



Disposal of Disposable Child Diapers by Caregivers and Their Environmental Health Implications in Kenya: A Review

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Abstract: Disposal of soiled baby diapers is a major global environmental problem as they constitute a large percentage of the municipal solid waste. The disposable diapers require 500 years to fully decompose because of its durable plastics and superabsorbent polymer. Soiled disposable diapers contain untreated urine and feces which increases the threat of bacteria and viruses leaching into surface and ground water. Landfilled diapers also increase the prevalence of greenhouse gases like methane. The review objectives were to investigate the practices of diaper disposal among mothers/caregiver and determining the environmental health effects caused by improper disposal of soiled diapers. Reviews were conducted using search terms to identify available articles and journals via the PubMed, Google Scholar and Science Direct search engines. The review managed to gather information on the practices of diaper disposal and their effects to the environment. This paper therefore looked at the environmental health effects caused by used baby diapers in solid waste. It also evaluated the worldwide options of its disposal such as composting, landfilling, incinerating and recycling with energy generation and then selecting the most practical, sustainable, effective and efficient method of disposing soiled diapers. In conclusion, there are improper practices of disposing diapers among the caregivers. Improper disposal also leads to adverse environmental implications. The study recommends the awareness of mothers and caregivers be raised on proper practices of diaper disposal and their environmental implications.

Keywords: Disposable diapers, landfill, Proper disposal, environmental effects, health effects

1. Introduction

Generation of solid waste and its management strategies poses a significant effect on the society due to the growth of urbanization and industrialization.(Rahat, Sarkar, Rafie, & Hossain, 2014). Waste management is safe and advanced in the developed countries as compared to middle and low-income countries. Developing countries lack adequate means of handling and disposing off various wastes in an environmentally harmless manner.(Kimani, Muchiri, & Makindi, 2015) Disposable diapers have replaced traditional cloth diapers because caregivers have recognized the awesome advantages in increased comfort, better hygiene and ease to use.

A study conducted in Ottawa, Canada, found out that 82.3% parents used disposable diapers while only 2 % used cloth diapers. Disposable diapers were mainly used

because they were pocket friendly, convenient, better fit and had greater absorbency and thinness.(Mutowo Jesca & Junior, 2015) In Canada, diapers are not separated from other waste hence they are disposed as solid municipal waste with the majority ending up in landfills, incinerators, composting pits or anaerobic digestion. People living in regions where there is poor waste collection always end up improvising use of plastic bags for storing their waste, which include soiled diapers and then dump the waste in open spaces near their residences where they end up in the municipal solid waste stream (Ramaswamy & Sharma, 2011)

The use of disposable diapers was embraced by the current generation without considering the impact to the environment. The diaper market in areas like India, West Asia and Africa grew fast and it was expected that babies in these regions would use about 8 billion diapers in a

year by 2017 due to the increase in birth rate and increased awareness in hygiene and demand for sanitary products (African Market Potential, 2014) Disposal of waste is more developed in developed countries where waste separation is done at the source unlike developing countries like Zimbabwe which still uses mixing of waste and dumping it at the tipping sites a traditional method (Remigios, 2014). Refuse containing human waste such as disposable diapers mixed with other domestic waste is common because of the inadequate refuse disposal systems. The negligence in disposal of soiled disposable baby diapers, therefore, increases human excreta content in solid waste. This also exposes municipal employees and other waste collectors to contaminants, which can lead to serious illnesses because of handling raw faecal matter as they dispose soiled disposable diapers. Scavengers also use bare hands to salvage materials and food disposed of at the landfills(R. V. Mangizvo & Mupindu, 2012)

There is inadequate supply of waste containers in developing countries hence the probability of dumping waste in open areas and roadsides is very high. Additionally, in developing countries insufficient financial resources also hamper the safe disposal of waste in well-equipped and engineered landfills (Mudzengerere & Chigwenya, 2012) Another study conducted in Kenya indicated that women chose using disposable baby diapers because they are not affected by cloudy and rainy weather as opposed to cotton diapers (Murage, 2013). Unfortunately, the increased demand of disposable diapers has formed disposal glitches because they generate waste more than 7 times that of cloth diapers.(Mutowo Jesca & Junior, 2015) Increased use of disposable diapers is connected with various environmental health challenges. Soiled diapers end up littering public spaces leading to aesthetic nuisance or to the disposal sites and landfills (Meallem, Garb, & Cwikel, 2010)

Exposure to sodium polyacrylate dust may lead to respiratory tract and lung irritation, aggravating existing respiratory conditions. Most disposable diapers may decompose within five months, because they are products of wood or cotton, however the super absorbent gel and the plastic products in diapers them takes longer to decompose and may require at least 500 years to decompose (Ali, Taib, Soon, & Hassan, 2017)

