PEDESTRIAN INJURY IN SOUTH AFRICA: FOCUSING INTERVENTION EFFORTS ON PRIORITY PEDESTRIAN GROUPS AND HAZARDOUS PLACES

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ABSTRACT

In South Africa, as in other low- to middle-income countries, pedestrians account for the major proportion of road traffic injuries (RTIs). In order to inform our social responses to pedestrian injuries this chapter attempts to provide an overview of the human and environmental context within which pedestrian injuries occur and examines existing pedestrian safety efforts. More specifically, this chapter presents an analysis of pedestrian fatal injuries (2001-2004) and a review of current selected pedestrian safety efforts in South Africa. The interventions are reviewed against international benchmarks and analysed for local relevance and appropriateness. The analysis points to the need for re-defining target pedestrian groups for intervention and increased sensitivity for local specificities. Pedestrian safety measures must take cognisance of the local context of perceived and real crime, poverty and increased urbanisation and adopt a multidimensional approach. The inordinate focus on educational interventions must widen to include engineering measures that recognise pedestrians as significant road users. Likewise this analysis suggests that interventions ought to address the pedestrian fatalities-alcohol nexus, at risk behaviours and at-risk environments.

Key-words: pedestrian injuries; pedestrian safety; prevention; South Africa

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INTRODUCTION
The magnitude and severity of road traffic injuries (RTIs) is widely acknowledged. The World Health Organization (WHO) ranks road traffic injuries (RTIs) as the 11th leading cause of death, accounting for 2.1% of all global deaths (Peden, Scurfield, Sleet, Mohan, Hyder, Jarawan & Mathers 2004). In low- to middle-income countries in particular, pedestrians and cyclists account for the major proportion of RTIs (Peden et al. 2004). In high-income countries, such as the Netherlands, pedestrian deaths account for 10% of all road traffic fatalities. In the USA, this figure is 13%, in Norway 16%, in Australia 18%, and in Japan 27% (Mohan 2002). By contrast, in Mexico the percentage of deaths from traffic crashes involving pedestrians soars to 57% (Hijar, Kraus, Tovar & Carrillo, 2001), in India this figure is 42% and in Thailand 47% (Mohan 2002). In African countries, estimates of annual pedestrian fatalities as a result of RTIs range from 39% in Tanzania, to 64% in Kenya, and to 75% in Cote d’Ivoire (Odero, Garner & Zwi 1997; Peden et al. 2004). In South Africa, similarly high figures are recorded, where in 2003 the MRC-UNISA National Injury Mortality Surveillance System (NIMMS) revealed that pedestrians accounted for the largest percentage (39.5%) of traffic-related deaths (Matzopoulos 2004).

The magnitude of the risk faced by pedestrians in low- to middle-income countries, such as those in South-East Asia, South America and Africa, is further evidenced by the pedestrian mortality rate in the major cities of these countries, which averages around 2-3 per 100 000 persons in Mumbai and Mexico City, and 10 in Sao Paulo (Mohan 2002). In 2004, South African mortality rates ranged from 12.4 per 100 000 in Pretoria to 19.3 in Cape Town (Mabunda, Swart & Seedat 2007). On the other side of the spectrum, in high-income cities, such as Tokyo and London, pedestrian fatalities rates drop to around 1 per 100 000.

The effect of the high number of pedestrian injuries in low- to middle-income countries includes not only the physical consequences of disablement and death, but also carries a psychosocial burden of trauma for both the victims and their families (Sukhai, Noah & Prinsloo 2004). Moreover, the economic impact on a broader societal level clearly identifies pedestrian injury as a serious public health concern and intervention in this area as a major challenge. In South Africa, the impact on the economy of RTIs has been well documented (see Sukhai et al. 2004). In order to appreciate the full scope of the problem in South Africa and to refine ways of addressing this situation, a full understanding of the human and environmental context is needed, coupled with an assessment of existing intervention efforts.
To begin the discussion that follows, Mabunda et al.'s (2007) analysis of pedestrian injuries that occurred between 2001 and 2004 in South Africa is presented. They found that the huge majority (76%) of these fatalities were male pedestrians, consistent with the trends reported in both other low- and high-income countries (Harruff, Avery & Alter-Pandya 1998; LaScala, Gerber & Gruenewald 2000; Odero et al. 1997; Holubowycz 1995). In contrast to age distributions seen in high-income countries (Assailly 1997; Rivara 1990), and comparable reports in low- to middle-income countries (Nantulya & Reich 2002; Odero et al. 1997), almost half (47%, n = 2,886) of the pedestrian fatalities were young adults between 20-39 years of age and another 26% (n = 1,591) were older adults between 40-59 years. Further to this, Mabunda et al. (2007) identified three groupings of pedestrian fatalities based on age, gender, the use of alcohol, day and hour, namely: first, children, adolescents, and young adult pedestrians killed primarily during the week in the afternoons and evenings (38.3%); second, female and elderly pedestrians involved in traffic accidents primarily in the morning between 06h00 and midday (34.4%); and third, male pedestrians who had high levels of alcohol concentration (27.3%). Importantly, Mabunda et al.'s (2007) profile of South African pedestrian fatalities recognised the omission of specific environmental descriptors related to the scene and circumstance of the injuries in the recorded pedestrian injuries.

