

Environmental and Health Impacts of Household Solid Waste Handling and Disposal Practices in Third World Cities: The Case of the Accra Metropolitan Area, Ghana

Kwasi Owusu Boadi, M.S., Ph.D.
Markku Kuitunen, Ph.D.

Abstract

Inadequate provision of solid waste management facilities in Third World cities results in indiscriminate disposal and unsanitary environments, which threatens the health of urban residents. The study reported here examined household-level waste management and disposal practices in the Accra Metropolitan Area, Ghana. The residents of Accra currently generate large amounts of solid waste, beyond the management capabilities of the existing waste management system. Because the solid waste infrastructure is inadequate, over 80 percent of the population do not have home collection services. Only 13.5 percent of respondents are served with door-to-door collection of solid waste, while the rest dispose of their waste at communal collection points, in open spaces, and in waterways. The majority of households store their waste in open containers and plastic bags in the home. Waste storage in the home is associated with the presence of houseflies in the kitchen ($r = .17, p < .0001$). The presence of houseflies in the kitchen during cooking is correlated with the incidence of childhood diarrhea ($r = .36, p < .0001$). Inadequate solid waste facilities result in indiscriminate burning and burying of solid waste. There is an association between waste burning and the incidence of respiratory health symptoms among adults ($r = .25, p < .0001$) and children ($r = .22, p < .05$). Poor handling and disposal of waste are major causes of environmental pollution, which creates breeding grounds for pathogenic organisms, and the spread of infectious diseases. Improving access to solid waste collection facilities and services will help achieve sound environmental health in Accra.

a lack of resources, both human and capital, waste management and sanitation in many Third World cities, particularly in Africa, are in very deplorable condition. Between 20 and 80 percent of solid waste in African cities is disposed of by dumping in open spaces, water bodies, and surface drains as a result of inadequate infrastructure (United Nations Environment Programme, 1999). Indiscriminate disposal of organic waste is detrimental to health because it creates unsanitary environments that have adverse impacts for urban residents. Where sanitary facilities are scarce, household solid wastes also tend to be mixed with fecal matter, further compounding the health hazards (Kjellen, 2001).

The residents of Accra generate in total an estimated 1,500 to 1,800 tons of solid waste per day (Senior Environmental Health Technologist of the Accra Waste Department, personal communication). The existing solid waste management system is capable of collecting only 65 percent of the waste generated daily, leaving the remaining 35 percent to gradually accumulate into waste mountains, which have become common sights in parts of the city. Home collection of solid waste is limited to households of high and medium wealth, while the poor dispose of their waste at communal collection containers, into surface drains, in open spaces, and in water bodies. Some residents

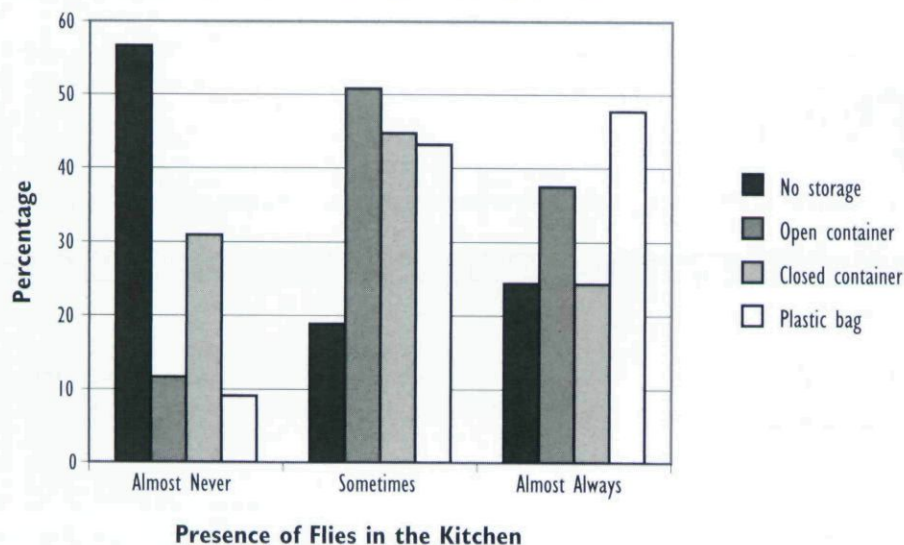
Introduction

The rapid growth of cities in the developing world in recent decades has resulted in increased consumption of resources to meet

the growing demands of urban populations and industry, and this situation leads to the generation of large amounts of waste in cities. Because of weak institutional capacities and

