



Determinants of Disposal of Disposable Diapers Among Caregivers in Kisumu City, Kenya

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Abstract

Background: A disposable diaper harbor feces and hazardous chemicals that if improperly handled and disposed, can lead to diseases and pollution. Objective: To assess determinants for disposal of disposable diapers in Kisumu city. **Methods:** A cross-section design was used. 246 Caregivers with children < 3 years were selected and data was collected using a semi-structured questionnaire. Data was analysed in SPSS and both descriptive and inferential statistics were performed with significance level set at 0.05. **Results:** Majority (86.5%) of the caregivers were women. The mean age of caregivers was 29.3 years (\pm 6.86). mean household size was 5, most (92.3%) households were male headed with an average monthly income of KES 21,833; Majority of mothers (73.1%) and fathers (93.2%) had attained secondary level of education. The usage of disposal diapers was 95.93% with appropriate disposal at 41.3%. Variables significantly ($P < 0.05$) associated with appropriate disposal of diapers were: Sex of the household head; Mother with high school education; father with high school education; home ownership status; and availability of onsite sanitation. **Conclusions:** Maternal literacy and household income are key determinants for disposal of diapers. Knowledge on risks posed by diapers is high but it has not translated into proper disposal practice.

Keywords: Determinants; Diapers; Disposal; Epidemiology; Environmental Health.

Received: 4/26/2023

Accepted: 5/12/2023

Published: 5/30/2023

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1. Introduction

A diaper allows the user to defecate or pass urine conveniently without using the need for a toilet because of its ability to absorb and contain urine and feces thus preventing the soiling of clothes or the environment[1]. Children primarily wear diapers because they may not be able to use a toilet or latrine due to their age and stage of physical development or the safety concerns of their caregivers, even if their household has access to one[2]. Adults with incontinence; including those of the aged, bed-bound patients, and people with some physical or mental disabilities also use diapers [3,4].

Soiled diapers harbor fecal wastes and potentially harmful chemicals and require proper disposal. Proper disposal of diapers reduces incidences of contamination of the environment, which can subsequently lead to diarrheal diseases[5]. Unsafely disposed of diapers have been associated with the risk of diarrhea[1]. An estimated 80% of used diapers in Kenya are disposed of unsafely[6]. Most of these are thrown out indiscriminately and some end up in municipal dump sites. Additionally, diapers need to be exposed to air and light for biodegrading. These conditions are not provided for in dumpsites and rubbish pits where most of the soiled diapers end. As a result, the soiled diapers linger for longer in the environment and pose a health risk

Diapers contain toxic chemicals like dioxin; Tributyl-tin (TBT); and phthalates. Dioxin is highly toxic and, if released into the environment, can accumulate in humans and animals and has the potential to cause growth and reproductive problems; destroy the liver and the immune systems; promote cancer and interfere with hormones[7]. Additionally, Low and Middle-Income Countries (LMICs) like Kenya generally lack adequate means to handle and dispose of wastes in an environmentally safe manner despite growing usage of diapers[8,9]. As a result, dirty diapers are mixed with household wastes and end up in municipal landfills or thrown indiscriminately in communal trash bins/pits. This leads to the accumulation of such waste close to people's settlements. Since part of the materials used in the diapers is not biodegradable, this makes the diapers to linger for long in the environment and poses a significant threat to public health, especially by soiled diapers, which require strict disposal measures[10]. Additionally, few studies in Kenya have delved into understanding the extent of this problem to public health. With the usage of Disposable diapers now gaining traction, their impacts on public health must be well understood by users and policymakers.

The magnitude of poor disposal of Disposable diapers in Kisumu is still unknown despite the disposal of diapers in Kisumu becoming a major headache for many households in rural and urban centers[11]. According to the authors' understanding, few studies have highlighted the determinants of the use and disposal of Disposable diapers. The most readily available literature is often on factors influencing the removal of child feces[1,12,13]. These studies have not been particular aimed to study determinants of disposal of Disposable diapers. Additionally, these studies have been done outside Kenya and may not reflect the Kenyan context. Few studies have indicated the proportion of mothers' and caregivers' usage of Disposable diapers in Kenya. Most have given an average of diapers used by a child per day. One study that provides the proportion of mothers and caregivers using Disposable diapers pegs the figure at 86.21% [6].

This study aimed to assess determinants for the use and disposal of Disposable diapers among mothers and

caregivers in Kisumu City. Specifically, the study aimed: to estimate the prevalence of usage of Disposable diapers among caregivers in Kisumu City; to determine households' socioeconomic characteristics that define the use of Disposable diapers in Kisumu City; to determine practices employed by mothers and caregivers in the disposal of used diapers in Kisumu City.

2. Materials and Methods

2.1 Study design and participants

3. This was a cross-sectional study conducted in Kisumu City. Kisumu is the commercial center and headquarters of Kisumu County. It is the third-largest city in Kenya after the capital, Nairobi, and the coastal city of Mombasa. Kisumu city is grappling with the management of solid wastes[9]. According to the County Government of Kisumu, the city's population is estimated at 566,810 persons as at the start of the plan period 2020 with an annual growth rate of 2.8% [14].

