

Safety issues relating to paraffin usage in Eshane, Kwazulu-Natal

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Abstract

This study describes results of a household survey conducted in Eshane in the rural Kwazulu-Natal Midlands in April 2002, including baseline socio-demographic, energy usage, paraffin-related injury and safety knowledge information. A total of 404 interviews were conducted in five villages that fell within a 10-kilometre radius of the proposed Eshane integrated Energy Centre.

Paraffin usage was high (86.6%) and there were no significant differences between electrified and non-electrified villages. Paraffin ingestion by children and paraffin-related fires were reported in 3.6% and 6.3% of households respectively. The majority of respondents had heard safety messages, but message retention was only demonstrated for messages relating to fires, and not ingestion. It seems that safety education may have a role to play in the prevention and response to paraffin-related fires, but that child-resistant packaging may be the only viable intervention for the reduction of ingestion among children.

Keywords: Eshane, Kwazulu-Natal, energy usage, paraffin, households, paraffin-related injuries, safety measures

Background

Paraffin related fires and burns, ingestion and subsequent poisoning are among the myriad health problems facing some of South Africa's poorest communities. Not only is paraffin implicated in unintentional poisoning, mainly among children

between 1 and 3 years of age (de Wet et al 1994), it is also associated with a considerable proportion of burn-related injuries, particularly as a result of paraffin flame stoves igniting (Steenkamp et al 2003; University of Cape Town 2002). As many paraffin ingestion cases are attributed to children drinking paraffin from unmarked containers or cooldrink bottles, pre-packaging paraffin with child resistant closures is an effective intervention for reducing childhood ingestion (Krug et al 1994) and also ensuring that paraffin was not contaminated with other more flammable products such as petroleum or methylated spirits.

This study describes results of a household survey conducted in Eshane in the rural Kwazulu-Natal Midlands in April 2002 (Matzopoulos et al 2003) prior to the establishment of an Integrated energy Centre (IeC) that aimed to introduce pre-packaged paraffin to be sold on a deposit basis. As the IeCs were to provide training to the community about energy-related topics, safety education was expected to play an important role in reinforcing the pre-packaging intervention and to increase awareness about fire safety practices. The survey included questions relating to the socio-demographic and fuel-usage characteristics of households in the Eshane area, as well as the recollection of paraffin-related injuries and knowledge, attitudes and practices regarding safety.

Methodology

Population and sampling

The target population comprised households in the five villages within a 10-kilometre radius of the proposed IeC, i.e. Eshane village (the site of the IeC), Matimatolo, Mbuba, Mbulwane and Lilane, as they would have the most immediate access to the pre-

packaged paraffin and would also be the first communities to receive safety messages. A systematic random sample was drawn, whereby in each village every *n*th household would be visited with the value of *n* determined by the estimated number of households in the area.

On the Statistics South Africa demarcation map there were an estimated 7 759 households in the five villages immediately surrounding the IeC (see Table 1). Data collection was contracted out to the UNISA Bureau for Market Research (BMR), who drew a sample of 404 households (Bureau for Market Research, UNISA 2002). The initial sample size was decided upon in conjunction with a local authority official, who advised that the Eshane population was much greater than the other study areas. The BMR also specified that each interviewer needed to complete a minimum of 45 questionnaires.

Table 1: Sample size and estimated population in the Eshane IeCs inner circle

| Village | Sample size | <i>n</i> th | No. of households (Statistics SA) |
|------------|-------------|-------------|--------------------------------------|
| Eshane | 184 | 10 | 1 980 |
| Matimatolo | 85 | 20 | 2 479 |
| Lilane | 45 | 20 | 1 111 |
| Mbuba | 45 | 20 | 1 327 |
| Mbulwane | 45 | 20 | 862 |
| Total | 404 | | 7 759 |

Data collection, cleaning and analysis

A questionnaire was designed to assess the incidence of fatal and non-fatal paraffin ingestion, pneumonia resulting from paraffin ingestion, paraffin-related fires and burns, usage of safety devices, action taken after paraffin ingestion or burns, and demographic information about the respondent. Nine field-workers, who were fluent in Zulu, the first language for all five villages, were recruited from the study area to minimise time and travelling costs. They were trained intensively by the BMR co-ordinator at the Eshane community market office.

