The impact of child-resistant containers on the incidence of paraffin (kerosene) ingestion in children

A. Krug, J. B. Ellis, I. T. Hay, N. F. Mokgabudi, J. Robertson

The commonest cause of accidental poisoning in the South African black paediatric population is paraffin ingestion. In this intervention study a specifically designed child-resistant container (CRC) was introduced to evaluate whether its use would decrease the incidence of paraffin ingestion. CRCs were distributed to 20 000 households in the study area (Gelukspan district). No CRCs were distributed in the control area (Lehurutshe district). Health education about paraffin poisoning prevention was given in both the control and the study areas. The monthly incidence rates of paraffin ingestion were monitored during the 14-month intervention period after the distribution and were compared with the pre-intervention incidence rates in the study and control areas.

The main finding was that the incidence of paraffin ingestion dropped by 47% in the study area during the intervention period. The circumstances surrounding the cases of paraffin ingestion that still occurred in the study and control areas were investigated by means of a questionnaire. We recommend that paraffin be sold in CRCs, and suggestions are made for improving health education to prevent paraffin poisoning.

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Many accidental childhood poisonings are preventable. The commonest cause of poisoning in black South African children is paraffin (kerosene) ingestion.[1-4] This has also been described in other developing countries.[5,6] Violari and Levenstein[7] report that between 5,5% and 16,5% of all admissions to the paediatric wards of a Transvaal hospital resulted from paraffin ingestion. Health educational campaigns about paraffin have been carried out but have not had a measurable impact.[8,9] In other countries health

Department of Paediatrics and Child Health, Medical University of Southern Africa, Pretoria

A. Krug, M.B. CH.B.

J. B. Ellis, M.B. CH.B.

I. T. Hay, M.MED. (PAED.), F.C.P. (S.A.), M.R.C.P.

N. F. Mokgabudi, N.F., R.N., R.M., B.K.

J. Robertson, S.R.N., S.C.R.N.

education alone has not reduced the hazards leading to childhood injuries or poisonings.[6,10,11]

In 1976 child-resistant containers (CRCs) for aspirin and paracetamol were introduced by law in the UK. This led to a 60% reduction in cases of accidental ingestion.[12-16] The American experience has also shown that CRCs reduce poisoning incidence rates significantly.[6,14,17,18]

This success motivated us to test the impact of a CRC for paraffin in a pilot study. We are not aware of any similar intervention study to prevent accidental paraffin ingestion.

Methods

The study and control areas for the intervention study are situated in the western Transvaal in Bophuthatswana, close to the Botswana border. The estimated 1988 population figures are 94 000 people for the study area (Gelukspan district) and 72 000 for the control area (Lehurutshe district). These figures are estimates, but based on the 1985 census. To determine the population figures for 1989 - 1992, we added 3% per year. We assumed that the two populations were similar in demographic structure and that the population growth rate was 3%. We chose these districts because they are two distinctly defined health wards with good records and all health care is rendered by public health services.

We collected retrospective data on all cases of paediatric paraffin ingestion from hospital and clinic records in both areas for the years 1988 - 1990.

Twenty thousand CRCs were distributed in the study area between September and December 1991. We had a special 2-litre plastic container designed according to the recommendations of the British Safety Standards Authorities for the storage of household substances. The bottle has a child-resistant cap. Instructions on how to open and close the bottle and a health educational message on poisoning prevention were printed on it in English and the local language.

All mothers who brought their children to the under-5 clinic received a CRC free of charge and their Road-to-Health cards were marked. Health workers then went from house to house to distribute the remaining bottles to those households with small children that had not received a CRC. These CRCs were filled with paraffin at local shops and could be re-used.

The intervention period lasted from 1 November 1991 to 31 December 1992. The distribution of CRCs was only completed in December 1991. We included November and December 1991 in the intervention period, however, as we found that some CRCs had broken after a relatively short time and we wanted to measure the impact of the bottle distribution from the start. The pre-intervention period, for comparative purposes, was a similar 14-month period from 1 November 1989 to 31 December 1990.

Data were collected from both hospital and clinic records. The health workers in both areas completed a questionnaire for every new poisoning case that occurred during the intervention period. The purpose was to investigate the circumstances of the poisoning and the containers involved.

The prevention of paraffin poisoning had been a common topic in ongoing health education in both the study and the control areas. Health education had taken place at the antenatal and under-5 clinics, in the outpatient departments and paediatric wards and on health days, but had not been successful in reducing the problem.

During 1991 both the study and the control areas had organised poster competitions, and pamphlets with standardised poisoning prevention messages were distributed. The customary health education programmes were also continued during the intervention period in both areas. The only differences between the control and the study areas was that households with small children in the control area did not receive the CRCs.