Epi info was used to estimate the sample size at a 95% confidence interval and 86.21% was taken as the outcome of interest. It represented the proportion of mothers/ caregivers disposing of diapers inappropriately [6]. A target population of 93,956 representing the estimated population of children under the age of three years in Kisumu city was used for sample size determination[15]. A multi-stage random sampling technique was applied to select the 246 sample households for this study. Firstly, the number of households to be interviewed in each stratum was determined. These were 88 for Kisumu central, 94 for Kisumu East, and 64 for Kisumu West. This was done by calculating the population proportions for under-fives for each of the four strata which were 36%, 38%, and 26% For Kisumu Central, Kisumu East, and Kisumu West respectively. Two wards were then randomly selected within each sub-county and the number of households to be surveyed was shared equally. The wards selected were Market-Milimani and Nyalenda B (Kisumu Central), Manyatta B and Kajulu (Kisumu East), and Kisumu North and Kisumu West (Kisumu West). Since all households in a village are listed in the community unit register, all the households with children below 3 years were initially identified and this formed the list from which households were picked at random. The target interviewee was a mother or a suitable caregiver in the mother's absence. This was so because mothers are in charge of childcare and decision-making on childcare options at the household.

2.2 Study design and participants

The study used a structured questionnaire to collect data from the household. The questionnaire was administered to collect information from residents in the study areas. The semi-structured questionnaire sought to assess how the residents were disposing of diapers. The first category of questions explored personal information about the respondents. The second category explored the determinants of the use and disposal of diapers, knowledge of risk factors of Disposable diapers, and practices employed in the disposal of the same. The responses from the questionnaire were counted and expressed numerically

2.3 Data Collection Procedures

The structured questionnaire was digitized in EpiCollect 5 App and the enumerators were trained on the administration of the same. Training of enumerators was conducted to develop their capacity to motivate mothers and caregivers to give accurate and complete responses while adhering to ethical considerations. The training was also intended to equip the enumerators with the knowledge and skills for doing their job well without compromising the quality and reliability of the data.

To systematically determine the proportion of usage of Disposable diapers amongst mothers and caregivers, data was collected on the type of diapers preferred for use by the mothers/caregivers. Data so collected were summarized in tables and frequencies populated for each type of diaper preferred. The questionnaire also collected data to ascertain mothers' and caregivers' knowledge of the risks of poor disposal of soiled diapers to public health and practices employed by them in the disposal of soiled diapers.

Additionally, the questionnaire was used to determine individual and household characteristics influencing disposal of disposable diapers in Kisumu City. These data were summarized in tables and frequencies for all the determining factors, and bivariate analysis was conducted to determine the strength of association between the factors and the use and disposal of disposable diapers.

All significant factors associated with the usage of Disposable diapers and disposal of Disposable diapers from the bivariate analysis were considered for inclusion in the multivariate analysis. Variables that were not significant in the full model were removed one at a time. This was conducted until all insignificant variables were excluded from the model. A pilot study to test the data collection instrument was conducted in Nyalunya village within Kisumu County.

2.4 Ethical Considerations

This study involved direct humans-involvement through face-to-face interviews, focus group discussions, and observation. However, no invasive procedures were conducted on the study subjects in the course of this study. The field questionnaire contained sensitive questions, such as household income, level of education, and intra-household defecation behaviors, practices, and beliefs. Having put this in mind, ethical and scientific approval was sought from Amref Ethics and Scientific Review Committee (ESRC) which was granted on January 14th 2022 via reference number P1109/2022. National Commission of Science and Technology (NACOSTI) research license was sought and given on 20th January 2022 under reference number 983046.

At the County Level, approval was sought from the director of public health at Kisumu County. The permission was given on 1st February 2022 under reference GN 133 VOL.X/ (462). Additionally, informed consent was sought from all the participants and efforts were made to make clear to the participants that their involvement in the study was voluntary, and any person had a right to withdraw from the study at any stage at their discretion.

3. Results and Discussion

A total of 246 mothers and caregivers comprising 93.1% female and 6.9% male participated in the study. The participants were either mothers or caregivers to 269 children <3 years of age. The majority (63.1%) (of the mothers and caregivers were in the 26–35-year age group (50.4%) with a mean age of 29.3 (standard deviation= 6.86) Years. A majority (86.5%), of the respondents, were Christians. Only 1 household reported not to have a mother with 99.6% of the households reporting availability of a mother. On the other hand, 92.7% of the households reported to have a father at the time of the survey. A majority, 82.52% of the households had just one child three years of age. In terms of education, 71.1% of the households reported to have had mothers who had attained at least a high school education where as 79.27% of the households reported to have fathers who had attained at least a high school education. Most (92.3%) of the households were male headed households. The mean household size was 5 and the mean household monthly was KES income was 21,833/-. Table1 gives a summary of all the background characteristics of the respondents.

Nearly all (95.93%) of households reported using disposable diapers at one point in time. A small percentage (2.48%) of the 246 households reported to only use reusable diapers. A small percentage (1.63%) of the households reported not using any kind of diapers. A bigger percentage (82.52%) of the respondents indicated convenience as a key driver for their preference of disposable diapers. Further, a few (18.29%) of the respondents mentioned that cost was a key driver for their choice of usage of disposable diapers.

