

Morbidity among children living around clinical waste treatment and disposal site in the Northwest region of Cameroon

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Abstract

Clinical waste is ineffectively treated and disposed in Cameroon. Disposal sites have unrestricted access and are located within communities. We hypothesize that vector proliferation and exposure to chronic low-level emissions will increase morbidity in children living around such sites. Self-reported disease frequency questionnaires were used to estimate the frequency of new episodes of intestinal, respiratory and skin infections among exposed children less than 10 years. Data was simultaneously collected for unexposed children of the same age, using the same questionnaire. Data reporting by the parents was done in the first week in each of the 6 months study period. The risk ratios were 3.54 (95% CI, 2.19-5.73), 3.20 (95% CI, 1.34-7.60) and 1.35 (95% CI, 0.75-2.44) for respiratory, intestinal and skin infections respectively. Their respective risk differences were 0.47 (47%), 0.18 (18%) and 0.08 (8%). The study revealed that poor treatment and disposal of clinical waste sites enhance morbidity in children living close to such areas. Simple health promotion and intervention programs such as relocating such sites can significantly reduce morbidity.

Introduction

Hospitals are today one of the major producers of solid wastes with potential environmental and public health hazards. Some of these wastes such as syringes, utility gloves and intravenous sets; made out of polyvinyl chloride (PVC)-rich plastics, are potentially contaminated with blood borne pathogens. Effective management, with efficient treatment and disposal methods, is of utmost importance to mitigate environmental contamination and curb unintended public health impacts. Management practices, including

treatment and disposal methods, in developing countries is unfortunately poor and ineffective. This is confirmed in a report from the World Health Organization (WHO) stating that the proportion of healthcare facilities in 22 developing nations that do not use appropriate waste disposal methods range from 18% to 64%.¹

Current management practices in Cameroon, according to Mochungong *et al.*,² are plagued with inefficient in-house segregation and the use of assorted containers for collection and temporal storage. According to the authors, waste transportation by waste pickers is carried out with minimal regard for safety; while treatment and disposal is done on-site in sub-standard small-scale incinerators, open surface dumps and landfills. The authors further reported that on-site treatment and disposal units are, most often, unprotected from the public, and clouds of visibly black smoke from the incinerators and other open fires, including foul smell from decomposing tissues constantly emanates from the area. Low income communities within the vicinity of such sites; especially children, can experience increase morbidity in common diseases such as respiratory, intestinal and skin infections. The emphasis is on children as they regularly play around the sites or scavenge for play-items such as intravenous sets and syringes.

The problems of poor clinical waste management in developing countries, including treatment and disposal issues, have been comprehensively addressed in scientific literature.³⁻⁵ However, the fact that potential impacts of these poor treatment and disposal sites on neighboring communities have attracted less research interest is worrisome. This is especially so because hospitals (including their poor on-site treatment and disposal facilities) are located within communities. Health problems associated with proximity to a waste disposal site have been comprehensively reviewed by Vrijheid⁶ and they were composed of specific and non-specific symptoms. The specific symptoms included irritation of the skin, eyes and nose, gastrointestinal and respiratory problems. The non-specific symptoms, on the other hand, included headaches, fatigue, allergies and psychological problems. The author identified that, due to issues related to population dynamics and susceptibility patterns, direct and more precise exposure quantification was a challenge. This could be the reason why there are so few studies linking poor treatment and disposal units for clinical waste to purported health outcomes. This study attempts to bridge that gap through the assessment of morbidity in children (<10 years) living close, and with access to a poor clinical waste treatment and disposal site in the Northwest region of Cameroon. The result from this survey is for orientation, and to

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encourage long-term extensive research and reliable data collection.

Materials and Methods

Study area and study population

The Northwest Region is the fifth largest Region in Cameroon. The capital city is Bamenda with a total urban population of about 1 million people. The region has 17 health districts, 184 integrated health centres, 22 ambulatory medical centres, 14 district and affiliated hospitals and 1 regional (referral) hospital. Both government and private establishments provide healthcare in the region. At the commissioning of this study, no rigid policy on clinical waste management existed in Cameroon.