In June 1992, 6 months after the distribution of the CRCs, Shell SA conducted a household survey in the study area. A semi-structured questionnaire was used to find out the proportion of households which had received the CRC, their acceptance and the durability, and the common storage places for paraffin containers. Three villages were chosen at random and 50 households were interviewed in each village. From a random starting point, every second house was surveyed.

Management boards of both hospitals and the Bophuthatswana Department of Health gave consent and ethical approval for this intervention study.

Limitations of the study

The population estimates may be inaccurate but the two populations are similar in demographic structure and were considered comparable.

The distribution of the CRCs took more than 3 months and involved a major effort on the part of a rural health ward with inadequate transport.

Questionnaires were completed in only 62% of the cases of poisoning that occurred in the study area during the intervention period. Some questionnaires were answered incompletely. This could be explained by staff shortages and inadequate questioner training.

Results

Fig. 1 shows the similar age distribution in the study and control areas. Most cases occurred in the 12 - 23-month-old group.

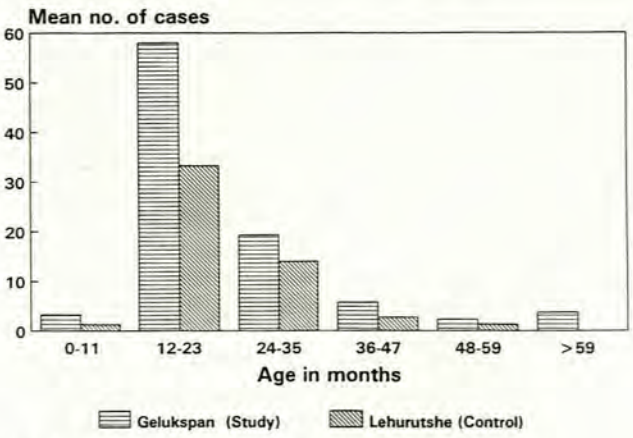

Fig. 1. Paraffin ingestion — age distribution, 1988 - 1990.

The seasonal variation is shown in Fig. 2. The highest number of cases occurred during the summer months. Figs 1 and 2 show retrospectively collected data for the years 1988 - 1990. The age distribution and seasonal variation for the years 1991 and 1992 were similar to the 1988 - 1990 data in both areas.

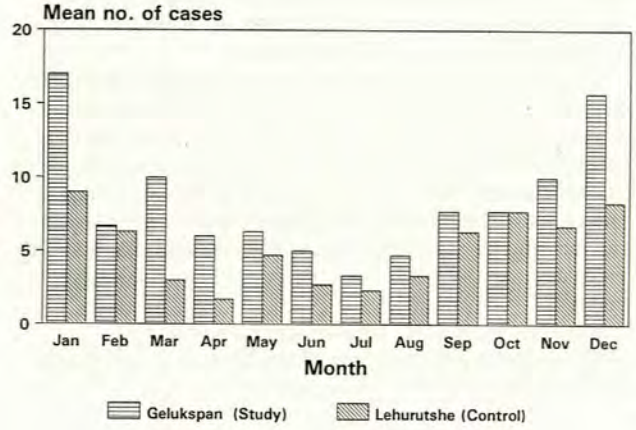

Fig. 2. Paraffin ingestion — seasonal variation, 1988 - 1990.

From 1988 to 1990, between 5% and 8% of all paediatric hospital admissions in both areas had resulted from paraffin ingestion.

The household survey done by Shell SA 6 months after the distribution of CRCs in the study area showed that 67% of *all* households (i.e. with and without small children) had initially received a CRC. Fifteen per cent of the households had subsequently lost or broken the CRC, so that 52% of all households still had one at the time of the survey. When these CRCs were inspected, only 43% of the households were found still to have an intact one and were actually using it for paraffin storage. Eighty-two per cent of the householders said that they liked the CRC. Ninety-five per cent mentioned that the child-resistant cap had never broken but 9% said the plastic bottle itself had cracked easily.

The storage places of all different kinds of paraffin containers were inspected. Some households had several containers. Eighty-five per cent of the households had a paraffin container on the floor, under the bed or behind the stove where it could easily be reached by children. Only 25% of households had a paraffin container inside or on top of a cupboard/sideboard which was out of reach of children.

Fig. 3 shows the monthly incidence of paraffin ingestion in the *study area* for the pre-intervention and the intervention period. The mean of the monthly incidence rates in the pre-intervention period was 8,63 (SD 4,87) and for the intervention period 4,54 (SD 3,46). The incidence rates fell by 47,4%. Statistical comparison was by means of the Mann-Whitney test. It showed a statistically significant difference ($P = 0,022$).