A smaller percentage of respondents (4.07%) highlighted the need for child comfort as a driver for their choice of disposable diaper. From the FGDs and IDIs conducted, it came out that disposable diapers were mostly preferred for the following reason; a status symbol to show that a mother is moving with current trends (has class), it is suitable to use at night as it does not need frequent changes, it is convenient when travelling, it is less bulky on the child, younger mothers do not want to come in contact with feces during washing of reusable diapers; and new mothers do not know how to tie the cloth diapers. However, it was indicated that a few mothers still use cloth (reusable) diapers and this is because; they are unable to afford disposable diapers, and some believe it is more safe on the baby skin than the disposable option.

Those with preference for disposable diapers further indicated that: disposable diapers were convenient and did not need washing after use, they stay on child for longer and need fewer changing times, wearing is less complicated compared to cloth diapers, they rarely leak compared to cloth diapers and they are less bulky to carry especially when taking baby out. They further argued that disposable diapers provided comfort to the baby by remaining drier on the skin as opposed to cloth diapers which wet the babies skin, they also add less wait making babies learning to walk to be easy.

Findings indicated that four variables had statistical significance ($P < 0.05$) association with appropriate disposal practices for diapers. These included: sex of the household head; household having a father; household having a father (or not); mother having attained high school education; and household income (either being above or below the minimum wage). However, five factors: sex of the respondent; religion of the respondent; age of the respondent; father having a high school education; and availability of a mother at a household. These results are

as shown in table 2.

This study found that among mothers and caregivers who used disposable diapers, 89.4% (n=211) of them had knowledge on how to properly dispose disposable diapers as shown in table 3 below. Additionally, most mothers and caregivers were able to mention either safety/health risks (53%, n=125) or environmental risks (79.2%. n=187) posed by poor disposal of diapers as shown in Table 4.

All the respondents from households that reported using disposable diapers (n=230) indicated that their households practiced more than one method of disposal of disposable diapers. A summary of these data is provided in table 5.

Any household that reported the practice of indiscriminate disposal or throwing diapers in trash pits were considered to be disposing of diapers improperly. On the other hand, households that practiced only throwing the diapers in latrines or with household trash to landfills were considered to be practicing proper disposal. Based on this criteria, 41.3% (95% CI 35.0% to 47.8%) were deemed to practice proper disposal of the same while 58.8% (95% CI 52.2% to 65.0%) were found to involve in improper disposal practices of disposal. This results are summarized in Table 6

This study has examined the determinants of usage and disposal of disposable diapers in Kisumu City in Kenya. The proportion of households using disposable diapers in this study (95.93%) was found to be higher than that reported in previous studies. Eke & Opara [17] had found the proportion to be 45% in their study in Zimbabwe. Muia [6] on the other hand, in the Study conducted in Nairobi Kenya, found the proportion to be 86.21%. A recent study conducted in 2020 found the proportion of usage of disposable diapers to be 60.7% [16]. The higher proportion in the usage of disposable diapers reported in this study is due to a growing cultural shift from traditional use of cloth to disposable diapers by young mothers and increasing awareness of availability of disposable diapers which appear to be more preferred by these mothers and caregivers as they are deemed more convenient, requiring less changing times and elimination of the need to wash, compared to reusable diapers. This study therefore agrees with sentiments from one other study [3] who concluded that there was a growing trend in the use of diapers today compared to previous years.

Findings from our study further show that convenience provided by disposable diapers is a key driver for their usage. This result, indicating that convenience plays a major role in determining usage of diapers, did not come as a surprise as it had been elucidated in other previous studies [2,3,5,7,8,17,18]. This study confirms that convenience provided by disposable diapers on their ease of use and no need of washing and requiring less changing times due to their absorbency is a key determinant for their usage. Our study agreed with [3] who indicated that more and more women were using disposable baby diapers and this was mostly driven by their perceived convenience. The study in Zimbabwe by [5] established that 78% of women used disposable baby diapers and 70% of them indicated that convenience was a key driver for their choice of the same. Authors of another study in Kuala Lumpur [7] indicated that disposable diapers are designed in such a way to absorb and retain urine and feces and this makes them convenient to use. A study in Bandung, Indonesia [18] found that a third of the children used disposable diapers and their use increased: during the rainy season; among pre-school

children; and when travelling or visiting due to their convenience. Another study in Port Harcourt, Nigeria [17] established that mothers were mostly using disposable baby diapers and one of the reason given for their preference was the social convenience they offered.

Our study found that maternal literacy was a significant determinant for use of disposable diapers. These findings support that education level is a determinant on the choice of disposable diapers used at household level. This results build on existing evidence that have concurred that education and most importantly maternal literacy plays an important role in the choice of diapers at households [17,18]. The Port Harcourt study [17] established that more educated the mothers were most likely to use disposable diapers because of various reasons among them being: time saving, ease of use, cost saving on water and soap for washing, and that they are less leaky. The study in Indonesia [18] that looked at patterns of child faeces management and disposable diaper usage, established that use of disposable baby diapers increased unhygienic disposal of feces and that but this decreased for mothers with higher education. This therefore indicates that maternal education is indeed a key determinant in the choice as well as the disposal of baby diapers.