TABLE 1**Household Solid Waste Storage Practices in the Accra Metropolitan Area, Ghana**

Waste storage	Number of Households (n)	Percentage
Do not store	217	22.6%
Open container	370	38.5%
Closed container	279	29.1%
Plastic bag	94	9.8%
Total	960	100%

FIGURE 1**Relationship Between Solid Waste Storage Practices and the Presence of Houseflies in the Kitchen During Food Preparation**

burn their solid waste, while others indiscriminately bury it. Indiscriminate disposal, burning, and burying of solid waste pose major environmental and health threats through pollution and through the breeding of pathogenic organisms. Infectious diseases of poor sanitation and poverty are the most common diseases affecting the residents of Accra. Like most other Ghanaian cities, Accra falls into the category of developing-world cities that Briscoe (1993) described as already facing the problems of improper waste disposal, contamination of water and streams, and many service management deficiencies.

Materials and Methods

The study involved interviews with 960 female heads of household selected from Ac-

cra. The survey was undertaken between June and August 2003. Interviews were conducted in two local dialects, Ga and Twi. The simple random method was employed for the population sampling. The greatest advantage of this method is that each member of the population is chosen completely at random in the study area, with no subjective influence or bias on the part of the field personnel. Residential communities were randomly selected by lottery. Within each selected community, households were randomly selected for interview. A household was defined as individuals who occupy the same living space and normally share food and amenities. The target population was female household heads since women are responsible for upkeep and general household environmental management. All re-

spondents older than 20 years of age were included in the study. A detailed structured questionnaire was used to collect information on household solid waste storage and disposal practices, waste burning, and waste burying. Information was also collected on pest infestation, the incidence of respiratory health symptoms, and the incidence of diarrhea among the 489 children under six years of age who were covered by the study. Diarrhea was defined as the passing of three or more loose, watery, or bloody stools within a 24-hour period (Martines, Phillips, & Feachem, 1993). The passing of bloody stools was further defined as dysentery, an acute form of diarrhea. The definition of respiratory health symptoms included sore throat, dry cough, and wet cough (Songsore et al., 1998). Health data are based on respondents' self-reporting of ill health, according to a two-week recall.

Since the interviewees were only women, all the interviewers were female students selected from the University of Ghana, Legon, in order to enhance cooperation and willingness to provide information. All the data collectors had had at least one experience in conducting interview surveys. For the purpose of this study, a two-day theoretical as well as practical training was conducted for the data collectors. The time taken to administer each questionnaire was between 25 and 30 minutes. Respondents were generally very cooperative in providing information. Questionnaires were checked for completeness and accuracy by the principal investigator before entry. Data were entered in an Excel spreadsheet and imported to SPSS 11.0 for Windows. The association between dependent and independent variables was measured with the Kruskal-Wallis test and Spearman's rank correlation. Multivariate analyses of variance were performed to evaluate the significance of associations obtained in the univariate analysis between variables and the incidence of respiratory infections and childhood diarrhea. Probability values of less than .05 were considered statistically significant.

Results

The majority of households store solid waste in the home, with only 22.6 percent of households storing their waste outside the home (Table 1). Household solid waste storage practices, particularly storage of waste in the home, are associated with the presence of houseflies in the kitchen during cooking ($r = .17$, $p < .0001$) (Figure 1).