During the *pre-intervention* period the incidence rates in the study area were not statistically significantly different from those in the control area: mean 8,63 (SD 4,87) versus 7,94 for the control area (SD 4,26).

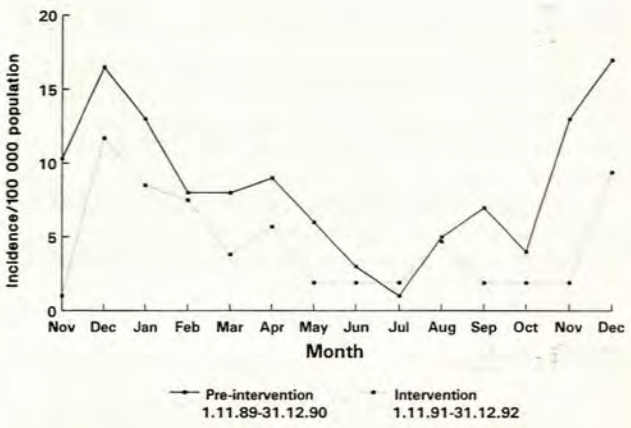

Fig. 3. Study area — incidence of paraffin ingestion per month, 1989/90 and 1991/92.

Fig. 4 compares the incidence rates in the *control* area for the *pre-intervention* period with those for the *intervention* period. These were not statistically significantly different (mean 7,94 ± 4,26 v. 9,80 ± 5,63).

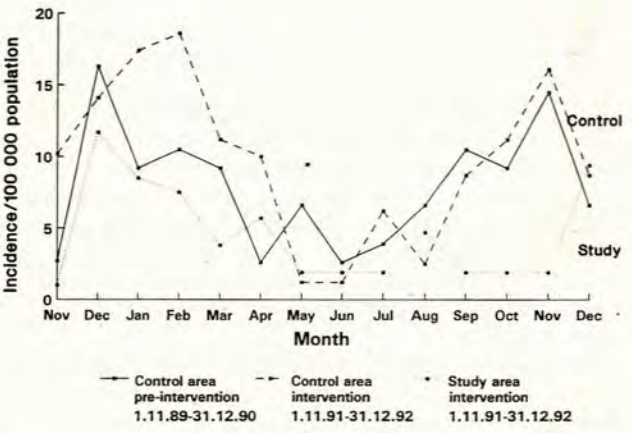

Fig. 4. Control and study areas — incidence of paraffin ingestion per month, 1989/90 and 1991/92.

Fig. 4 also shows the comparison between the *study* area and the *control* area for the *intervention* period. After the CRC distribution the incidence rates in the study area were less than one-half of those in the control area (mean 4,54 ± 3,46 v. 9,80 ± 5,63). This difference was statistically significant ($P = 0,015$).

During the entire period of our data collection, 1988 - 1992, neither the study nor the control area recorded any paediatric deaths from paraffin poisoning.

For the 69 poisoning cases which occurred in the study area during the intervention period, 43 questionnaires were returned (62%). These showed that 13 children came from households where CRCs were present and that 5 of these had ingested the paraffin from the CRC. In 4 of these 5 cases the mothers said that the CRC had been left open or

had not been properly closed. In 1 case the child had opened the CRC, though it was not known how. The other children had ingested the paraffin from cold-drink bottles (2), intermediate containers or paraffin lamps (3), and an unknown container (1), or at a neighbour's house ('next door') (2). Intermediate containers are open tins or cups which people use to pour a small amount of paraffin into their appliances.

Fig. 5 indicates the different containers involved in the paraffin poisonings in all households in the study and control areas (irrespective of whether CRCs were present or not). One-litre or 2-litre bottles, together with the intermediate containers, were responsible for the majority of cases of paraffin ingestion.

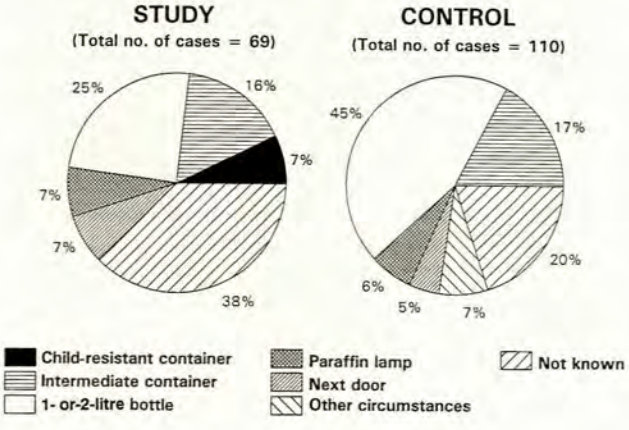

Fig. 5. Containers from which children drank paraffin.