Further, our study found that household's income was significantly associated with use of disposable diapers. Household income is an important factor in determining decisions that a household take. It determines the ability of households to pay for assets and consumer goods. Our findings agreed with one previous study [19] that showed that income was a determinant in the usage of disposable diapers. However, our findings disagreed with finding from one study [18] which showed that income at household level was not a determinant of usage of disposable diapers. However, our finding settles well with the view of Agestika and others [18] on the fact that diapers are more affordable and that lower-income households spend less than higher-income households on baby diapers. High income households go for higher quality diapers that are more expensive while low income households go for cheaper diapers that may be of low quality. Our findings therefore provide us with confidence to indicate that diapers are becoming more and more affordable even for low income earning households.

Concerning disposal of diapers, our finding indicated that income was a significant determinant of diapers disposal practice. This finding in part seemed to agree with findings from another study in Congo [21] that looked at waste disposal in general, the study findings indicated that safe waste management tended to depend partly on socio-economic status of a household. These sentiments differed with findings by another study by Adzawla et, al. who indicated that association between income and waste disposal was negligible but significant in the collection and public dumping systems. They concluded that proper waste disposal was largely attitudinal or demographically related but not associated with income [20]. Our findings on indication of association between income status of a household and proper disposal practice of baby diapers may point to the general part that socioeconomic status of a household plays as expounded by Manun'Ebo and others [21]. We note that households with higher socio-economic status are able to afford better education and go to higher levels of education. They by extension are more informed and understand better the risks of poor disposal of wastes. They are also in a better position to afford safer waste disposal systems compared to those from low socioeconomic background that have to direct their income to their most pressing needs, and safe disposal may not be among those needs.

Our study findings indicate that female headed households were more likely to properly dispose disposable diapers compared to those that were male headed. This does not come as a surprise since women are more likely to be more conscious of household cleanliness and when they are in decision making positions at the household, they take seriously matters touching on family health. These sentiments correspond with those of other previous studies [20,22,23]. Our findings seem to point to Adzawala and others [20] sentiments that indicate females tend to adopt systems that guarantees maximum hygiene whenever they are in a position of final decision making. Our study agreed with Muia [6] finding that age of the Caregiver, income status of the household, gender of Caregiver, and number of children in a house are less significant determinants of proper disposal of soiled diapers.

On the awareness of risks posed by soiled diapers, our study found that mothers and caregivers' education was not a determinant of both use of disposable diapers and proper disposal of diapers. These findings disagree with previous studies by [6,8,13,24] that found that education levels of caregivers were significantly associated with disposal practices of dirty diapers and or faeces. According to [6].

a rise in education is directly associated with a rise in environmental awareness. We agree with their sentiments that educated individuals have got knowledge on the effects of poor waste management and by extension comprehend the negative impacts of improper disposal of soiled diapers. The importance of environmental awareness on disposal of soiled diapers was also elaborated by [8] who stated that individuals with education were more willing to take soiled diapers to a collection center than those with low or no education at all. Similar sentiments are shared with [13] who found that an increase in maternal education was more likely to reduce the unsafe disposal of children's stools. We aver with all these sentiments that maternal education is key in determining the disposal practice of baby single-use diapers.

Our findings indicate that a most of the households were disposing off used diapers improperly. During field work, the research team observed diapers damped in rivers, roadsides, open plots of land, drains and even play fields. Similar observations were noted by the study in Uganda (25) who noted the presence of disposed soiled baby diapers in drainage channels, road ways, and abandoned pieces of land. Similarly, the study in Zimbabwe (27) noted cases where women who had no ability of getting disposable bins resorted to dumping baby diapers in open fields in the evening when no one was watching and that these casual dumpsites were mostly within less than twenty meters from built up areas. In our observations, the city of Kisumu lacks a structured waste disposal system and this may be the greatest contributing factor to the poor disposal practices observed in the area.

In our study, we noted that 29.2% of the respondents indicated that they disposed their wastes together with household wastes. This was a lower proportion compared with 35.6% from a study by [8]. The study by Kimani and other (8) was conducted in Nairobi City and we believe that is why they reported a higher figure. Nairobi has more organized waste management system compared to Kisumu which is a smaller city in terms of age and infrastructure. Our study considered disposal of diapers to city landfills to be a proper disposal practice for diapers provided the respondents mentioned that they emptied the fecal content in a latrine or toilet before they safely through this in trash bins used to store household trash.

However, we note that this may not be safe disposal of the diapers as they may end up in the environment in the course of movement from the house to the city landfills. A guidance for considering diapers disposed with household trash to landfills as safe was provided by Bain & Luyendijk (2015), who guided that the following criteria should be considered before classifying disposal of diapers to landfills as safe: How was the faeces handled getting to the garbage; how is the garbage disposed of; how are scavengers and animals kept away from the garbage; and where is the garbage stored in relation to households and water sources?. It is therefore our belief that a bigger burden of managing the diaper waste after it leaves the household is a responsibility of the city government and not the household.

