Paraffin (kerosene) poisoning in under-five children: A problem of developing countries*

Wananani Tshiamo RN, MSN, (PhD student)
Lecturer, Faculty of Health Sciences, Department of Nursing Science, University of Botswana, Gaborone, Botswana

Accepted for publication February 2009

Tshiamo W. *International Journal of Nursing Practice* 2009; **15**: 140–144

Paraffin (kerosene)* poisoning in under-five children: A problem of developing countries

Although developed countries have largely eliminated the problem of paraffin ingestion in young children, many developing countries have not. Paraffin, used as a home energy source, particularly in rural area, accounts for a significant percent of paediatric poisoning and can lead to serious health problems, complications and death.

This paper presents a review done by a nurse clinician concerned about the number of paediatric poisonings she saw in the hospital in one developing country, Botswana. The first stage of solving the problem is presented in which she established the extent and epidemiology of the issue. Suggestions for its solution are also discussed. It is hoped that this can serve both to increase awareness in developing countries of the dangers of paraffin poisoning and serve as a model for nurse clinicians and researchers in developing countries.

Key words: Botswana, developing country, kerosene, paraffin, poisoning.

INTRODUCTION

Importance of paraffin* poisoning

Home ingestions are a leading cause of childhood morbidity and mortality in developing countries. It has been reported from: Zimbabwe,[1] India,[2,3] Ghana,[4] Trinidad,[5] desert areas of Israel,[6] Nigeria,[7] the Caribbean[8] and Jordan.[9] Of all these countries, paraffin (Kerosene)* is the most frequent offender in young children, vulnerable because of their immature respiratory and metabolic systems as well as their exploratory nature. The uptake of ingested materials is quick and toxicity occurs by direct contact as well as through inhalation.[10,11]

Correspondence: Wananani Tshiamo, School of Nursing, University of Botswana, Private Bag UB 00702, Gaborone. Email: tshiamowb@mopipi.ub.bw

* This fuel source is called paraffin in some countries and kerosene in others.

Not only has the case fatality in South Africa been reported at the rate of 0.74%,[12] there are other problems associated with accidental paraffin poisoning including long hospital stays, heavy financial burdens and serious grief and inconvenience for families. As most accidental poisoning occurs in the rural areas, transportation to the nearest health facility is often a problem. As a result, some of the poisoning events may not be reported. However, there is no research that has explored accidental poisoning or paraffin ingestion among children in Botswana.

This paper is based on the clinician's observations and evidence derived from findings from several research articles that were conducted in various countries where paraffin still pause a problem like in Botswana. The aim of the review was to establish the extent and epidemiology of paraffin poisoning in the context of Botswana. Specifically, the objectives were: (i) to find out the magnitude of paraffin-related poisoning in Botswana; and (ii) review

literature from countries similar to Botswana regarding paraffin poisoning.

Aetiology and symptoms of paraffin poisoning

Paraffin contains hydrocarbons that have a low viscosity, low surface tension and high volatility. Children who ingest paraffin often aspirate the hydrocarbons which penetrate into distal lung airways. When aspirated, these hydrocarbons cause irritation that leads to loss of lung surfactant resulting in chemical pneumonitis. Chemical pneumonitis is reported to occur in 12–40% of children hospitalized for paraffin ingestion.[6,13]

Aspiration or inhalation of even a small amount of the paraffin molecules has been associated with severe necrotizing haemmorrhagic pnuemonitis.[10] Additionally, the compromised respiratory function caused by these pneumonias places the child at a high risk for other lung diseases like asthma, or tuberculosis.

Children who ingest paraffin may present with symptoms ranging from fever, vomiting, cough with intercostal retractions, decreased breath sounds, crepitations, drowsiness, stupor and or convulsions.[2,6,9] The latter symptoms may be indicative of serious central nervous system involvement. Management of this poisoning often requires emergency specialized care. Unfortunately, chances of getting more appropriate management, such as that which could be provided by specialized poison centres are remote. The use of paraffin as energy source has resulted with other accidents, such as burns in young.

Risk factors

Risk factors for paraffin ingestion can be categorized into six groups: (i) age; (ii) season of the year; (iii) poverty; (iv) living in a rural area; (v) inadequate supervision; and (vi) inadequate/inappropriate packing and storage of paraffin.