When soiled disposable diapers are thrown together with untreated urine and feces in landfills leaching can happen causing contamination of underground water, breeding sites for parasites and spread of communicable diseases and viruses like Hepatitis B (Ahmad, Baharun, & Arshad, 2010; Mangizvo & Mupindu, 2012). Methane is a greenhouse gas from landfills and it represents 12% of total global methane emissions. Disposable diapers are responsible for 630kg of greenhouse gases (Ali et al.,

2017) Research shows disposable diapers make up 50% of household waste. They account for possibly between 1.5% and 4% of the total municipal solid waste and it is still a growing problem hence constituting to the third individual largest municipal solid waste. (Meseldzija, Poznanovic, & Frank, 2013; Yeh, Ogawa, Ogai, & Sakiyama, 2006) Most parents are not aware of the long term effects of disposable diapers to the environment. (Umachitra, 2012)

In Kenya, and in many developing countries, little literature is available concerning handling and the proper disposal of disposable diapers regardless of the substantial rise in use of diapers among women of child bearing age during the last decade. Proper disposal of diapers reduces incidences of drainage water contamination, which can cause diarrheal diseases. Inorganics from diapers lead to potential environmental impacts such as non-renewable energy, global warming, and respiratory effects (Kimani et al., 2015). There is very little literature on disposable diapers practices and on how soiled diapers should be disposed. Therefore, the purpose of this paper is to determine current practices regarding soiled diaper disposal among caregivers and their effects to the environment.

The purpose of this paper was twofold: first to review on the practices of diaper disposal among caregivers, secondly to determine the existing environmental health implications of diaper disposal.

2. Literature Review

Solid waste problem has reached distressing proportions in developing countries and the amount of waste generated daily is overwhelming to the municipal authorities. In most cultures domestic chores which generate the waste in these countries are done by women and therefore they can be critical partners in solving this crisis (Ngugi, 2017)

Among the developing countries in Asia, issues of waste recycling are still backward as there is less awareness on waste recycling and also ineffective policies. Some Asian developing countries, municipal solid wastes contain approximately 50% organic matters, 30% recyclable materials hence a total of 80% (Khajuria, Yamamoto, & Morioka, 2008). In comparison with industrialized nations, wastes are potentially composed of high moisture contents because of their origins in organic materials. The waste generation rate in developing countries is lower than industrialized countries because of the widespread recovery and reuse of materials before and during collection and also the lower level of prosperity and consumption(Alam & Siwar, 2015)

2.1 Practices of diaper disposal by mothers and caregivers

The environmental effects cannot be denied though the percentage of diapers in solid waste may be very little. Disposable diapers consist of organic compound. Some US states and some countries have started the effort to keep the disposable diapers away from landfill because of the perceived impact on the landfill space. Together with that, little work has been done in the past due to lack of cost-effective and widely acceptable recyclable methods. An online survey was conducted on the lack of awareness concerning diaper disposal use. A number of assessment methods were used in this study to determine the best possible method of disposal of diapers. (Fodzi, 2019; Rahat et al., 2014)

In the US, approximately 27.4 billion disposable diapers are used every year leading to more than 3.4 million tons of soiled diaper waste each year (Bender & She, 2017). In Korea it is estimated that 240,000 tons of used diapers are generated yearly leading to increased methane production and leaching of organic compound into the soil and ground water (Kim & Kim, 2018). In Europe, an estimate of about eight million disposable diaper use every day because 95% of families prefer disposable baby diapers, this accounts for about 3% of total household waste generated on a daily basis (Thaman & Eichenfield, 2014). In Mexico where the population of babies under the age of 2 years is beyond 5 million, more than 32 million diapers are discarded on a daily basis and this accounts for 6.5% of the urban waste that is sent to landfills each day (Espinosa-Valdemar et al., 2014). In Dhaka city, diapers are collected together with household waste then it is disposed in the landfill or incinerated. Landfilling of such biodegradable contents is risky because of methane emission, leachate percolation is possible in the groundwater and land occupation (Fodzi, 2019). In Zimbabwe, noxious waste like diapers are scattered at the riverbanks of the Mukuvisi River in Harare (Remigios, 2014). Disposable diapers are not easily biodegradable, hence after their disposal into the environment they pollute the environment for longer period because they take between 400 and 1000 years to decompose (Amarnath, 2011). According to the US Environmental agency, approximately 20 billion disposable diapers end up in landfills throughout the country yearly, leading to about 3.5 million tons of waste (EPA, 2016). In developing countries, most households dispose diapers with household waste or in landfills or incinerate them. The custom requires diaper to be cleaned and the soils drained down the toilet, however, untreated feces and urine are thrown away when soiled diapers are disposed (Meseldzija et al., 2013).

