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Burns, scalds and poisonings from household energy use in South Africa: Are the energy poor at greater risk?

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ABSTRACT

Household energy related accidents such as burns and poisonings are not included amongst the causes of health burdens from residential energy use in the Global Burden of Disease (GBD) and other similar assessments. This is a serious omission in the case of transitional developmental states, such as South Africa, where these can be significant. This study analyses the risks associated with burns, scalds and poisonings from the use of household fuels in South Africa, adopting an environmental risk transition framework. We employ quantitative data from a nationally representative household energy consumption survey and hospital treatment data on energy incident injuries from a sample of 17 hospitals around South Africa to assess the relationship between the risk of these accidents, household income and energy poverty. Previous research on risk transitions provides clear evidence of a transition away from risks associated with household pollution with rising income, and also suggests that the evidence regarding injuries appears to decrease with rising income. We, however, find that in the case of South Africa, the relationship between poverty and burn and poison incidents due to household energy use maybe non-linear. The results of our analysis suggest that the risks of burn incidents and fires initially rise with income only to decrease at higher income levels. Moreover, for households below an energy poverty threshold, the risks of energy related accidents rise with an increase in household energy use, but falls once households cross this threshold. This suggests that a pro-poor approach is needed in designing programmes that lower the overall risk of these incidents. In addition, more rapid household energy transitions that displace paraffin with LPG and candles with electricity or solar power can help reduce the incidence and burden of these accidents.

Introduction and motivation

Despite the primacy of energy in people's lives, most sub-Saharan Africans live in energy poverty. About 80% of Sub-Saharan Africans primarily rely on solid fuels for meeting household energy needs, whilst about 7% use paraffin in their homes (World Bank, 2013; UNDP and WHO, 2009). The use of paraffin and solid fuels has been associated with fires, poisonings, and household air pollution related health losses (Polsky and Ly, 2012; Lam et al., 2012; Truran, 2009). Lack of access to modern energy carriers and efficient and safe energy using devices is a cause of the prevailing “energy poverty” that traps households in a vicious cycle of deprivation (UNDP, 2006; Masud et al., cited in Pachauri et al., 2012). A transition to safer energy carriers and equipment could reduce the vulnerability of energy-poor households, leading to better human health and welfare.

South Africa has made good progress compared to the rest of sub-Saharan Africa in providing access to electricity in recent decades. However, there are still 3.5 million South African households that are defined as energy poor by the government (Statistics South Africa [StatsSA], 2011). These households depend on unsafe and inefficient energy carriers and technologies for cooking and lighting. Amongst the most hazardous energy technologies used by poor households are paraffin stoves, lanterns and candles. Thus the energy-poor regularly suffer from fires and exposure to health damaging pollutants. It is reported that over 200,000 South Africans are injured or lose property each year due to paraffin related fires. In addition 80,000 children are estimated to accidentally ingest paraffin with very serious consequences (Mills, 2012). Apart from the deaths, many burn injury and paraffin ingestion survivors suffer lifelong disabilities and trauma that severely limit their productivity.

In this paper, we analyse the health risks of unintentional fire and burn related injuries and poisoning in South Africa caused by poor housing construction and unsafe storage and use of household fuels. We undertake quantitative analyses using a nationally-representative household energy consumption survey and sample of hospital treatment data to obtain an understanding of the kinds of issues that affect the occurrence and magnitude of shack fires. Thus, our study addresses

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a largely unexplored topic of hazards from fires and paraffin poisoning amongst poor households living in informal settlements in South Africa, relating these risks to energy poverty and poverty, more generally.

The recent Global Burden of Disease (GBD) study estimates that pollutant emissions from inefficient household cooking and heating killed nearly four million people in 2010 (Lim et al., 2012). This figure is almost twice the previous estimate. The higher estimate is, in part, a result of including additional diseases where there is new evidence of significant risk due to exposure to household air pollution, such as cardiovascular disease. However, this assessment still excludes risks associated with home energy use that extend beyond pollution alone, such as those due to burns, scalds, and poisoning, that kill thousands of people, especially women and young children in developing countries. The current global deaths from fires are estimated at 195,000 people (World Health Organization [WHO], 2012), which is a reduction from the 322,000 that were estimated to die from fires ten years ago (Mathers et al., 2003 cited in Golshan, Patel and Hyder, 2013). In addition, the WHO estimates that non-fatal burn injuries are a leading cause of morbidity. Peck et al. (2008) contend that these figures grossly underestimate the magnitude of burn mortality and morbidity, principally due to incomprehensive statistical information.