A review of intervention efforts in South Africa in light of international trends by MacKenzie, Seedat, Mabunda and Swart (2006) is then presented. Their review refers to international literature that shows while education programmes have tended to dominate pedestrian safety initiatives, the trend is now moving towards comprehensive strategies that incorporate engineering components as more appropriate for long-term success in pedestrian injury reduction. Although limited, multifaceted interventions are taking place in South Africa and other African countries. This approach is supported by South African researchers, such as Ribbens (1996), who has acknowledged the need for enhanced engineering strategies and the provision of pedestrian facilities in South Africa in a proactive manner that emphasises prevention over post-injury intervention in order to create a user-friendly pedestrian environment. The review of pedestrian interventions emphasises the broader context in which injury occurs, recommending that interventions should reach beyond the issue of road safety by taking into account the context of crime, urbanisation and poverty in which pedestrians in these countries find themselves.

This chapter aims to first present a summary of the key findings and conclusions from both contributions, followed by a discussion. The first
The aim of the discussion is to determine whether existing intervention efforts in South Africa are appropriate to the identified target groups in Mabunda et al.'s (2007) study, and the second is to ascertain what information and action is further required to combat the problem. This must be done in a way that takes into account those who are most at risk and the types of intervention that have been judged as most effective. The limitations of available data and the shortcomings of existing South African intervention strategies in this regard are discussed.

TWO CONTRIBUTIONS TO THE AREA OF PEDESTRIAN SAFETY IN SOUTH AFRICA

CHARACTERISING FATALY-INJURED PEDESTRIANS IN SOUTH AFRICA

Research in high-income countries has identified children, followed by the elderly, and intoxicated people as the highest risk groups of pedestrians (Assailly 1997; Fontaine & Gourlet 1997; LaScala et al. 2000). For example, the greatest risk to schoolchildren from bus-related injuries was found to be as pedestrians after alighting from a bus in New South Wales, Australia (Cass, Ross & Lam 1997); injury to pedestrians was the most frequent cause of multiple trauma (54%) among children 0-16 years in a large Spanish urban area (Sala, Fernandez, Morant, Gasco & Barrios 2000); in California a motor vehicle versus pedestrian accident study reported that these accidents were common and the high mortality rate among the elderly indicated the need for more aggressive and effective prevention efforts (Peng & Bongard 1999); a study from Canada showed that children's greater exposure to traffic was associated with higher injury rates (MacPherson, Roberts & Pless 1998); and a study of older people's lives in the inner city in Sydney, Australia, showed that environmental hazards, such as pedestrian safety and traffic management, affect the whole population and require intervention at government level (Russell, Hill & Basser 1998).

Evidently, children and the elderly in high-income countries face greater risk of injury due to their exposure to the traffic, as they are the greater pedestrian groups in these countries. Accordingly, intervention efforts are directed towards these groups.

While children are also at risk in low- to middle-income countries, research has shown that the majority of pedestrian accidents involve young adults (see Khan, Jawaid, Chotani & Luby 1999). Lower motorisation is characteristic of these countries where a large proportion of the population are obliged to walk, and in turn, lower motorisation has been associated with higher pedestrian fatalities, where a greater number of people are exposed to the risk of pedestrian injuries (Mohan 2002). Young adults comprise the...
major component of any country’s workforce and have to travel on a regular, if not daily, basis for work in addition to other activities. Thus, as young adults are generally the most mobile group of any population, having to walk as a primary means of transport means that young adults in low- to middle-income countries are the most at risk of pedestrian injury.

An analysis of data obtained from the MRC-UNISA NIMMS between 2001 and 2004 by Mabunda et al. (2007) characterises the demographic, temporal and behavioural trends of 7,433 pedestrian injuries in the cities of Cape Town, Durban, Johannesburg and Pretoria, South Africa. The NIMMS uses a range of existing medico-forensic investigative sources, including post-mortem reports, SAPS 180 forms, chemical pathology laboratory results and criminal justice system reports. The analysis reports on the age, sex, month, day, time and blood alcohol concentration (BAC) levels recorded for these deaths. Notably, Mabunda et al. (2007) found that information relating to the scene of the injury is represented solely by one item delineating road/street/highway, but no other information relating to the scene and circumstances of injury is recorded.