2.2 Environmental implications of disposable diapers

Disposable diapers have a large carbon footprint. According to the Environmental Agency, disposable diapers are responsible of 630 kg of greenhouse gas an average emission of a car driven 1800 miles. The most common effect of disposable diapers on environment piling up garbage daily (Meseldzija et al., 2013). A greater percentage of these disposable diapers end up in landfills. The lifetime of landfill is shortened because of landfilling of disposable diapers for they are huge in volume. They also possess health and environmental hazards. Disposable diapers take a long time to decompose. Viruses and microbes which are of public health concern when leached out from the landfill into the soil and ground water may be contained in soiled diapers. (Ali et al., 2017)

Diapers are also discarded together with the untreated feces and urine, a forbidden practice by the World Health Organization (WHO). The human feces can cause contamination and spread communicable disease when dumped in the landfills through leaching. Most disposable diapers can decompose within five months because they are made of cotton or wood product, but the plastic and superabsorbent gel require at least 500 years to decompose (Mutowo Jesca & Junior, 2015). Dumping of soiled diapers at illegal open dump sites exposes communities to diarrheal diseases and obnoxious odors as opposed to the use of cloth diapers (R. Mangizvo, 2014). The production of disposable diapers is more noxious and has a higher degree of air pollution because chemicals such as sodium polyacrylate, chlorine, dioxin TBT are also released in the air (Meseldzija et al., 2013). Soiled diapers end up in landfills where during decomposition methane a greenhouse gas is released which replaces oxygen it significantly contributes to the global warming. When they are burned or incinerated, they emit dioxins and furans into the air and produce other toxic air emissions and toxic ash leading to air pollution. Disposable diapers stay a long time in landfills because they contain plastic and super-absorbance gel and when exposed to air and sunlight they take hundreds of years for them to decompose. (Meseldzija et al., 2013; Remigios, 2014).

According to a study in Mberengwa district, Zimbabwe, soiled diapers are disposed in open places mostly in bushes and on road sides while 25% burn the used diapers (Tembo & Chazireni, 2017). Another study conducted in rural Orissa, India, revealed that most child feces (67.5% and 58.1%) of pre-ambulatory and ambulatory children respectively, were deposited with other household waste (Majorin et al., 2014). In Kenya, a study conducted in Nakuru County, established that 73.6% of caregivers dispose of soiled diapers with other household garbage while 18.9% dispose of in pit latrines with 0.7% disposing of in compost pits. Poor disposal of soiled diapers, which contain urine and faecal matter,

pose threat to human health and the environment through pollution of valuable resources like air, water and soil (Kimani et al., 2015). Another study conducted in Nairobi county sought to establish the methods used by caregivers to dispose of soiled diapers. The study found out that majority (35.63%) disposed soiled diapers together with household waste, 16.09% of the respondents disposed their soiled diapers in compost pits, 10.34% burned used diapers and 8.05% dumped diapers on open fields. The caregivers who were using the recyclable cloth diapers were 13.79% and they reported to be recycling the soiled diapers (Muia, 2018).

Baby diapers have a likelihood of containing infectious material because of fecal matter and urine. Hazardous waste is a category of waste that has immediate or long-term health effects like skin rashes, asthma, allergic reactions, cancer and other long-term diseases. Human feces contain viruses that can pose health problems in the long term. Mostly diapers are disposed together with other household garbage, some in compost pits while litter the estates' streets posing pollution and may cause infection to those who come into contact with them (Kimani et al., 2015).

Non-renewable energy, global warming, and respiratory effects from inorganics are the most relevant of the potential environmental impacts for the diapers (Mutowo Jesca & Junior, 2015). While incineration has the ability to destroy the hazardous components of waste and also of reducing the waste volume into only ash, however, the air impurities produced from burning the waste causes environmental pollution (Ahmad et al., 2010)

The most hazardous toxins produced during incomplete combustion are Dioxin and furan. Greenhouse gases like chlorine and carbon monoxide are also produced during incineration of diapers (Colón, Ruggieri, Sánchez, González, & Puig, 2011; Mutowo Jesca & Junior, 2015). Open burning of garbage at waste disposal sites causes a very great health risk from inhalation of smoke and odor. Toxins may be leached from remaining ash, which could lead to the contamination of surface water or groundwater and others inhaled leading to respiratory diseases. The non-collection of refuse has encouraged people to bury waste such as diapers in the ground. However this has devastating effects on water supplies because through sewage, waste eventually mixes with underground water and increases the probability of contaminating the source of drinking water by pathogens such as bacteria and viruses (Maponga et al., 2013; Murage, 2013). Results from Kenya, indicated that some residents flushed used disposable diapers leading to sewer blockage (Murage, G. (2013).

Soiled baby diapers with baby's feces disposed in landfills each year are potential health hazards due to the

spread of communicable disease found in human feces. These viruses found in feces may multiply in moist and warm environment of the landfill. Hepatitis B and polio viruses from vaccines given to newborns can spread in the landfill to the scavengers (Meseldzija et al., 2013). Surrounding communities also are at a serious health risk of contracting various diseases. The risk of disease transmission increases when rodents, flies, insects and birds that are attracted to landfill as they also pick-up the virus and spread it (Ali et al., 2017).