All questionnaires were administered in April 2002 either with caregivers or the head of household where a caregiver was not available. Data was entered by the BMR. The village estimates were weighted to obtain an overall estimate using Statistics South Africa village sizes. Coding errors, pertaining mostly to filtering questions or those with a multiple choice option, were dealt with appropriately.

Ethical considerations

Eshane, Matimatolo, Mbuba and Mbulwane have their own local tribal authorities, and Lilane falls

under the control of Eshane’s local tribal authority. The ‘gate keepers’ of each area granted permission to conduct the survey, and a letter of introduction and authorisation, which also explained the objective and purpose of the study, was presented to each respondent.

Results

Demographics and household information

The majority of the respondents were females (71.5%) with an average age of 47 years. Only 32% of the respondents had secondary or tertiary education and more than three-quarters of the respondents were unemployed. The average household size was 6.81 with more than half of the sample (53%) earning an income of less than R500 per month.

As is typical of many low-income communities in South Africa, paraffin usage was high (86.6%). Only 23% of households had access to electricity, but this was concentrated in two villages, Matimatolo and Mbuba, where 68% and 76% respectively had access. Surprisingly, access to electricity did not significantly impact on paraffin usage; the significant predictors were education levels, the age of the respondent, as well as the presence of a television in the household. Paraffin usage was significantly higher among lower educated respondents (*p* < 0.01), among older respondents (*p* = 0.02) and in households owning a television (*p*=0.04). The panda/flame stove was the most commonly used appliance for cooking (56.6%), but households also used wood or coal fires (60.4%).

Recollection of paraffin-related injuries

The high incidence of paraffin-related injuries and fatalities in the study area, confirms the findings in the medical literature, which highlight paraffin-related injuries as a significant problem among the low-income black population. Incidents of paraffin ingestion were reported in 6.3% (95% CI: 3.7% to 8.8%) of households in the study area over a one-year period. Pneumonia resulting from the ingestion of paraffin was reported in 20 of the 24 households who reported cases of ingestion. Deaths due to paraffin ingestion were reported in two households in Eshane and four households in Lilane, a high mortality rate for these two areas. Comparing prevalence ratios for ingestion by each of the household and respondent variables described in the preceding sections revealed that working status was potentially a significant predictor for ingestion, with part-time workers 2.8 times more likely to have a child ingesting paraffin in their household than unemployed people or people working full-time (OR = 2.8; 95% CI: 1.1 to 7.1). Lilane, the village with the highest percentage of part-time employed respondents (57.8%) had a disproportionately large number of paraffin ingestions (15.6%). This indi-

cates that part-time workers may leave their children unsupervised more frequently than full-time or unemployed workers.

Fires were reported in 27 households (6.7%), 11 of which were paraffin-related (40.7%). This implied that there were an estimated 597 (375-819) fires in the study area in the year preceding the survey, 209 (75-338) of which were related to paraffin. Paraffin-related burns were reported in 17 households in the study area (3.9%), which implied that there were 354 (222-485) paraffin-related burns in the year preceding the survey. Whereas paraffin burns were less common than paraffin ingestion, outcomes were frequently more severe and required longer periods of hospitalisation. There were 7 fatalities from burn injuries and 6 fatal poisonings, representing incident fatality rates of 47% and 25% respectively.

Paraffin safety knowledge

The majority of the respondents (84.4%) had heard paraffin safety messages in the year preceding the survey. The sources of these paraffin safety messages are shown in Table 2.