A total of 20 children below the age of 10 took part in this case study. Children were selected because of their fragility, developing immune systems and for the fact that they often play at such sites. They were categorized in to 2 equal groups of 10 exposed and 10 unexposed children. The exposed group consisted of those children living in close proximity to a site where clinical waste is poorly treated and disposed. Sub-standard incineration and open fires, open landfills and surface dumps are all methods interchangeably and sometimes jointly used at the site. Distance to and from the disposal site was not taken into consideration as all the children had unrestricted access to the site. The unexposed group consisted of those children living in a separate neighbourhood, with an estimated 20 km from the exposed. Such a distance was deemed sufficient enough to ensure that the

children do not play together as a control for cross-contamination. This area had no hospitals or clinics and no waste dump site. Living conditions in both the exposed and unexposed groups were similar.

Study design and data collection

The conceptual model of exposure assessment adopted for this study is shown in Figure 1. Based on the model, a poor treatment and disposal site serves as an unrestricted source of emissions such as columns of black smoke and fly ash containing potential toxicants such as dioxins. These are transported through air and in dust particles. Flies and other vermin from the site potentially deposit bacteria on open food and other edible items in the homes. Respiratory and dermal contacts are probable exposure routes through breathing and playing at the site. Ingestion can be a direct or an indirect exposure route through eating unprotected food at home and hand-to-mouth contamination respectively. Assessment of internal absorbed dose and biologically effective dose and early effect in the children, represented by the broken line boxes in the figure, was out of the scope of this case study. The outcome of interest was the number of episodes of respiratory, intestinal and/ or skin infection in the children.

Data was collected through a designed self-reported disease frequency questionnaire. The questionnaire was pre-tested to ensure consistency and clarity at the Unit for Health Promotion Research, University of Southern Denmark in Esbjerg. The questionnaires were issued to parents or adult guardian of the exposed and unexposed children in the first week of the month over a period of six months, from May to September 2008. The questionnaires were collected at the end of that first week, as the parents were required to provide information only for that week.

Data analysis

A 2x2 epidemiological table in Stata 10.1 was used for the data analysis. Cases and non-cases among the exposed and unexposed children were recorded. The 20 children observed over 6 months gave 120 person-6 months study period. Risk ratios (at 95% confidence interval) are reported as well as the risk of infection and the risk difference between the groups.

Ethical issues

As the participants in the survey were children (<10 years) informed consent was obtained from their parents and/ or legal guardians. Ethical approval was also obtained from the Regional Delegation for Public Health in the Northwest region. The institutional and review committee of the regional hospital for the Northwest region also approved the study.

Results

The overall response rate for the self-reported disease frequency questionnaire was 100%. Summary statistics, risks and risk ratios for the outcomes of interest in the study population during the entire risk period are shown in Table 1.

According to the findings of this study, 39 new episodes of respiratory infection were reported in the exposed group against 11 in the unexposed group during the 6 months study period. This means that the 10 exposed children had 39 new episodes of respiratory infection between them compared to 11 for the unexposed children. The risk in the exposed group was 0.65, higher than the risk of 0.42 in both groups while the risk in the unexposed group was 0.18. The risk difference was 0.47 (47%), with a 95% CI of 0.29-0.64. The risk

ratio (RR) for respiratory infection was 3.54 (95% CI, 2.19-5.73). This means that the exposed children were three and a half times more likely to suffer a respiratory infection than the unexposed children during the risk period. The risk for respiratory infection was statistically significantly ($P=0.0001$). The values for the lower and upper confidence intervals of the risk ratio also validate respiratory infection as an identifiable risk factor.

Sixteen cases of intestinal symptoms were reported in the exposed group compared with 5 in the unexposed group. On the other hand 44 non-cases were reported in the exposed group compared with 55 in the unexposed group. The risk in the exposed group was 0.27 while the risk in the unexposed group was 0.08. The total risk between the 2 groups was 0.17, lower than the risk in the exposed group. The risk difference was 0.18 (18%), with a 95% CI of 0.05-0.32. The RR for intestinal symptoms was 3.20

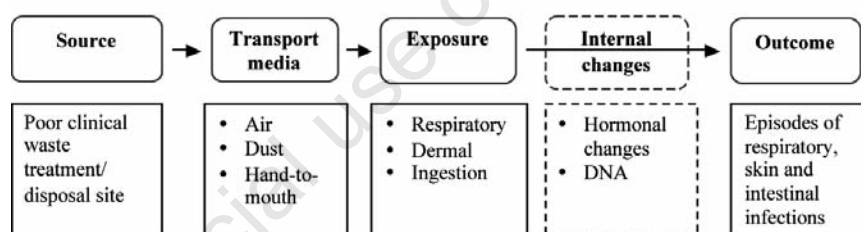


Figure 1. Conceptual model for exposure assessment.