The presence of flies in the kitchen is also related to the method of solid waste disposal ($r = .24, p < .0001$). More than 33.6 percent of respondents who dispose of waste at collection points, 32.4 percent of those who dispose of solid waste in empty yards, and 44.4 percent of those who dispose of waste in waterways reported that flies were always present in the kitchen. This result indicates that solid waste is usually disposed of close to the home. Households that store solid waste in the home are more likely to report the presence of flies in the toilet ($\chi^2 = 40.03, 3 \text{ df}, p < .0001$). The presence of flies in the toilet is correlated with the presence of flies in the kitchen ($r = .28, p < .0001$). The majority of respondents who reported always seeing flies in the toilet (51.0 percent, $n = 153$) also reported that flies were always present in the kitchen during food preparation. A significant association was also obtained in the multivariate analyses of variance between flies in the toilet and flies in the kitchen ($p < .0001$).

It was found that 19.2 percent ($n = 94$) of the children covered by the study had had diarrhea in the two weeks preceding the study. There was a positive correlation between the presence of houseflies in the kitchen during cooking and the incidence of childhood diarrhea ($r = .36, p < .0001$). High incidence of diarrhea is particularly associated with flies always present in the food area (Figure 2). A total of 24 (85.7 percent) of children with dysentery cases live in homes where the mothers reported that houseflies were always present in the kitchen. Fly infestation in the kitchen maintained its significant association with the incidence of diarrhea in the multivariate analyses ($p = .002$, 95 percent confidence interval [CI]). High incidence of childhood diarrhea also was found to be associated with the presence of flies in the household toilet ($r = .35, p < .0001$). In addition, the multivariate test showed a significant association between the presence of flies in the toilet and the incidence of diarrhea ($p = .006$, 95 percent CI). About 71.4 percent ($n = 20$) of dysentery cases lived in homes reporting that flies were always present in the household toilet.

Only 13.5 percent of households have door-to-door collection of solid waste, while the rest dispose of their waste at communal collection points, in open spaces, or in waterways (Table 2). Indiscriminate disposal of waste is high among households

FIGURE 2

Distribution of Childhood Diarrhea According to the Presence of Houseflies in the Kitchen During Food Preparation

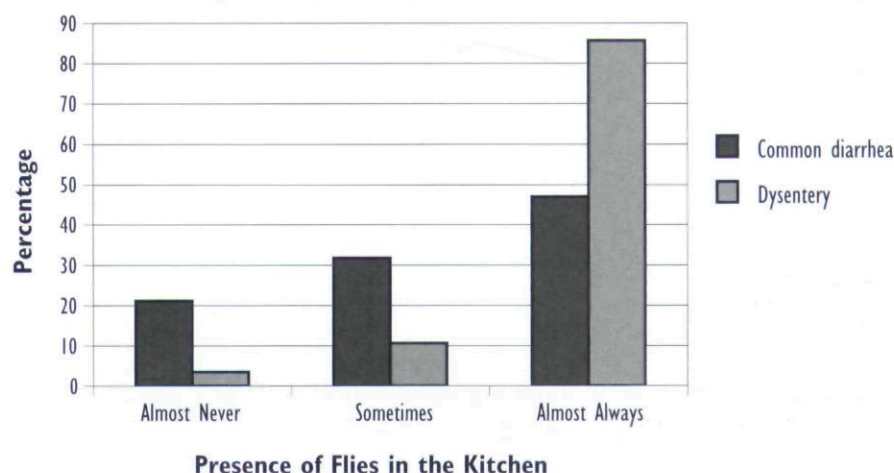


TABLE 2

Household Solid Waste Disposal Practices in the Accra Metropolitan Area, Ghana

Waste Disposal Systems	Number of Households (n)	Percentage
Home collection	130	13.5%
Collection point	663	69.1%
Empty yard	108	11.2%
Natural waterway	45	4.7%
Other	14	1.5%
Total	960	100%