Age

Because of their cognitive, psychological and psychomotor immaturity, young children are at high risk for home accidents of all kinds. Toddlers (below the age of three) are particularly at risk of ingesting poisons because they explore their world through the senses. Because their senses of smell and taste are still relatively undifferentiated, they are more likely to mistake paraffin for clear liquids like water, sprite, or lemonade, and drink it, believing it to be a pleasant drink with which they are familiar. Studies report a high occurrence of poisoning in children 3 years and younger.[5,6,7,12,14–16]

Season

There is a higher incidence of paraffin poisoning in summer when the intense heat causes extreme thirst and sometimes dehydration. A dehydrated child will drink eagerly if they access any fluid. The amount of poison that may be swallowed will be directly influenced by the degree of thirst.[2,9] However, Tagwireyi, Ball and Nhachi reported an insignificant difference in the rate of admissions due paraffin poisoning between the summer and winter months.[1]

Poverty

Paraffin poisoning also appears to be related closely to the socio-economic status with low-income groups more likely to use paraffin as an energy source. This is because paraffin is relatively cheap and readily available even in rural areas. In many parts of the developing world and especially in sub-Saharan Africa, open fire, using wood is the main source of energy and paraffin is used for illumination, as both are inexpensive.

Rural areas

Many households in rural areas are dependent on paraffin for cooking, lighting, heating and refrigeration. This increases the risk of accidental paraffin ingestion among rural children compared with their urban counterparts whose main household energy source is electricity. Reed and Conradie[17] found that 96% of children admitted with hydrocarbon poisoning came from the rural areas. Considering the common problem of transport in many rural areas, it is assumed that many parents are not able to access health facilities' and therefore a number of poisoning events may be not reported, unless the victim appear distressed.

Inadequate supervision

Inadequate parental supervision has an important role to play in paraffin ingestion and poisoning of the young children. The young children who are left in the care of their older siblings are at higher risk. In many developing countries, delegating the responsibility of young children to their siblings, often not older than 8–10 years is common; they are often sent to the filling or petrol stations to purchase paraffin accompanied by their young siblings. During the trip, the older sibling may be tempted to make

a stopover. It may be during this time that the younger child could grab the water-like substance to drink only to be poisoned.

Inadequate packing and storage of paraffin

The use of sub-standard containers for paraffin storage may add to the risk that young children may mistake it for something they normally drink. Paraffin containers may be old beverage containers. Data show that the incidence is highest in summer when children accidentally ingest paraffin to quench their thirst.[6,9] Another factor that may contribute to paraffin poisoning is the place of its storage in the home. Many households have no lockable cupboards or other proper storage facilities. As a result, families keep paraffin in open areas like under the bed or in the midst of the family's groceries. In such a situation, paraffin becomes readily accessible to the young child who may not differentiate it from water or a cold drink. Without standard containers with childproof or child resistant lids, young children may end up drinking from a paraffin container, as children are able to open such storage containers with ease.

METHODS

As a paediatric nurse clinician in Botswana, the author was concerned about the frequent cases of paraffin poisoning encountered on the paediatric ward. She sought to establish the extent and epidemiology of the issue in the country in three stages: (i) consulting what statistics were available in Botswana that were related to paraffin poisoning; (ii) reviewing literature from countries similar to Botswana regarding paraffin poisoning; and (iii) doing a record review of a tertiary hospital in Botswana to find the incidence of paediatric hospitalizations for this problem.

In spite of the frequency, seriousness and preventability of this problem, awareness of the problem has been low in Botswana. As in many developing countries, in Botswana, the epidemiology of the problem has not been documented and preventive measures have not been instituted; however, some useful statistics were available from the Central Statistics Office.[18] The statistics found there revealed that there were population characteristics that predisposed Botswana to be vulnerable to an increased incidence of paraffin poisoning. The country has a population of about 1.7 million, 80% of whom live in rural areas where paraffin use is prevalent. The number of children under 5 years in Botswana is approximately 208 273, and most of these children live in rural areas where paraffin is the main source of energy. Observational work in public health made the author aware that paraffin is normally kept in the hut or room that is used by all members of the family including young children. It may be for easy access or because the room or hut is the only space available for the family. Lang, Thuo and Akech[19] also reported this practice in Kenya. Like other developing countries, Botswana has no mandatory safety policies regarding the containers used for dispensing paraffin and individuals can be purchase it in any form of container, from most community stores, shops or even a kiosk (semausu). Botswana does not have a poison control centre or primary health personnel skilled in the management of common poisonings.