Table 1. Summary statistics, risks and risk ratios for respiratory, intestinal and skin infection for the study population during the risk period.

Characteristics	Exposed	Unexposed	Total
N	10	10	20
Sex			
Males	6	4	10
Females	4	6	10
Respiratory infection*			
Cases	39	11	50
Non-cases	21	49	70
Risk	0.65	0.18	0.42
Point estimates			
Risk difference = 0.47 (0.29-0.64)			
Risk ratio = 3.54 (2.19-5.73)			
Intestinal infection ^o			
Cases	16	5	21
Non-cases	44	55	91
Risk	0.27	0.08	0.17
Point estimates			
Risk difference = 0.18 (0.05-0.32)			
Risk ratio = 3.20 (1.34- 7.61)			
Skin infection [#]			
Cases	19	14	33
Non-cases	41	46	87
Risk	0.32	0.23	0.27
Point estimates			
Risk difference = 0.08 (-0.08-0.24)			
Risk ratio = 1.36 (0.75-2.44)			

* χ^2 (1) = 26.88, $Pr > \chi^2$ = 0.0001; ^o χ^2 (1) = 6.98, $Pr > \chi^2$ = 0.008; [#] χ^2 (1) = 1.04, $Pr > \chi^2$ = 0.306.

(95% CI, 1.34-7.60), indicating that exposed children were 3-times more likely to suffer from intestinal infections, when compared with the unexposed children during the risk period. The values of the lower and upper 95% CI also validate the result. The result is also statistically significant ($P=0.008$).

The reported total number of skin infection was 19 for the exposed and 14 for the unexposed, giving a total of 33 cases in both groups. Non-cases for skin infection were 41 in the exposed group and 46 in the unexposed group, amounting to a total of 87 in both groups. The risk for skin infection in the exposed group was 0.32, higher than the risk of 0.23 in the unexposed group. The total risk in both groups was 0.27, while the risk difference was 0.08 (8%) (95% CI, 0.08-0.24). The RR was 1.35 (95% CI, 0.75-2.44), meaning that the likelihood for skin infection was slightly higher in the exposed compared with the unexposed children. The P value of 0.306 shows that the result is statistically insignificant, while the values for the lower and upper confidence intervals of the RR indicate that skin infection was less common among the exposed and unexposed children. A reason associated with this finding is that, children can easily cover-up skin infections thus making it difficult for the parents to notice and report.

Discussion

The results for the respiratory infection could be associated with the heavy pollution from the incinerator and rampant open fires in the area. The constant pungent smell could also be a contributing factor. All the factors together can seriously bring respiratory challenges to the young children, who might just be at home, or playing/scavenging around or on the site. Regular hospital visits due to the frequent respiratory symptoms can exert considerable pressure on meager economic resources available to such families. Increased episodes of respiratory infection have been reported in neighborhoods close to municipal waste dumpsites but not clinical waste dump sites. For example, Heller and Catapreta⁷ reported a less evidenced relationship between respiratory diseases in a nearby community bordering a solid waste disposal site in Belo Horizonte, Brazil. The authors observed that the site contained treatment and disposal facilities with design and operational problems and deposits of waste which can end up providing a likely location for proliferation of diverse vectors and favoring uncontrolled emission which may affect health for both the people at work and those living nearby. This observation corresponds with the existing situation at the

clinical waste treatment and disposal location in the Northwest region of Cameroon. Other studies have associated exposure to a waste dump site and several hazardous waste disposal sites with larger probability of respiratory symptoms in children, as well as irregular heartbeat, history of heart problems, cases of anemia and other blood disorders in people neighboring such sites when compared with a control.^{8,9}