that store solid waste in plastic bags ($\chi^2 = 42.07, 3 \text{ df}, p < .0001$). About 18.1 percent of respondents who store waste in plastic bags dispose of waste in empty yards, compared with only 9.7 percent of those who do not store waste and 11.8 percent of those who store waste in closed containers. Whereas 17.0 percent of those who store waste in plastic bags dispose of waste in waterways, only 3.8 percent of those who store waste in open containers and 5.4 percent of those who store waste in closed containers dispose of waste in waterways. A total of 137 respondents (14.3 percent) burn part of their solid waste, while 11.3 percent ($n = 99$) bury part of their waste. Households that practice open disposal of solid waste are also more likely to burn part of their waste ($\chi^2 = 279.12, 4 \text{ df}, p < .0001$) (Table 3). Waste burning is high among households

that store waste in plastic bags ($\chi^2 = 20.14, 3 \text{ df}, p < .0001$). About 27.7 percent of those who store waste in plastic bags burn part of their waste, compared with 14.7 percent of those who store waste in closed containers, 14.1 percent of those who store waste in open containers, and 8.3 percent of those who do not store waste. Burning solid waste is correlated with the incidence of respiratory health symptoms among both adults ($r = .25, p < .0001$) and children ($r = .22, p < .05$). In the multivariate test of variance, solid waste burning showed a significant association with the incidence of respiratory infections in adults ($p = .004$, 95 percent CI) and children ($p = .01$, 95 percent CI).

Discussion

Home storage of solid waste is a common practice among households in Accra.

TABLE 3**The Association Between Household Solid Waste Disposal Practices and Solid Waste Burning**

Waste Disposal Practice	Burn Part of Solid Waste		Total	
	Yes (%)	No (%)	(%)	(n)
Home collection	4.6	95.4	100	130
Collection point	6.3	93.7	100	663
Empty yard	59.3	40.7	100	108
Natural waterway	53.3	46.7	100	45
Other	7.1	92.9	100	14
Total	14.3	85.7	100	960

Many households store their waste in open containers ranging from baskets to plastic bags, making home storage unhygienic. Over 70 percent of household solid waste generated in Accra is organic matter (Lar-yea, 1997), which, under prevailing high tropical temperatures, decomposes rapidly and produces bad odors. Decomposing organic waste, when improperly stored in open containers for long periods, becomes detrimental to health because it increases the breeding of disease-carrying vectors like rodents and insects. The storage of organic waste in open containers also attracts houseflies to the household kitchen. Houseflies are vectors for various infectious diseases and transmit diseases through food contamination either by direct contact with food or through their droppings. The high incidence of diarrhea among children under six years of age is related to food contamination by flies. Domfeh (1999) found that infectious diseases from poor sanitation, including diarrhea, are among the most common health problems reported at outpatient facilities in Accra.

Access to disposal facilities is limited for the majority of households. Only a small proportion of households in Accra have home collection services, while the great majority dispose of their waste at communal collection containers provided by the Waste Management Department. The few waste containers that serve as collection points, however, are inefficient because of their small volume, the small numbers serving large communities, and infrequent removals of waste (Boadi & Kuitunen, 2003). The Waste Department has 528 refuse containers, but only 330 are presently on site

(Senior Environmental Health Technologist of the Accra Waste Department, personal communication). Stephens and co-authors (1994) reported that many households were more than 500 meters from central refuse containers. Households facing inadequate access to dumping facilities dump their waste in waterways and in any available open spaces that gradually become refuse mountains in parts of the city. Open spaces and empty yards in which refuse accumulates serve as breeding grounds for rats, flies, and other vectors of disease pathogens. Solid waste burning is a serious problem because of inadequate access to proper disposal facilities and services. Waste burning contributes to localized as well as citywide air pollution problems (Kjellen, 2001). Smoke from burning waste may be detrimental to the health of urban residents through the inhalation of respirable suspended particulates, including carbon monoxide, nitrogen dioxide, and sulfur dioxide. The burning of solid waste is associated with high incidence of respiratory health symptoms among households that burn their waste. A similar study of household-level environmental problems in Jakarta found a correlation between uncollected garbage and the occurrence of respiratory diseases in mothers and children, probably because households with no collection services burned their garbage (Surjadi, 1993).