In South Africa, as is in many nations, it is the lower socioeconomic stratums that are disproportionately affected by household energy incidents. The same situation has been observed in South Asia where burn injuries happen in such households during cooking episodes (Golshan, Patel and Hyder, 2013). Previous research by Smith (1997); Smith and Ezzati (2005) outline a conceptual framework for environmental risk transitions to identify a shift in the character of these risks over the course of development. A transition away from environmental health risks seems to accompany rising incomes (Smith and Ezzati, 2005). However, evidence of how the risks of burns and paraffin poisonings are related to poverty, more generally, and energy poverty, in particular, is lacking for South Africa. An important consideration, beyond determining aggregate or national estimates of the health burden of these accidents, is in understanding the disparities in the incidence of such health risks across regions and population sub-groups and the underlying factors affecting these. In South Africa, the provinces with the least energy poverty (Gauteng and Western Cape) are the most affected by shack fires. This is because the urban centres in these rich provinces attract a lot of migrant workers who reside in fire-prone informal settlements. Thus, it is important to consider the role of informality in shack fire propensity. It has been pointed out in the literature that informal settlements are a shameful feature of poverty and inherited inequalities in South Africa (Huchzermeyer and Karam, 2006). However, within these informal settlements, this research indicates that income levels and energy poverty strongly correlate with the risks of burns and poisonings.

Energy poverty in many nations has been traditionally measured in terms of the household budget share on energy, in order to capture the affordability of energy. In this case, the higher the proportion of total household budget spent on energy; the less affordable it is said to be. However, the indicator performs poorly when some fraction of household energy is self-collected or non-commercial (e.g. firewood). Another problem with this measure is that the energy budget share of a household is dependent not only on the types of energy used and their market prices, but also the efficiencies and the costs of appliances needed for using the specific energy types, all of which are not captured by the measure (Pachauri et al., 2004). For these reasons, alternative measures of energy poverty have been proposed that combine elements of access to different types of energy, their efficiencies of use, and the actual amounts consumed to better capture the level of energy services households have. Such measures have also been found to correlate better with other dimensions and measures of poverty (Vermaak et al., 2009; Pachauri et al., 2004; Pachauri and Spreng, 2011). In this paper, we build on previous research by Vermaak et al. (2009) that developed an end-use and access-adjusted energy based poverty indicator for South Africa using data gathered from a nationally representative South African household survey.

The rest of the paper is organized as follows. In the next section we briefly examine the existing patterns of household energy access and use in South Africa and the incidence of energy-use related fires, fire and burn related injuries and poisonings. Section 3 describes the sources of data employed and the methods used in this analysis. Section 4 then presents results from our analysis of disparities in household risk across regions and how this risk varies by poverty and energy poverty levels. Finally, Section 5 concludes with a discussion of the results and some broad implications for policy.

Household energy use patterns and energy related accident incidents

Energy use patterns in low income households

Energy consumption patterns amongst low income South African households show a strong correlation with spatial location and socioeconomic characteristics (DoE, 2009). Rural–urban divide, climatic conditions, and locality have a large influence on energy choices. Choices seem to be largely influenced by availability and affordability, with woody biomass being more commonly deployed in rural provinces, coal on the Highveld, and paraffin in urban provinces. Multiple fuel use is common in both electrified and non-electrified households. In this regard, wood is commonly substituted with paraffin and candles with electricity.

Table 1 illustrates energy consumption patterns in electrified and non-electrified households by spatial location. The rural–urban divide signifies different levels of energy accessibility due to divergent incomes and the non-availability of some energy carriers in certain places. The urban areas are further categorised into formal and informal settlements which typify income proxies. The extent to which households that lack access to electricity must rely on poorer sources of energy is clearly apparent. In non-electrified urban formal and informal settlements, there is over 80% reliance on paraffin (Table 1). Firewood is a significant but inefficient source of energy in rural areas, both amongst the electrified and non-electrified, thereby contributing to the incidence of rural energy poverty. The firewood is mostly collected from indigenous woodlots or bought from vendors. Another poor energy source is candles, a widely used light source in non-electrified areas, but also a significant alternative and back-up illumination technology in electrified areas.

The more affluent provinces of Western Cape and Gauteng have the highest number of informal dwelling structures (shacks) and correspondingly high paraffin dependency for cooking tasks (Table 2). These provinces are also frequently in the news due to the occurrence of shack fires. Non-electrified households in rural provinces (e.g. Limpopo and Northern Cape) seem to rely on firewood for their most thermal-intensive household energy tasks. Although LPG offers a clean cooking

Table 1
Household use of energy source by electrification status and location.

Energy source	Electrified (%)			Non-electrified (%)		
	Rural	Urban formal	Urban informal	Rural	Urban formal	Urban informal
Candle	67	46	50	87	82	79
Electricity	98	99	100	3	0	0
Firewood	73	15	8	85	28	22
Paraffin	32	37	26	56	81	92
Batteries	3	3	7	33	24	29
Gas	4	6	2	12	8	7
Coal	3	9	7	4	13	4
Generator	1	1	7	6	3	4
Solar	1	1	0	5	2	0

Source: DoE, 2009.