Other research has found that in South Africa pedestrian fatalities peak in the 30-34 year age group (Harris, Sukhai & Matzopoulos 2004). Similarly, the analysis by Mabunda et al. (2007) reported the average age of pedestrian fatalities as 32.9 years (SD = 17.10), with nearly half of the total pedestrian fatalities comprising young adults aged between 20-39 years of age. The highest number of deaths occur in the 30-34 year age group. Among the children and adolescent deaths, a peak in the 5-9 year age group is apparent.

In terms of gender, the majority of pedestrian deaths in South Africa during the 2001-2004 period were male (76%), representing a ratio of 3.3 male deaths for every female pedestrian death. Notably, in the 20-39 year age group this ratio increased to 4.59 male deaths for every female death. Thus, a picture of a high number of pedestrian deaths occurring among young adult males in South Africa emerges.
The BAC levels were tested for just over half of the pedestrian fatalities occurring between 2001 and 2004 in South Africa. Out of these cases, 58% tested positive for alcohol in their blood stream. Again dominant gender and age characteristics were revealed in the results, where nearly two thirds of those tested positive for alcohol were males and more than one third of the pedestrian fatalities in the 25-54 year age group tested positive for alcohol.

Mabunda et al.’s (2007) research also reported on the temporal characteristics of the pedestrian accidents during this period in terms of month, day and time of death. Pedestrian fatalities were lowest at the beginning of the year in January, and then increased in February and again in March, ranging from 609 to 683 per month through to December. Nearly a quarter of pedestrian deaths occurred on a Saturday, representing the highest number for the days of the week, followed by Sunday. The peak for Saturday was more pronounced among the 20-39 year age group. Just over half of pedestrian deaths occurred early to late evening between 17h00 and 23h00. While the deaths among children and adolescents peaked in the early afternoon, the peak for those in the 20-39 year age group was later, where over one third were killed between 18h00 and 21h00.

As a means of identifying the relationship between the five variables of age, sex, BAC, day and time of death Mabunda et al. (2007) used multiple correspondence analysis, followed by a two-step cluster analysis to identify homogenous groups of pedestrians involved in fatal accidents based on these variables. Three distinct groups were delineated as follows:

1) **Children, adolescent and young adult pedestrians:** Comprising 38% of all the pedestrians included in the analysis, the majority of this cluster were male (76%). The highest proportion (44%) was under 19 years
of age, followed by those aged 20-39 years (33%). Over half of these deaths occurred during the week; 40% in the evening between 18h00 and midnight; and 36% in the afternoon between midday and 17h00. BAC was not suspected and thus not tested in this group.

2) Female and elderly pedestrians: Just over one third (34%) of the fatally-injured pedestrians were clustered in a group that comprised mainly females (60%). All age groups were represented, where 47% were aged between 20-39 years; 23% in the 40-59 age group; and 9% in the 0-10 year age group. Of particular interest is that the remaining 21% were all the pedestrians in the elderly group aged 60 years and older. Most accidents occurred between 18h00 and 23h00, although compared to the total sample, accidents occurring in the morning between 06h00 and midday were over represented in this group. Of those tested for alcohol, the majority (81%) were negative.

3) Male pedestrians with high BAC levels involved in a night accident: This cluster comprised 27% of all the fatally-injured pedestrians. The cluster was almost exclusively male (98%) mostly aged between 20-39 years (65%), followed by those aged 40-59 years (32%). Three-quarters of the accidents in this group occurred over the weekend and tended to take place between 18h00 and 06h00 (81%). Almost all those tested for BAC (96%) were over the legal limit (in excess of 0.05 BAC).

Source: Mabundu

**Figure 2:** Multiple correspondence analysis: Factorial plan 1 – 2
In their report, Mabunda et al. (2007) drew similarities between the South African pedestrian fatality data and research from other low- to middle-income countries showing that the majority of fatalities were male pedestrians and that the predominant age group was 20-29 years. They argued that these results, in addition to the three groupings of pedestrian fatalities, have implications for pedestrian accident prevention in South Africa. In this way they emphasised that pedestrian safety programmes need to be designed specifically to target the different groups. Suggestions for two of the groups include safe places for children to play in the afternoons and retro reflective clothing for the evening (first group), and alcohol awareness campaigns (third group).