Inadequate access to disposal facilities results in indiscriminate disposal in open spaces and surface drains. Almost every surface drainage channel in Accra is blocked with solid waste. Stagnant waters in blocked drains provide breeding grounds for disease vectors and pathogens, including the

anopheles mosquito, which transmits malaria. Malaria accounted for 39.7 percent of all reported diseases at outpatient facilities in 1995 and 53 percent in 1998 (Domfeh, 1999; Healthy Cities Programme, 1999), and it is the leading cause of morbidity in Accra. The resulting environmental health hazards are worsened when overflowing drains are contaminated with fecal matter. These wastewaters may carry a spectrum of endemic fecal pathogens, including helminths, protozoans, bacteria, and viruses, at concentrations that can be great enough to create the potential for human infections (Shuval, Adin, Fattal, Rawitz, & Yekutieli, 1986). Some pathogens, including *Trichuris trichiura*, *Taenia saginata*, and *Ascaris lumbricoides*, can survive at infective stages outside their host for months (Cointreau, 2000) in contaminated grounds. Children in particular are exposed to pathogenic organisms when they play on fecally contaminated grounds, increasing their risk of infection.

Household solid waste contains both hazardous and nonhazardous components, which are lumped together and disposed of in the open, or buried. Hazardous wastes pose many serious health threats, including chronic and acute toxicity, cancer, birth defects, explosion, and corrosion. Leachate from the organic matter in open dumps could easily pollute underground water and pose major environmental health threats. It has been associated with the contamination of aquifers underlying landfills (McFarlane, Cherry, Gilman, & Sudicky, 1983; Reinhard, Goodman, & Barker, 1984; Zaroni, 1972). The potential for surface-water contamination increases in the rainy season because of flooding in low-lying areas in the proximity of open dumps (United Nations Environment Programme, 1996). Also, waste may eventually get washed away by rainwater to contaminate water bodies or block drainage channels (Kjellen, 2001). Open dumps are associated with bad and unpleasant odors in Accra. Odors result from concentrations of odorous constituents of decomposing organic matter emitted into the atmosphere and have been described as an environmental nuisance (Young & Heasman, 1985; Young & Parker, 1983). Residents in close proximity to open dumping sites, usually the urban poor, are exposed to direct contamination from hand to mouth and through the inhalation of dangerous volatile compounds and aerosols (Zurbrugg, 1999).

Conclusion

The study reported here demonstrated the problems of household solid waste practices and the associated environmental and health problems. Access to safe disposal facilities is limited for the great majority of households, and this circumstance results in indiscriminate disposal practices, improper burning, and burying of solid waste. Deteriorating environmental quality is a major cause of high incidences of infectious and parasitic diseases. These problems obstruct in no small way the possibility of sustainable development. An efficient solid waste management system remains an appropriate tool for achieving sound environmental health in Accra. Improving access to safe disposal facilities, in

addition to conducting awareness campaigns on the health impacts of poor sanitation, will help alleviate the problems of improper waste disposal and eventually improve the quality of the environment in the city. Recycling mountains of waste into useful resources will create jobs for recyclers, while also improving the environment by reducing indiscriminate disposal, the amount of waste being disposed of in landfills, and the depletion of resources. Metals such as aluminium can be recovered and sold to small-scale recyclers to produce valuable items such as lamps and cooking utensils to compete with imports. Organic waste can be composted and used as fertilizer in urban farming and help reduce reliance on inorganic fertilizers. Waste recycling is usually undertaken by informal

recyclers, whom it is essential to fully integrate into the waste management stream in order to realize the benefits of their contributions to environmental management in Accra. Informal recyclers can be mobilized into cooperative organizations to pull resources together for investment, and also can be provided with training, protective clothing, and equipment to reduce accidents, infections, and deaths. The Waste Management Department must also provide the necessary incentive packages to attract private investors into the sector through competitive bidding for contracts. ■

Corresponding Author: Kwasi Owusu Boadi, P.O. Box KB 635, Korle-Bu, Accra, Ghana. E-mail: kwaboad@yahoo.com.

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