We therefore confirm that if a household ensures that they have observed the manufacturers recommendation on disposal of diapers as pointed out by Poinsett (2023), that fecal matter should be dumped into the toilet/latrine then be wrapped into a tight ball, secured and placed in a sealed container before it is disposed according to local waste management regulations then they have conducted proper disposal of the diaper.

Our finding indicated that households that disposed household trash within their compounds were more likely to properly dispose disposable diapers. This may be due to the fact that a majority of the households in this study were owner occupied as opposed to rented households. However, our findings differ with two previous studies [18] that had indicated that owner-occupied households had a higher likelihood of disposing trash in open places. The reason why we differ with this sentiment is that owner occupied households have more say on what they can do within their homesteads than tenants who have to rely on waste disposal system (or lack of one) put up by the landlords. Additionally, people who live in their own compounds are more likely to invest in proper waste management as opposed to tenants.

Our findings further indicated that 34.7% of households used trash pits for disposal of diapers. One previous study by [8] had indicated that 0.7% of households reported disposing diapers in trash pits. This difference may be due to the difference in the study population. Our study sort to study the city residents of all divide while the study by Kimani studied the middle income cohort of Nairobi population.

Our study further found that the site of final trash disposal and sewage(feces) disposal site were significantly associated with disposal of disposable diapers. Households that disposed trash within their homesteads had higher odds of disposing of disposable diapers improperly. Similarly, households who used latrines within their own homesteads had higher odds of disposing off diapers properly.

Our findings differ with one previous study [18] that had indicated that owner-occupied households had a higher likelihood of disposing trash in open places. The reason why our study differ with this sentiment is that owner occupied households have more say on what they can do within their homesteads than tenants who have to rely on waste disposal system (or lack of one) put up by the landlords. Additionally, people who live in their own compounds are more likely to invest in proper waste management as opposed to tenants.

We did not find any studies that made sought to compare association of sewage disposal with disposal of diapers. However, one study by [24] found that women from households with improved sanitation had greater

odds of safely disposing of their children's stools. We believe that most owner occupied households that owned pit latrines mostly disposed-off diapers in them.

However, households that lived in rented houses or used water closets to the City’s sewerage system had options of disposing the diapers together with household trash, into trash pits or indiscriminately throw into the environment. This is so as water closets cannot take in diapers as they will clog the piping system of the sewer. People who live in rented houses even where there is a pit latrine are discouraged from disposing diapers in them as they may fill up latrines and pose a challenge especially when fecal sludge has to be emptied from the pits. Such households have to also depend on using the city’s waste management system or to throw the diapers into the environment.

The findings of this study have to be seen in light of some limitations. The first is that this study relied on information provided by respondents who may have bias in responding to questions in a manner to make them appear “better” to the researchers rather than their authentic response and thus presenting a social desirability bias. To the best of our knowledge, this limitation was managed by including observation of the environment around households and providing follow-up questions to the responses in order to seek clarity of responses.

Table 1: Summary of background characteristics of respondents.

Characteristic	Proportion (%)	95% Confidence Interval
Sex of the respondents		
Male	17 (6.9%)	3.73%-10.07%
Female	229 (93.1%)	89.93%-96.27%
Sex of the household head		
Male	227 (92.3%)	88.97%-95.63%
Female	19 (7.7%)	4.37%-11.03%
Religion of household:		
Christian	213 (86.6%)	82.3%-90.9%
Islam	12 (4.9%)	2.2%-7.6%
African traditional Religion	21 (8.5%)	5.0%-12.0%
Household has a mother.		
Yes	245 (99.6%)	98.8%-100.4%
No	1 (0.4%)	0.4%-1.2%
Household has a father.		
Yes	228 (92.7%)	89.4%-96.0%
No	18 (7.3%)	4.0%-10.6%
Mother has high school education.		
Yes	172 (73.2%)	67.5%-78.9%
No	63 (26.8%)	21.1%-32.5%
Father has high school education.		
Yes	220 (93.2%)	90.0%-96.4%
No	16 (6.8%)	3.6%-10.0%
House Ownership by household		
Rental	169 (68.7%)	62.9%-74.5%
Owner occupied	77 (31.3%)	25.5%-37.1%

Household Monthly Income (KES)	
Lowest	1,000/-
Highest	300,000/-
Average	21,736/-
Mean Salary	21,833/-
SD	28,143/-
Average household size	5

Table 2: Results of the bivariate analysis of variables associated with proper disposal of disposable diapers.