While the study provides a useful means of highlighting specific high-risk groups, the authors also pointed out that a major limitation of the data was that environmental factors associated with pedestrian fatalities were not recorded. They stressed that information pertaining to the specific environmental circumstances of pedestrian injuries is vital for the effective implementation of environmental interventions. In addition, they suggested that further research should be undertaken to uncover the social determinants of pedestrian accidents.

**Reviewing intervention efforts in South Africa and other African countries**

By way of understanding the typical classification of pedestrian interventions, it is useful to refer to the description by Stevenson and Sleet (1997) as comprising “various combinations of pedestrian skills training, parent education, legislation, environmental modifications and changes to vehicle design” (p. 212). Three main intervention categories are thus identified, namely: educational, engineering and enforcement.

Interventions based on the educational approach to improving pedestrian safety focus on teaching pedestrians road safety skills and can occur in a variety of contexts and employ different methods. Enforcement interventions focus on the road users’ adherence to traffic regulations and for the most part have been directed at regulating driver behaviour, although there have been some efforts to monitor pedestrian behaviour. Engineering interventions can be further differentiated as either engineering-environmental or engineering-design interventions. Environmentally-based interventions involve structural changes to the road environment, such as pedestrian bridges, pedestrian crossings, etc. Engineering-design approaches to pedestrian safety include the development of safety or injury-reducing products, such as retro-reflective clothing and other visibility aids.
Published in the Cochrane Database of Systematic Reviews (CDSR), the review of 15 randomised-controlled trials of pedestrian safety education interventions by Duperrex, Bunn and Roberts (2003) revealed a strong focus on international educational interventions that target school-going children. Duperrex et al. (2003) found that the effect of safety education on actual pedestrian behaviour varied considerably, and they concluded that there was no reliable evidence to show that pedestrian education prevents pedestrian injuries. Similar research has shown that while road safety training programmes increase children’s traffic knowledge, they do not necessarily improve children’s real-life road crossing behaviour (e.g. Zeedyk, Wallace, Carcary, Jones & Larter 2001). Research has thus concluded that educational programmes are useful for increasing traffic safety knowledge, but insufficient when used by themselves as an intervention (Mohan 2004).

Duperrex et al. (2003) recommended that greater enforcement of traffic laws, such as speed limits, should be promoted, in addition to an increased emphasis on interventions that incorporate engineering interventions. Similarly, the Cochrane review by Bunn et al. (2003) promoted traffic calming interventions, such as speed humps and roundabouts, as well as speed limits, substantiated by reports of injury rate reduction in targeted areas. Engineering interventions comprising a design aspect, such as visibility materials, were supported to a certain degree in a review of such interventions by Kwan and Mapstone (2003). Bunn et al. (2003) recommended that the effects of such engineering interventions should be studied in low- and middle-income countries, noting a significant gap in this area.

For reasons, such as a lack of resources (Downing, Baguley & Hills 1991), there has been comparatively little research and intervention in the area of pedestrian safety in low- to middle-income countries. This provided the rationale for a review of pedestrian safety interventions in South Africa and other African countries. Providing a context for this review, MacKenzie et al. (2006) drew on international findings, such as those discussed above, to derive five potential “success criteria” or international benchmarks that should be considered when planning a pedestrian safety intervention strategy:

1) to acknowledge the limitation of educational interventions and specify their primary function as increasing traffic safety knowledge
2) to make educational interventions part of a comprehensive multi-component programme that includes more than one intervention approach
3) to promote the development of engineering-environmental interventions, such as traffic calming measures, given the likelihood that they can reduce road traffic deaths and injuries for all road users
4) to include engineering-design interventions, such as visibility aids, as part of holistic pedestrian safety programmes
5) to evaluate programmes thoroughly by means of randomised controlled trials in order to increase knowledge and learning in this area.

Nine organisations hosting a total of 26 pedestrian safety programmes participated in the survey of pedestrian safety programmes by MacKenzie et al. (2006). Six of the organisations were South African, and the others were based in Uganda, Kenya and Mauritius. The organisations included government agencies, non-profit and non-governmental organisations, research organisations and private companies. The full range of intervention categories was reported by these organisations.

Most of the educational programmes surveyed targeted school-going children. Programmes were sometimes integrated into the school curriculum taking the form of workshops, with training often becoming the responsibility of educators. Educational materials, such as flip charts, manuals, videos and resource packs, supplemented these programmes. Others applied an “edutainment” approach, where performances by entertainers at road safety talks attracted participation from adults and children alike. Interactive pedestrian safety games at these events also encouraged active involvement. The use of traffic models at schools was also described, for example, traffic training centres comprising small-scale streets and traffic signs were constructed where children could gain practical experience with regard to correct behaviour, sharing the road and observation.