However, Botswana has no official government statistics on the epidemiology of paraffin poisoning. The available statistics is not disaggregated. This makes it difficult to identify specific linkages of data. The author searched for information on the neighbouring countries that have similar population and ecological characteristics.

Studies were found from South Africa, a country with many similarities to Botswana. A study of young black children in South Africa found paraffin poisoning to be responsible for 59% of childhood poisonings.[20] It is the commonest cause of acute accidental childhood poisoning among the black paediatric population in South Africa.[14,15] Zimbabwe and Kenya also reported similar findings.[1,19]

These findings are relevant to Botswana because it is geographically and socially similar to South Africa and Zimbabwe. Like these countries, Botswana has large areas of rural families with young children, and these families use paraffin as an inexpensive, common source of home energy. Also like South Africa and Zimbabwe, Botswana has no clear governmental safety regulations concerning the packageing, selling or storing of paraffin even though its consumption in the rural areas averages 8.9 L/month per household.[21]

With the knowledge that Botswana's population statistics indicated a vulnerability to paraffin poisoning and those two countries adjacent and similar to Botswana had found a significant incidence of the problem, the author began the third step of her research. She received permission to do a secondary analysis of the unpublished institutional data from one major referral hospital in the country. She inspected the database for paediatric admissions between the years of 2003 and 2004. The total number of children admitted because of any kind of poisoning during this time was 116. Of these, the most

frequent cause of poisoning in young children was paraffin; 55 or 47.4% of the 116 admissions were for paraffin poisoning. As these data were obtained from the referral center in Botswana, it would be expected to represent only the most serious of the paraffin poisoning cases and thus may actually be an under-representation. Children from rural areas where paraffin poisoning is most likely to occur would be admitted first to local hospitals and only referred to the tertiary hospital if the situation was so serious that it couldn't be handled at the primary or district level. This documentation made it clear that paraffin poisoning is an important, but previously unappreciated, paediatric problem in Botswana. This documentation is the first step towards initiating steps for prevention.

DISCUSSION

The importance of this review is two folds: (i) it lays the mandate for preventive measures and provides a baseline against which the effectiveness of the intervention can be compared; and (ii) it provides an example of how clinical observation research in developing countries can proceed.

This study made it clear that paraffin poisoning in Botswana is a serious problem; and it is important that preventive measures be initiated. Three types of primary prevention regarding childhood poisoning seem to be most relevant: (i) educating parents; (ii) educating communities; and (iii) providing child resistant containers. Although preventive education for parents and communities does exist in Botswana, before choosing to devote significantly more money to broaden this approach, it is important that the success of the approach to child resistant containers be considered a viable option as it has been experienced in other countries—both developed and developing.

The usefulness of the child resistant containers was first tried in the USA and UK, and was shown to be far superior to previous educational approaches,[22] but it is important to determine whether this is also the appropriate solution for developing countries. Krug and others conducted a comparative study of the incidence of paraffin poisoning in two South African communities, one of which had been given child resistant containers and education and the other, which received only education regarding paraffin poisoning. The incidence of paraffin poisoning in the community receiving the child resistant containers dropped by 47% whereas the community receiving only education showed no change in incidence.[12] A similar 50% decrease in poisoning was also shown in another study in South Africa.[23]

Still in South Africa, the child resistant containers have been shown to be cost-effective compared with the expense involved in the management of the victims of paraffin poisoning.[14] And, of course, the non-financial cost of the loss of a child must be considered. Governmental strategies are needed to improve packaging and dispensing of paraffin in Botswana and, child resistant containers might be a more practical recommendation.

The author believes that the second important contribution of this article is providing a model for clinical nursing research for other developing countries. Developing countries do not often have the sophisticated datasets, computer analysis capabilities that more developed countries have, and they have clinical issues that are different and require different approaches. This study is an example of approaching a clinical issue whose importance has not even been appreciated in a country and for which data are not easily available. Concerted effort is required in developing toxicological database that can be useful in setting up a poison centre for the country as there is none at the moment.

In conclusion, it is hoped that this paper has contributed to the renewed awareness of paraffin poisoning in developing countries and to the methods of approaching clinical problems in developing countries. The proposed preventative cost-effective measure of adopting child resistant lid paraffin containers is in line with the primary health-care strategy for Botswana.

REFERENCES

1 Tagwireyi D, Ball DE, Nhachi CT. Toxicoepidermiology in Zimbabwe: Admissions resulting from exposure to paraffin (kerosene). *Clinical Toxicoloy Philadelphia* 2006; 44: 103–107.