Independent Variables		Proper Disposal	Improper Disposal	X ²	P value
1. Sex of the respondent	Male	7(3.0%)	8(3.4%)	0.15	0.79
	Female	92 (39.0%)	129 (54.7%)		
2. Religion	Christian	87(36.9%)	119(50.4%)	0.05	0.85
	Islam and ATR	12(4.1%)	18(7.6%)		
3. Age of the respondent	< 26 Years	87(36.9%)	119(50.4%)	0.05	0.85
	≥ 26 Years	12(5.1%)	18(7.6%)		
4. Sex of the household head	Male	98(41.5%)	121(51.3%)	9.79	0.00
	Female	1(0.4%)	16(6.8%)		
5. Household has a Mother?	YES	99(41.9%)	136(51.3%)	0.73	1.00
	NO	0(0.4%)	1(6.8%)		
6. Household has a father?	YES	99(41.9%)	121(51.3%)	12.40	0.00
	NO	0(0.4%)	16(6.8%)		
7. Mother has at least high school education	YES	83(70.2%)	89(1.2%)	10.36	0.00
	NO	16(26.1%)	48(2.4%)		
8. Father has at least High school education	YES	80(77.6%)	97(2.2%)	3.07	0.09
	NO	19(18.9%)	40(1.3%)		
9. Household Income	Income above minimum wage	77(32.6%)	82(34.7%)	8.40	0.00
	Income below minimum wage	22(9.3%)	55(23.3%)		

Table 3: Awareness on proper disposal of disposable diapers.

Awareness on risks for poor disposal	Proportion (%) n=236	95% CI (%)
Have awareness	89.4%	84.8-93.0
Lacks awareness	10.6%	7.0-15.2

Table 4: Awareness on risks Posed by disposable diapers (mentioned by respondents).

Type of Risk		Proportion (%) n=236	95% CI (%)
Aware of safety or health risks	Yes	53.0%	46.4-59.5
	No	47.0%	40.5-53.6
Aware of environmental risks	Yes	79.2%	73.5- 84.2
	No	20.8%	15.8-26.5

Table 5: Disposal practices reported by households in disposal of disposable diapers.

Diaper disposal practice	Number of households/respondents	Proportion of households
With household trash to the city landfill	69	29.2%
Thrown in pit latrine	39	16.5%
Thrown in trash pits	82	34.7%
Indiscriminate disposal	48	20.3%

Table 6: Association of homestead characteristics with disposal practices of disposable diapers.

Household Characteristic			Proper Disposal	Improper Disposal	Fisher's Exact two tailed P
Home ownership status	Owner occupied		71(30.1%)	92(39.0%)	0.48
	Rented		28(11.9%)	45(19.1%)	
Sewage disposal	Onsite		69(21.1%)	115(0.4%)	0.01
	Offsite		30(74.8%)	22(3.7%)	
Trash disposal site	Onsite		21(8.9%)	8(3.4%)	<0.00
	Offsite		78(33.1%)	129(54.7%)	

4. Conclusion

Disposable diapers are most preferred among mothers and caregivers in Kisumu city. Increasing awareness on disposable diapers and growing literacy levels in the country will see a continued increase in the use of disposable diapers due to the convenience they provide to mothers and the perceived comfort they offer to the babies. The increase in usage of diapers and their improper disposal poses a public health risk especially through contamination of water sources, it is possible that current common outbreaks of diarrheal disease could be as a result from the common practice of disposing diapers improperly

Maternal literacy, household income and father's presence at a household are key socio-economic determinants for use of disposable diapers in Kisumu city. Maternal literacy is key to exposing mothers and caregivers to

knowledge on trends in baby care. Household income is a key determinant but more less wealthy households seem to also prefer disposable diapers but spend less on them.

Parental literacy levels, household income and having a father in a household are key socio-economic determinants of disposal of disposable diapers. Literacy levels play a key role in awareness level of the risks posed by poor disposal of diapers. Income provides the means to support a household or individuals to actualize their awareness and intention into practice. Awareness on risks posed by poor disposal of diapers in Kisumu city is high.

A majority of people in Kisumu city understand that poorly disposed diapers has an impact on the environment and on public health. However, this knowledge has not translated into practice of proper disposal of diapers. Most of the disposable diapers are improperly disposed.

A majority end up in the environment as a way of indiscriminate disposal or throwing into rubbish pits. A good proportion is collected from households and end up in the environment at landfills or dropped on their way route to landfills. People who dispose off trash at home and those with latrines within their homesteads in Kisumu city have better diaper disposal practices than those who use water closets that empty in the City's sewers and those who use garbage collectors to dispose their wastes.

Acknowledgements

The researchers expresses their deepest appreciation to the faculty of Amref International University, for their invaluable patience, feedback, knowledge, and expertise they provided during the whole process of this work. Our appreciation goes to our research team members; Derick Omondi, Doris Olela, Patrick Maloba, Jay Ochieng, and Pauline Muthoni whose immense contribution made data collection an existing experience.

Lastly, the researchers appreciate the support from Eshitemi's family led by his wife Joyce Favour Eshitemi; son, Samuel Eshitemi Junior; and Daughter, Ella Elsie Eshitemi for providing all the funds and emotional support towards this work.