Table 2: Sources of paraffin safety messages (n=404)

| | No.* | % |
|---|------|------|
| Radio | 231 | 57.2 |
| Television | 29 | 7.2 |
| Newspaper/magazine | 32 | 7.9 |
| Traders | 18 | 4.5 |
| School children | 30 | 7.4 |
| Community worker | 17 | 4.2 |
| Survey/researchers | 6 | 1.5 |
| Health worker/clinic/hospital | 53 | 13.1 |
| Other | 1 | 0.2 |
| Not applicable/ haven't heard safety messages | 63 | 15.6 |

* Respondents were able to select more than one source of safety message

Respondents were significantly more likely ($p < 0.01$) to know that you used a fire extinguisher or sand to put out a paraffin fire (58%), than knew the correct treatment for a child who had ingested paraffin (42%) - i.e. taking the child directly to a hospital or clinic without giving them anything to eat or drink. This could be explained by the perceived relative impact of a fire compared to an ingestion or poisoning case. As fires were prevalent in the study area, and as fires have the potential to spread, the community was aware of the severe outcome of a fire that is not doused, whereas ingestions only affect a single household.

As expected, respondents who were exposed to

safety messages were significantly more likely ($p < 0.01$) to know the correct action to be taken in the event of a paraffin-related fire than those who had not been exposed to the messages (see Figure 1).

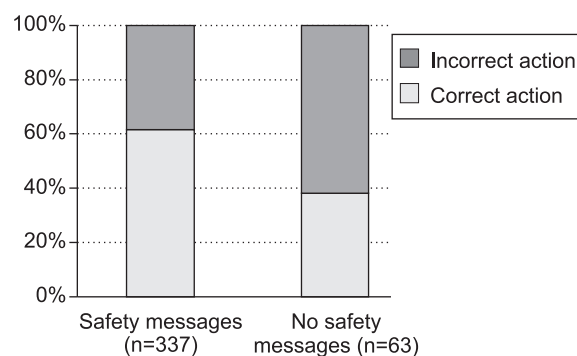


Figure 1: Safety messages and the association with correct action for paraffin fires

However, the same was not true for ingestions. Of the respondents who were exposed to safety messages significantly fewer ($p < 0.01$) knew the correct action to be taken following paraffin ingestion than respondents who had not been exposed to safety messages (see Figure 2). This finding may highlight the ineffectiveness of health education in changing behaviour to reduce the incidence of paraffin ingestion, which would be consistent with the findings of other studies conducted in South Africa (Krug et al 1994; Donald et al 1991).

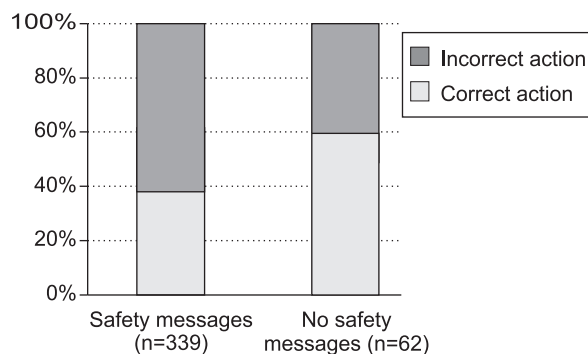


Figure 2: Safety messages and the association with correct action for paraffin ingestion

Discussion

Paraffin was the most commonly-used fuel in the five villages surrounding the IeC in Eshane. Although limited access to electricity may have been a contributing factor, it was not an important one, as villages with access to electricity such as Matimatolo and Mbuba, reported an equal proportion of paraffin-using households as the other villages. These results suggest that even when electrified, households will still utilise paraffin for some of

their energy requirements, especially when paraffin appliances are already in use. The significant predictors of paraffin usage were old age, less education, and the presence of a television in the home. The latter probably indicates households being unable to afford both televisions and other appliances, and even with electricity, these households would be more likely to utilise electricity for television and paraffin for cooking: a more affordable option.