Intestinal parasitic infections are globally known to be endemic and have been described as constituting the greatest single worldwide cause of illness and disease.¹⁰ People of all ages are known to suffer from intestinal infections but children are known to have the worst morbidity and mortality.^{11,12} The fact that children most often, have their hands in or around their mouth can significantly increase their risk of infection through feco-oral transmission and contamination while their developing immune systems can increase their risk of morbidity. A study of primary school children in Cameroon aged 9-16 revealed that infection rates with intestinal nematodes were as high as 98% in some rural areas.¹³ In a more recent study, Fogwe and Ndifor¹⁴ investigated intestinal nematodes in urban dwellers in the city of Douala, Cameroon and found that children (aged 5 to 9 years) were most affected (88.9%) as opposed to adults. Explanations to the aforementioned findings may be two-tiered; firstly, the children were exposed to poor conditions of waste treatment and disposal similar to what is reported in our study and secondly, intestinal parasitic infections may be endemic to Cameroon. Other risk factors such as latrine facility, quality of portable water and general sanitation in the home can increase incidences of intestinal infection in the children, but these were not considered in this study due to insufficient logistics. Disease vectors settle on food and other edible items in the homes and potentially deposit disease-causing microbes on them. Through eating the possibly contaminated food, with poorly washed hands, there is a double pathway of exposure and contamination, with parasites such as *Ascaris lumbricoides* and *Trichuris trichiura*. In most developing nations, intestinal parasitism is seen as an indicator for poor living conditions and personal hygiene.¹⁵ With living conditions in the homes of both the exposed and unexposed children in the study similar and adding the possibility that intestinal parasitic infections may be endemic in Cameroon, the proximity and unrestricted access of the exposed children to the poor clinical waste dump site increases their germ pool exposure, which might explain their slightly above threefold likelihood of suffering from the infection.

Despite the findings from this study

(RR=1.35 (95% CI, 0.75-2.44), skin infections and especially bacterial skin infections are a common and important cause of morbidity in communities with meager resources,¹⁶ such as those reported in this study. Paediatric populations within such communities are particularly at risk.¹⁷ In developing countries, skin infections in children account for a high proportion of ambulatory visits, for example, in Ghana they fall in the fifth most frequent diagnostic category.¹⁸ Various reasons such as proper sanitation and access to other hygienic conditions are responsible for the high proportion of skin infections. During the search for play items such as syringes and intravenous sets, the children expose parts of their body to insect bites and different types of germs. For example, they are sometimes without shoes and often wear shorts and sleeveless t-shirts. Such attire increases the possibility for dermal exposure and possible contact with germs and substances (in salvaged items) that can cause various infections and allergic reactions.

Strengths and limitations of the study

This is the first study in the Northwest Region of Cameroon addressing the impact of poor clinical waste disposal sites on morbidity and child health. Clinical waste has been reported as not being more infective than residential waste, and that clinical waste disposal practices have not caused diseases in the community.¹ The results of this case study indicate that poor clinical waste treatment and disposal can enhance morbidity in communities neighbouring such sites, especially respiratory infection in children.

The small sample size of 20 children was a major limitation of this study. Even though hospitals and their on-site treatment and disposal units are located within communities, the sizes of these neighbourhood communities are often small (about 10 to 20 houses) and their demography is constantly changing. This makes it difficult to recruit a substantial sample size. Identifying several neighbourhoods to treatment and disposal units for clinical waste could be an approach to overcome this difficulty in future related studies.

The possibility for cross contamination, especially with respiratory and skin infections, is another limitation of this study. Since the children were always together, it was difficult to identify those who got infected as a result of direct exposure and those who were infected as a result of indirect exposure to the treatment and disposal unit. Some of the homes, compared to others, were closer to the disposal site and this can have a bearing on exposure in the homes. This can be controlled in future studies by linking health effects with estimated distance from homes.

Conclusions

Living in close proximity to a poor clinical treatment and waste disposal site can be a major underlying factor in poor child health, especially as it enhances respiratory, intestinal or skin infections. The high relative risk for respiratory infection can be associated with the emissions resulting from the uncontrolled and frequent burning of clinical waste in the open pits and sub-standard incinerators. The relative risk for intestinal infections is high too, and could have as explanation the possibility of the infection being endemic in Cameroon. Skin infection is relatively low, compared to the others, due to the difficulty the parents (who are not professionals) can face in identifying them. The children can, for example, hide skin infections and only report when the discomfort becomes unbearable. The commitment shown by the parents of the children towards the success of this study confirms the urgent need for better clinical waste management and efficient and secured treatment and disposal options. Simple health promotion and intervention program such as relocation of the dumpsite and improvements in community sanitation can curb morbidity and primary health care visits.

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