References

- [1]. Mahfuza I, Ercumen Ayse, Ashraf Sania, Rahman Mahbubur, K. SA, Luby SP, et al. Unsafe disposal of feces of children <3 years among households with latrine access in rural Bangladesh: Association with household characteristics, fly presence and child diarrhea. Dearden KA, editor. PLOS ONE [Internet]. 2018 Apr 5 [cited 2022 Jun 7];13(4):e0195218. Available from: <https://dx.plos.org/10.1371/journal.pone.0195218>
- [2]. Ellis A, McClintic EE, Awino EO, Caruso BA, Arriola KRJ, Ventura SG, et al. Practices and Perspectives on Latrine Use, Child Feces Disposal, and Clean Play Environments in Western Kenya. Am J Trop Med Hyg [Internet]. 2020 May 6 [cited 2022 Oct 19];102(5):1094–103. Available from: <https://ajtmh.org/doi/10.4269/ajtmh.19-0389>
- [3]. Edem EN, Mfon E Ntekepe, Mbong EO, Hussain S. Disposable Diapers: Impact of Disposal Methods

- on Public Health and the Environment. *Am J Med Public Health* [Internet]. 2020 Nov 30 [cited 2021 May 26];1(2):1009. Available from: https://www.researchgate.net/publication/346641495_Disposable_Diapers_Impact_of_Disposal_Methods_on_Public_Health_and_the_Environment
- [4]. Shiru. Diaper Disposal-Can we do better? [Internet]. Wowmom Kenya. 2022 [cited 2022 Jun 28]. Available from: <https://wowmom.co.ke/diaper-disposal-can-we-do-better/>
- [5]. Mutowo J, Mzengi J. Practices Regarding Disposal of Soiled Diapers among Women of Child Bearing Age in Poor Resource Urban Setting. *IOSR-J Nurs Health Sci* [Internet]. 2015 [cited 2020 Dec 17];4(4):63–7. Available from: <https://www.iosrjournals.org/iosr-jnhs/papers/vol4-issue4/Version-3/I04436367.pdf>
- [6]. Muia VK. DISPOSAL METHODS OF SOILED DIAPERS IN LOW-INCOME HOUSEHOLDS OF NAIROBI COUNTY IN KENYA. *IJRDO-J Appl Sci*. 2018 Jul 31;4(7):11–20.
- [7]. Ali N, Taib MR, Soon NP, Hassan O. Issues and management for used disposable diapers in solid waste in the city of Kuala Lumpur. *Perintis EJournal* [Internet]. 2017 [cited 2021 Jun 30];7(1):43–58. Available from: https://perintis.org.my/ejournal/wp-content/uploads/2018/11/paper_4__2017_vol._7_no._1_pp._43-58_.pdf
- [8]. Kimani WE, Joseph Muchiri, Dr Stanley Makindi. Soiled Diapers Disposal Practices among Caregivers in Poor and Middle Income Urban Settings. *Int J Sci Res Publ* [Internet]. 2015 Oct [cited 2021 May 30];5(10):1015. Available from: <https://www.ijsrp.org/research-paper-1015.php?rp=P464648>
- [9]. Sibanda LK, Obange N, Awuor FO. Challenges of Solid Waste Management in Kisumu, Kenya. *Urban Forum* [Internet]. 2017 Dec 1;28(4):387–402. Available from: <https://doi.org/10.1007/s12132-017-9316-1>
- [10]. Maluni JK. Disposal of Disposable Child Diapers by Caregivers and Their Environmental Health Implications in Kenya: A Review. *J Res Innov Implic Educ* [Internet]. 2020 Nov 2 [cited 2021 May 30];4(1):22–8. Available from: https://www.researchgate.net/publication/359355371_Disposal_of_Disposable_Child_Diapers_by_Caregivers_and_Their_Environmental_Health_Implications_in_Kenya_A_Review
- [11]. Matete F. Disposal of diapers becoming headache for households in informal settlements. *The Star Newspaper* [Internet]. 2022 Feb 7 [cited 2022 Apr 26]; Available from: <https://www.the-star.co.ke/counties/nyanza/2022-02-07-disposal-of-diapers-becoming-headache-for-households-in-informal-settlements/>
- [12]. Sahiledengle B. Unsafe child feces disposal status in Ethiopia: what factors matter? Analysis of pooled data from four demographic and health surveys. *BMC Public Health* [Internet]. 2020 Dec [cited 2022 Jun 7];20(1):800. Available from: <https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-08945-6>
- [13]. Bawankule R, Singh A, Kumar K, Pedgaonkar S. Disposal of children’s stools and its association with childhood diarrhea in India. *BMC Public Health* [Internet]. 2017 Dec [cited 2022 Jun 7];17(1):12.
- [14]. County Government Of Kisumu. *Kisumu-County-Urban-Institutional-Development-Strategy-CUIDS-2018-2019-final.pdf* [Internet]. County Government of Kisumu; 2018 [cited 2022 Oct 2]. Available from: [https://www.kisumu.go.ke/wp-content/uploads/2019/08/Kisumu-County-Urban-Institutional-](https://www.kisumu.go.ke/wp-content/uploads/2019/08/Kisumu-County-Urban-Institutional-Development-Strategy-CUIDS-2018-2019-final.pdf)