In terms of paraffin-related injuries, a pronounced effect was evident in all but one of the villages, Mbulwane. The estimates from the other four villages showed that paraffin ingestion and subsequent pneumonia, hospitalisations and burns were significant health problems. If we exclude the Mbulwane data from the analysis, the paraffin ingestion rate rises to 7% (4.2 to 9.9%) of households in the other villages (Eshane, Matimatolo, Mbuba and Lilane). Paraffin-related fires were reported in four of the villages and paraffin-related burns were reported in three. Again, the results from Mbulwane were not consistent with the rest of the sample, as no fires or burns were reported. The incidence of paraffin-related burns rose from 3.9% to 4.4% (2.3% to 6.5%) of households following the exclusion of Mbulwane from the sample.

It is worth noting that the Eshane area was divided between supporters of the African National Congress and the Inkatha Freedom Party at the time of the survey. Mbulwane was the only Inkatha-affiliated community among the five villages and the anomalous data may have been the result of mistrust between the research team and the community.

Nevertheless, the initial baseline survey provides useful information about energy usage, paraffin-related injuries and safety knowledge in a rural South African community and the findings resonate with others from rural areas of South Africa. At Ga-Rankuwa hospital, just north of Pretoria, paraffin ingestion accounted for 78% of acute accidental childhood poisoning in 1992 (Ellis et al 1994) and in 1990 between 5.5 and 16.5% of all admissions to the paediatric wards of Natalspruit hospital in Gauteng were due to paraffin ingestion (Violari & Levenstein 1991). A more recent study (Reed & Conradie 1997) reported that 9% of all paediatric admissions to a rural hospital in Mpumalanga over a 33 week period were due to paraffin ingestion and between 1994 and 2001, 8.6% of all paediatric admissions at Ga-Rankuwa Hospital were due to paraffin ingestion (Dr U. MacIntyre, personal communication, January 16, 2003). It is also clear that these findings are not peculiar to South Africa, as paraffin is also the leading cause of poisoning in many other low-income countries that rely on paraffin as a source of fuel such as India (Gupta et al (1998); Orisakwe et al (2000); Nhachi et al

(1994)).

The higher incidence of paraffin ingestion among households with part-time workers than those with unemployed or full-time workers suggested that the children of part-time workers' may receive more erratic supervision than the children of unemployed or full-time workers. The finding is consistent with the study by Krug et al. (1994), which found that poisoning incidents tended to occur when there was a lack of supervision. The unemployed are frequently at home and full-time workers are likely to ensure that children are supervised when they are at work, whereas part-time workers may not always be able to make arrangements for their children's supervision, particularly if they are involved in irregular casual labour.

While there were fewer paraffin burns than paraffin ingestions, the case fatality rate for paraffin burns (47.1%) was considerably higher than that reported in the medical literature where the highest reported hospital fatality rate was 25% at the Tygerberg Hospital Burns Unit (Steenkamp et al 2002). The mortality rate for paraffin ingestion (25%) was also higher than studies in the medical literature, with most authors reporting hospital case fatality rates of between 0.72% and 2.1% (Krug et al 1994; Simmank et al 1998; Joubert 1990). These findings could be explained by surveys being more sensitive to severely traumatic events like the death of a child than less serious events such as a child's illness or, as in this study, a non-fatal ingestion, as well as having an actual recall period greater than the 12 months specified in the questionnaire.