3. Methodology

A qualitative research methodology using a desktop-based documentary reviews was conducted. This was accomplished through the following reviews: Conducting a scoping review on the practices of diaper disposal among caregivers. Conducting a review on the level of awareness of the environmental health implications of diaper disposal. A scoping review was conducted from journals and articles between 2009 – 2019 for the global, regional and local literature on the practices of disposing disposable diapers and their environmental health implications. Reviews were conducted using search terms to identify available articles and journals via the PubMed, Google Scholar and Science Direct search engines. The analysis of documents was conducted in stages, with incremental deepening of the analysis. Descriptive account of the identity and basic characteristics of each document was captured. The variables that were captured included: title, year of publication, country, level at which document was produced (global, regional, local).

The Documents at each level of the system were analyzed separately, so at the end of the analysis there was a synthesis of Global, Regional, local articles. Information was extracted from the accessed articles depending on the key terms from the topic.

4. Results and Discussion

Proper disposal of soiled diapers can reduce the incidences drainage water contamination, which can cause diarrheal diseases. Respiratory effects, global warming and non-renewable energy from inorganics are the most rampant environmental impacts of diapers (Kimani et al., 2015). A recycling process has been embraced by Cuban mothers where, they unfold the used diapers, remove the padding, and wash the diaper and dry it. Once it has dried, they fold pieces of cloth and stuff them into the pocket where the padding was. If the adhesive has worn off, they use two safety pins to keep the diaper on the baby. This can be used by caretakers to give diapers another life (Times, 2013)

Alethia Vázquez-Morillasa scientist found a way to turn the 500 year span estimated time taken for a diaper to decompose to four months through the use of oyster mushrooms to accelerate the breakdown (Cowan, 2011). Natra Care Company, for example, has reduced the environmental impact of sanitary pads and liners made from biodegradable, totally chlorine free cellulose and bio plastics that are compostable under the correct conditions and are safe for septic tanks. Versus Energy and Knowaste, United Kingdom based companies partnered to make a diaper recycling plan that converts the organic materials into energy. The bulk of the remaining materials are separated to eventually make various products. It is also possible to use the modern cloth diaper which is a custom-made baby pant which protects the child from experiencing leakage in case they soil themselves. The diaper which is made from natural fibres, man-made materials or a combination of these two is reusable (Kimani et al., 2015). In Malaysia, Waste-to-energy (WtE) strategy has been used to curb the menace of diaper disposal where facilities that prevent air pollution using modern air pollution control (APC) systems to filter and scrub the pollutants before releasing into the air have been put in place (Ali et al., 2017).

There are significant environmental and health hazards posed by dumping disposable diapers in landfills, thus, landfill is not a desirable waste treatment option. Recycling and composting disposable diapers are also not economically sustainable because it requires steady supply of feedstock, source-separate collection, high operating cost and market for its end products. Composting disposable diapers generates plastics which still end up in landfills or incinerator (Ali et al., 2017) In Kenya, recycling is done on plastics, paper and glass. Due to lack of policies and guidelines on good waste recovery, recycling and reuse, it is sold to private firms who buy at exploitative prices. There is need to consider the 4 Rs of waste management on how the product's consumption can be Reduced, Repaired, Reused and

Recycled. Solid waste recycling addresses both pollution and resource depletion problems as it uses resources that had already been extracted. (Kimani et al., 2015). In Kenya, as it is in most African countries, the use of disposable diapers is rising. However, handling and disposal of soiled diapers is an significant challenge in the country with most caregivers unaware of the environmental and health risks associated with improper management of this waste and also the safe methods of disposing soiled diapers. (Muia, 2018) It is therefore important to determine the current practices of diaper disposal and determine some of the best practices that can be embraced to reduce the environmental health effects posed by the improper disposal of baby diapers.

5. Conclusion and Recommendations

This review recommends notices that, disposal of diapers in landfill has several environmental and health effects. However, due to lack of a better disposal method, diapers end up in landfills together with other household waste. Scavengers are at a risk of contracting communicable diseases and also spreading viruses contained in baby fecal matter as they sort the waste for sale. Caregivers and mothers lack the knowledge of proper disposal of soiled baby diapers and its environmental effect after improper disposal.

Mothers and caregivers should be educated on the proper ways of disposing diapers and the environmental effects caused by improper disposal. Policy makers should set up clear guidelines on the proper disposal of baby diapers with emphasis on segregation from other household and other municipal waste.

A study should be conducted among the key stakeholders in solid waste management to determine the factors hindering proper disposal of baby diapers and the mitigation measures in place.

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