Development-Strategy-CUIDS-2018-2019-final.pdf

- [15]. KHIS. Population estimates-Kenya Health Information System [Internet]. 2022 [cited 2022 Feb 23]. Available from: <https://hiskenya.org/dhis-web-reports/index.html>
- [16]. Nyamayedenga V Kufa, Tsvere M. Real Time Data Capture: A Response to Unsustainable Dumping of Disposable Diapers and Sanitary Pads in Gweru City, Zimbabwe. *EAST Afr J Educ Soc Sci* [Internet]. 2020 Sep 30 [cited 2022 Jun 7];1(2):54–64. Available from: <https://ejess.ac.tz/2020/07/16/real-time-data-capture-a-response-to-unsustainable-dumping-of-disposable-diapers-and-sanitary-pads-in-gweru-city-zimbabwe/>
- [17]. Grace Eke, Opara PI. Mothers Knowledge and Home Management of Nappy Rash in Port Harcourt, Nigeria. *AJOL- Niger Health J* [Internet]. 2016 Mar 14 [cited 2021 Aug 26];13(4):152–7. Available from: <https://www.ajol.info/index.php/nhj/article/view/131957>
- [18]. Agestika L, Sintawardani N, Hamidah U, Nyambe S, Yamauchi T. Pattern of child faeces management and disposable diaper usage among under-fives in an Urban Slum of Bandung, Indonesia. *J Water Sanit Hyg Dev* [Internet]. 2022 Jan 1 [cited 2022 Jun 2];12(1):32–40. Available from: <https://iwaponline.com/washdev/article/12/1/32/84883/Pattern-of-child-faeces-management-and-disposable>
- [19]. Thaman LA, Eichenfield LF. Diapering Habits: A Global Perspective. *Pediatr Dermatol* [Internet]. 2014 Nov [cited 2022 Jun 7];31:15–8. Available from: <https://onlinelibrary.wiley.com/doi/10.1111/pde.12468>
- [20]. Adzawla W, Tahidu A, Mustapha S, Azumah SB. Do socioeconomic factors influence households' solid waste disposal systems? Evidence from Ghana. *Waste Manag Res J Sustain Circ Econ* [Internet]. 2019 Jan [cited 2022 Feb 18];37(1_suppl):51–7. Available from: <http://journals.sagepub.com/doi/10.1177/0734242X18817717>
- [21]. Manun'Ebo MF, Ndombe DM. Household waste storage and waste disposal: factors associated to safe practices in Ndanu Locality in Kinshasa, Democratic Republic of the Congo. *Int J Eng Sci* [Internet]. 2020 [cited 2022 May 2];9(9):07–12. Available from: <https://www.theijes.com/papers/vol9-issue9/B0909010712.pdf>
- [22]. Handayani D, Gitaharie BY, Yussac RN, Rahmani RS. How does household characteristics influence their waste management? Herdiansyah H, editor. *E3S Web Conf* [Internet]. 2018 [cited 2023 Feb 17];74:06005. Available from: <https://www.e3s-conferences.org/10.1051/e3sconf/20187406005>
- [23]. Manun'Ebo MF, Ndombe DM. Household waste storage and waste disposal: factors associated to safe practices in Ndanu Locality in Kinshasa, Democratic Republic of the Congo. *Saje J Waste Manag Res*. 2019;37(1):51–7.
- [24]. Nkoka O. Correlates of appropriate disposal of children's stools in Malawi: a multilevel analysis. *BMC Public Health* [Internet]. 2020 Dec [cited 2022 Jun 7];20(1):604. Available from: <https://bmcpubhealth.biomedcentral.com/articles/10.1186/s12889-020-08725-2>
- [25]. Kazibwe R. Assessment of the knowledge, attitudes and practices of caretakers on disposal of used baby diaper in Urban slums of Kyengera Town Council, Wakiso District, Uganda [Internet] [Masters]. [Kampala, Uganda]: Makere University; 2022 [cited 2022 Nov 27]. Available from: <http://dissertations.mak.ac.ug/handle/20.500.12281/11502?show=full>

- [26]. Leaska M. Solid Waste Management of Disposable Diaper Sanitation and the Connection to Environmental Awareness for Women in Zanzibar. 2016; Available from: https://digitalcollections.sit.edu/isp_collection/2441/?utm_source=digitalcollections.sit.edu%2Fisp_collection%2F2441&utm_medium=PDF&utm_campaign=PDFCoverPages
- [27]. Mangizvo RemigiosV. The environmental health implications of the use and disposal of disposable child diapers in Senga/Nehosho suburb in Gweru City, Zimbabwe. *Glob J Biol Agric Health Sci* [Internet]. 2014;3:122–7. Available from: <https://www.walshmedicalmedia.com/abstract/the-environmental-health-implications-of-the-use-and-disposal-of-disposable-child-diapers-in-senganehosho-suburb-in-gwe-2118.html>
- [28]. Bain R, Luyendijk R. Are burial or disposal with garbage safe forms of child faeces disposal? An expert consultation. *Waterlines* [Internet]. 2015 Jul [cited 2023 Mar 26];34(3):241–54. Available from: <https://www.developmentbookshelf.com/doi/10.3362/1756-3488.2015.023>
- [29]. Poinsett P Mimi. How to Properly Dispose of Dirty Diapers [Internet]. *Mom Loves Best*. 2023 [cited 2023 Mar 25]. Available from: <https://momlovesbest.com/diapering/diapers/how-to-dispose>