanitation practices and improved sanitation practices amongst the residents in Tigania East Sub County. The residents have latrines which are differently structured due to the differences in knowledge and skills held by the individuals. The toilets that are full are strongly negatively correlated (-1) with perfect sanitation practices held by the individuals in Tigania East Sub County. Open defecation was seen among the community besides availability of toilets. Improper disposal of human excreta certain breakthroughs of contagious infections such as cholera and other diseases, it would lead to wastage of resources in their treatment and sometimes increased mortalities. Such impacts can be prevented by adoption of good sanitation practices which also influence individual behaviour by employing motivation determinants to achieve desired behaviour for effective toilet use.

Data Availability: The primary data used to support the findings of this study are available from the author upon request.

Conflict of Interest: The authors have declared that no competing interests exist.

Author's contribution: The author (SMM) designed the study, analysed data, discussed and made conclusion. The author (DK) contributed to the design of the study, while (JJR) and (MGG) contributed to the design of the study, supervised the study and wrote the manuscript.

ACKNOWLEDGEMENTS

Our special gratitude to Meru University of Science and Technology and all the respondents in the households where data was collected for their great contribution towards the success of this study.

Special thanks to Mr. Nyaga Josphat and the data assistants for their support towards the completion of the project.

Funding: The study was not funded.

REFERENCES

- Achoki, T., Miller-Petrie, M., & Glenn, S., N. K.-T. L. G., (2019). Health disparities across the counties of Kenya and implications for policy makers, 1990–2016: a systematic analysis for the Global Burden of Disease Study. Elsevier. Retrieved November 3, 2021, from <https://www.sciencedirect.com/science/article/pii/S2214109X18304728>
- Alemayehu, M., Alemu, T., & Astatkie, A. (2020). Prevalence and Determinants of Diarrhea among Under-Five Children in BennaTsemay District, South Omo Zone, Southern Ethiopia: A Community-Based Cross-Sectional Study in Pastoralist and Agropastoralist Context. *Advances in Public Health*, 2020. <https://doi.org/10.1155/2020/4237368>
- Bauza V, Byrne DM, Trimmer JT, Lardizabal A, Atiim P, Asigbee MAK, Guest JS. (2018). Child soil ingestion in rural Ghana—frequency, caregiver perceptions, relationship with household floor material and associations with child diarrhoea. *Trop Med Int Health* 23: 558–569
- Busienei, P. J., Ogendi, G. M., & Mokua, M. A. (2019). Latrine structure, design, and conditions, and the practice of open defecation in Lodwar Town, Turkana County, Kenya: a quantitative methods research. *Environmental Health Insights*, 13, 1178630219887960.
- Crow, B., & Odaba, E. (2010). Access to water in a Nairobi slum: Women's work and institutional learning. *Water International*, 35(6), 733–747. <https://doi.org/10.1080/02508060.2010.533344>
- Godana, W., & Mengistie, B. (2017). Exploring barriers related to the use of latrine and health impacts in rural Kebeles of Dirashe district Southern Ethiopia: implications for community lead total sanitations. *Health Science Journal*, 11(2), 0-0.
- Kamara, I., Tumwebaze, Orach, C. G., Niwagaba, C., Luthi, C., & Mosler, H. J. (2013). Sanitation facilities in Kampala slums, Uganda: users' satisfaction and determinant factors. *International journal of environmental health research*, 23(3), 191-204.
- Kasiulevičius, V., Šapoka, V., Gerontologija, R. F. (2006). Sample size calculation in epidemiological studies. *Researchgate.Net*, 7(4), 225–231.
- Kothari, C.R. (2004) *Research Methodology: Methods and Techniques*. 2nd Edition, New Age International Publishers, New Delhi.
- Kenya National Bureau of Statistics (2019). *Kenya Population and Housing Census: Volume II*
- Majorin F, Freeman MC, Barnard S, Routray P, Boisson S, Clasen T. (2014). Child feces disposal practices in rural Orissa: a cross sectional study. *PLoS One* 9: e89551.
- Mwirigi, S. N., Muchiri, E. M., Kubai, P., & Rutto, J. (2020). Physical and Social Demographic Factors Affecting Utilization of Pit Latrine in Tigania East, Meru County, Kenya.
- Okurut, K., Kulabako, R. N., Chenoweth, J., & Charles, K. (2015). Assessing demand for improved sustainable sanitation in low-income informal settlements of urban areas: a critical review. *International journal of environmental health research*, 25(1), 81-95.
- O'Reilly, K., Dhanju, R., & Goel, A. (2017). Exploring “the remote” and “the rural”: Open defecation and latrine use in Uttarakhand, India. *World Development*, 93, 193-205.
- Rah, J. H., Sukotjo, S., Badgaiyan, N., Cronin, A. A., & Torlesse, H. (2020). Improved sanitation is associated with reduced child stunting amongst Indonesian children under 3 years of age. *Maternal & Child Nutrition*, 16(S2), e12741. <https://doi.org/10.1111/MCN.12741>
- Routray, P., Schmidt, W.-P., Boisson, S., Clasen, T., & Jenkins, M. W. (2015). Socio-cultural and behavioural factors constraining latrine adoption in rural coastal Odisha: An exploratory qualitative study. *BMC Public Health*, 15(1), 880. <https://doi.org/10.1186/s12889-015-2206-3>

- Russpatrick, S., Tiwari, A., Markle, L., Musonda, E., Mutunda, A., Osbert, N. & Larsen, D. A. (2017). Mobility up the sanitation ladder following community-led total sanitation in rural Zambia. *Journal of Water, Sanitation and Hygiene for Development*, 7(3), 436-444.
- Shashikantha, S., Sheethal, M., & Vishma, B. (2016). Dietary diversity among women in the reproductive age group in a rural field practice area of a medical college in Mandya district, Karnataka, India. *International Journal of Community Medicine and Public Health*, 3(3), 746-749.
- Wangui, G. M. (2016). The Influence of Socio-cultural and Economic Factors on the Adoption of Ecological Sanitation Facility: A Case Study of Mathare Slum of Ngong Town, Kajiado County, Kenya. 109.