Fig. 6 shows that only a minority of children were under adult supervision when the poisoning occurred.

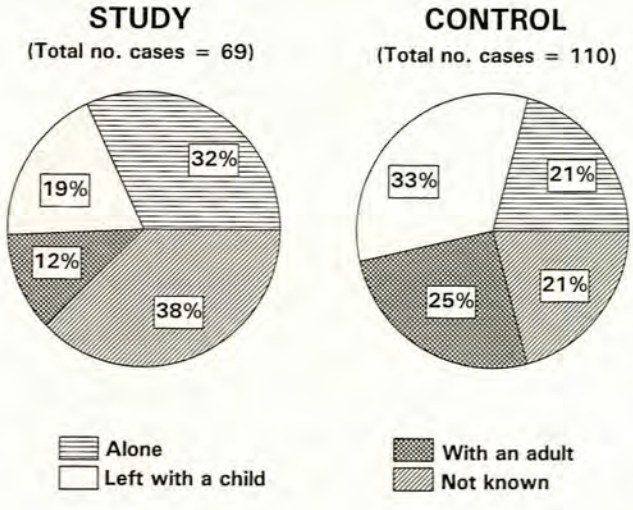

Fig. 6. Who was with the child when he/she drank paraffin?

Discussion

The age distribution of cases of paraffin ingestion in this study showed that the young toddler (12 - 23 months) is most at risk. Similar findings have been reported by Crisp,[1] Joubert[2] and Press.[19]

More children drink paraffin during the summer months when they are thirsty. Paraffin is mistaken for water as it is often stored in cold-drink or milk bottles. The higher incidence during summer months has been well described in the literature.[20-23]

The fact that only 67% of all households had received a CRC initially can be explained by the character of the distribution campaign, which targeted households with small children.

The CRC used for the study was not ideal as it should have been more durable and possibly made of opaque plastic. This would, however, have entailed an even higher cost.

Only 25% of paraffin containers were stored out of reach of children. Similar findings have been described by other authors.[24-27] This has important implications for health education.

The distribution of CRCs in the study area reduced the incidence of paraffin ingestion by 47,4%. This is comparable to other observations on the effects of safety packaging.[28] Our study shows the impact of the intervention. It is, however, difficult to determine the effect of the CRC alone on the result of the study as the whole distribution campaign made people more aware of the problem.

The fact that the incidence rates did *not* change in the control area during the intervention period shows that the present health education or secular changes during this period did not have any major impact.

In our study, there were no known deaths from paraffin ingestion. Lazner[29] and Anne St John[30] also reported no fatalities in their studies. Other authors mention case fatality rates of between 2% and 10%, 2% being the most commonly reported.[1,2,21,24,31,32] The case fatality rate at Ga-Rankuwa Hospital was 0,74% for 1992 (unpublished data).

Five children drank paraffin from a CRC and 1 of them actually opened the CRC. Similar cases of failure of CRCs have been reported by Scherz,[6] Wiseman *et al.*[15] and Arena.[33]

The open tins and cups which people use as intermediate containers are frequently found on the floor or the table and can easily be reached by children. This problem has been mentioned by Rom *et al.*,[34] and has implications for health education.

Fergusson *et al.*,[35] Sibert[36] and Wiseman *et al.*[37] noted that poisonings also occur away from the child's home. This was confirmed in our study and underlines the need for CRCs to be used by all households and not only those with small children.

Most of the children in our study were not sufficiently supervised. Similar findings have been reported by Gained *et al.*,[22] Mahdi,[27] Anne St John,[30] Wiseman *et al.*[37] and Eriksson *et al.*[38] This also has implications for the health education.

Recommendations

1. All paraffin should be sold in CRCs. The costs, however, are high — the CRC we used cost R2,20 per bottle — and this might therefore not be a feasible solution in the near future.

2. Health education should be improved: (*i*) the dangers associated with the use of intermediate containers must be stressed; (*ii*) paraffin containers must be stored in a safe place and out of reach of children. Several authors have commented that even a CRC cannot compensate for an unsafe storage place;[15,26,39] (*iii*) home visits should be part of poisoning prevention strategies. As health education aims to achieve a complex change in behaviour, it must be directed at target groups and take their social background into account.[11,13,40,41] The already overburdened mother may be unable to put the recommended safety measures into practice in her overcrowded living conditions.[4,40,42] Home visits should focus on the implementation of advice and empowerment of the mother; (*iv*) health education stresses that children should not be left unsupervised. In a developing country, it is a fact of life that many toddlers are supervised by their elder siblings. Health education for poisoning prevention should also be given at schools via the child-to-child approach.

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