Exposure to the ignition of paraffin from appliances such as stoves and lamps is a common cause of burns in countries using paraffin as a source of household fuel. In Cairo, Egypt, Mabrouk et al. (2000) found that of the 759 burn cases presenting to a Burn Unit in Cairo over a twenty-month period, 40% sustained the injury as a consequence of paraffin stove fires. In India, Sawhney (1989) found that of 339 patients with burn injuries, 302 had thermal burns and 65% of these were due to paraffin pressure stove accidents. An analysis of 11 196 burn admissions to India's second largest burn unit over an 8 year period, found that 82.15% of the burns were due to flame accidents, 35.3% of which were caused by malfunctioning paraffin pressure stoves (Ahuja & Battacharya 2002). In Nepal, stoves and lamps, which mostly used paraffin, were reported to be the second most common cause of flame burns after housefires (Liu et al 1998). In their prospective analysis of 237 burn patients, 64.2% of the burns were of the flame type, of which 60.8% were caused by housefires, 20.3% were caused by lamps and 13.1% were caused by stoves. According to Liu et al. (1998), 7 (35%) of the stove burns were due to paraffin stove explosions.

Similar results have been found in South Africa.

Hudson et al. (1994), in a retrospective analysis of 194 patients admitted to the Burns Unit at Woodstock hospital between January 1990 and June 1992, showed that primus stove (i.e. pressurised paraffin stove) burns accounted for 11.9% of the admissions to the Burns Unit, and Godwin, Hudson and Bloch (1996) attributed 16% of burns among shack fire victims to primus stoves. Steenkamp et al. (2002) in another Cape Town study investigated burn injuries caused by paraffin stoves and found that paraffin stoves were involved in 40 (25%) of the 160 adult admissions to the Tygerberg Hospital Burn Unit over two eleven-week periods. Paraffin lamps were also identified as a cause of burn injury but the incidence was not reported. Flame stove explosions were reported in 38 (95%) of the 40 cases and the two remaining participants sustained burns after their clothing caught alight when they moved too close to primus stoves (Steenkamp et al 2002). In the Joe Slovo informal settlement in 2000, 26% of the 22 fire events were reportedly triggered by a gas/paraffin stove exploding. While the figures show a decrease in fires caused by gas/paraffin stove exploding in 2001 to 9.1%, there was an increase in 2002 to 28% (University of Cape Town, 2002). Godwin et al. (1996) highlighted one patient who sustained burns as a result of an exploding primus stove, and several newspapers also reported injuries and fatalities due to exploding paraffin stoves and heaters (Cape Argus 2001, Cape Times 2001, Daily Dispatch 2000 & 2002, Zoutpansberger 2000).

This study highlights the importance of addressing issues of paraffin safety, as the energy usage results suggest that paraffin will still be widely used in the short to medium term in South Africa's rural areas even with the roll-out of electrification. It was clear that paraffin fires are too frequent and measures will need to be taken to reduce their incidence. One of the most needed interventions is the enforcement of safety standards for paraffin stoves, as a recent study commissioned by the Paraffin Safety Association showed that nine of South Africa's most commonly used paraffin stoves failed current SABS standards (Paraffin Safety Association 2004a). The absence of legislation governing the packaging, handling, storage, and delivery of paraffin to the end-user may also result in the distribution of contaminated paraffin, as evidenced by an incident in the Northern Province, where 2 people died and several others were severely burnt in paraffin explosions (Lubisi & Matari 2001). Even so, safety education may have an important role in supporting some of these interventions, as safety messages about the correct action to be taken in the event of a paraffin fire were well-received by respondents in this study.

However, the role of safety education in the prevention of paraffin ingestion was not as clearly

demonstrated, and it seems that legislation ensuring that paraffin is safely packaged may be the only solution. The Paraffin Safety Association have already recommended that retailers ensure that paraffin is only sold in child resistant packaging with adequate labelling, that it is tested prior to packing to ensure that it has not been contaminated and that the Department of Minerals And Energy propose the safe packaging legislation (Paraffin Safety Association 2004b). Although the Paraffin Safety Association have curtailed their involvement in the IeC programme, it is clear that an alternative strategy for the introduction of child resistant packaging is imperative, as this study suggests that the possibility of affecting behaviour changes based on media and public awareness campaigns may be difficult to achieve.

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