2 Shotar AM. Kerosene poisoning in childhood: A 6-year prospective study at the Princess Rahmat Teaching Hospital. *Neuro Endrocrinology Letters* 2005; 26: 835–838.

3 Thomas M, Anandan S, Kuruvilla PJ, Singh PR, David S. Profile of hospital admissions following acute poisoning—Experiences from a major teaching hospital in south India. *Adverse Drug Reactions and Toxicological Review* 2000; 19: 313–317.

4 Clarke EEK. The experience of starting a poison control centre in Africa- the Ghana experience. *Toxicology* 2004; 198: 267–272.

5 Pillai GK, Boland K, Jagdeo S, Persad K. Acute poisoning in children: Cases hospitalized during a three-year period in Trinidad. *The West Indian Medical Journal* 2004; 53: 50–54.

6 Lifshitz M, Sofe S, Gorodischer R. Hydrocarbon poisoning in children: A 5-year retrospective study. *Wilderness and Environmental Medicine* 2003; **14**: 78–82.
7 Adejuyigbe EA, Onayade AA, Senbanjo IO, Oseni SE. Childhood poisoning at the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria. *Nigerian Journal of Medicine* 2002; **11**: 183–186.
8 Martin TC, Brinkman W. The spectrum of accidental childhood poisoning in the Caribbean. *Pan American Journal of Public Health* 2002; **12**: 313–316.
9 Abu-Ekteish F. Kerosene poisoning in children: a report from northern Jordan. *Tropical Doctor* 2002; **32**: 27–29.
10 Broadhead RL. Poisoning. In: Coovadia HM, Wittenberg DF (eds). *Paediatric and Child Health: A Manual for Health Professionals in Developing Countries*. South Africa: Oxford University Press, 2003; 675–683.
11 Pillitteri A. *Maternal Child Health Nursing: Care of the Childbearing and Childrearing Family*. Philadelphia: Lippicott Williams &Witkins, 2007.
12 Krug A, Ellis JB, Hay IT, Mokgabudi NF, Robertson J. The impact of child-resistant containers on the incidence of paraffin (kerosene) ingestion in children. *South African Medical Journal* 1994; 84: 730–734.
13 The South African Medicines Formulary. *Emergency Treatment of Poisoning*. Available from URL: http://web.uct.ac.za/depts/mmi/jmoodie/v03bhtml.html. Accessed 17 March 2005.
14 de Wet B, van Schalkwyk D, van der Spuy J, du Plessis J, du Toit N, Burns D. Paraffin (kerosene) poisoning in childhood—Is prevention affordable in South Africa? *South African Medical Journal* 1994; 84: 735–738.
15 Ellis JB, Krug A, Robertson J, Hay IT, MacIntyre U. Paraffin ingestion-the problem. *South African Medical Journal* 1994; 84: 727–730.
16 Orisakwe OE, Egenti L, Orish C. Childhood no-drug poisoning in Nnewi, Nigeria. *Tropical Doctor* 2000; **30**: 209–211.
17 Reed RP, Conradie FM. The epidemiology and clinical features of paraffin (kerosene) poisoning in rural African children. *Annals of Tropical Paediatrics* 1997; **17**: 49–55.
18 Central Statistics Office 2001. *Population and Housing Census Dissemination Seminar 8th–11th 2003*. Gaborone: Government Printer Gaborone, 2003.
19 Lang T, Thuo N, Akech S. Accidental paraffin poisoning in Kenyan children. *Tropical Medicine and International Health* 2008; **13**: 845–847.
20 Kerosone and diesel fuel. Available from URL: http://www.angelfire.com/biz/pharmapact/update2.html. Accessed 21 May 2005.
21 Revision of the Botswana Energy Master. *Plan and Development of the Energy Policy Draft Final Report*. Gaborone: Department of Energy Affairs, 2003.
22 Lawson GR, Craft AW, Jackson RH. Changing pattern of poisoning in children in Newcastle 1974–81. *British Medical Journal* 1983 July 2; 287(6384): 15–17 from PDF file: doi: l0.1136Ibmj.287.6384.15
23 Paraffin Safety Association of Southern Africa. *Paraffin Safety*. Available from UR: http://www.bp.co.za/opencms/openccm/portal/Environment/Paraffin. Accessed 15 March 2005.