Taking a more inclusive approach, community-driven road safety training workshops involving other target groups, such as parents, volunteers, law enforcement officers and community leaders, were also reported. The aim of these workshops is to empower all community members with knowledge and skills to train young children to participate safely in the traffic environment. Themes, such as road crossing, visibility and the effects of alcohol and drugs, are included in the content of these programmes. In a Ugandan programme, a focus on injury prevention is included, in addition to a first aid component.

Adults are targeted in educational interventions to a lesser degree, where a handful of the surveyed pedestrian safety programmes imparted pedestrian safety training through community workshops. Important for the South African context, these programmes accommodate different language usage and literacy levels through varying forms of educational materials, for example, an adult pedestrian safety programme run by a South African government agency uses a pictorial format for flipcharts and manuals, in
addition to safety videos. At a broader national level, media campaigns are oftentimes employed by government organisations in both South Africa and other African countries, employing television and radio broadcasts, newspaper advertisements and the use of billboards.

Assessing the pedestrian safety programmes against the first and second international criteria pertaining to educational interventions, it was found that 18 of the 26 programmes adopted this approach, with half of these adopting educational activities as their exclusive focus. Thus, while the importance of increasing safety knowledge was realised (criterion one), only half of these programmes were integrated into multifaceted intervention approaches (criterion two). Fourteen of the educational intervention strategies specifically targeted children, comprising interventions that aim to teach children road safety skills through instruction involving written material, audiovisual aids and sometimes practical examples. Thus, for the most part the target group for intervention is children.

Support of both the third and fourth criterion was evident in a recent summation by Sukhai and colleagues (2004) which noted that passive interventions of the engineering category (both environmental and design) were generally more successful than active measures (education and enforcement interventions) in the South African context.

Specific to the third international criterion, the pedestrian safety programme review reported that there were a few programmes that focus on engineering-environmental pedestrian safety interventions. Contextualising these findings, the review drew on Ribbens’ report (1996) which described two main strategies in the South African context: integration and segregation approaches. The former involves integrating pedestrians with the road traffic and managing their movement through “temporal separation”, such as pedestrian crossings and traffic lights or through “soft separation”, such as traffic calming measures (Ribbens 1996). Traffic calming measures, such as road narrowing, roundabouts, rumble strips and speed bumps, aim to prevent motorised traffic from travelling at the high speeds considered to endanger pedestrians (Peden et al. 2004). Ribbens (1996) noted a stronger emphasis on temporal separation in South Africa and that traffic calming is less developed. Segregation approaches separate pedestrians from the road traffic either horizontally, for example, via pedestrian malls, sidewalks, and separate walkway systems, or vertically, for example, foot bridges and subways (Ribbens 1996). Ribbens (1996) pointed out that factors, such as cost restraints, have meant that these approaches are less evident in South Africa when compared to developed countries.
Examples of both integration and segregation strategies were evident in the review, for example, an engineering consulting practice in South Africa is involved in a range of national engineering-environmental interventions, such as constructing pedestrian crossings, pedestrian walkways, pedestrian bridges, traffic calming and pedestrian road signs. Another programme has developed manuals that supplement engineering-environmental interventions by providing road authorities and engineers with suggestions for appropriate facilities for pedestrians and cyclists, such as pedestrian crossings, traffic circles, etc.

Engineering-design interventions were also detailed in the survey of pedestrian safety programmes. Importantly, their objective aligns with the fourth international criterion of being part of holistic intervention approach, where it is reported that, in combination with educational activities, some programmes distribute visibility materials, such as armbands, sashes and t-shirts, to learners and parents in areas regarded as hazardous for pedestrians. Similarly, multi-component programmes, such as scholar patrol programmes, involve the training and supervision of volunteer learners by teachers in close collaboration with law enforcement officers, as well as the provision of visibility materials. In South Africa, reflective materials are also given out during sports events. Sukhai et al. (2004) also reported an initiative undertaken by the CVLIP together with the CSIR, 3M and Drive Alive to pilot and evaluate the use of reflectorisation among child pedestrians.

Other holistic South African programmes identify hazardous locations and develop pedestrian safety management plans in South Africa involving engineering-environmental modifications, in conjunction with education and communication strategies with communities and law enforcement agencies. Some of these programmes are part of broader initiatives, such as poverty alleviation and community development.

Across the nine participant organisations only one specifically enforcement-focused programme was reported, involving the regulation by on-site traffic police officers of pedestrians crossing the road. Police officials are designated to pedestrian-heavy street corners where they select those pedestrians transgressing the rules of the road, providing them with correct pedestrian protocols and instructions. In line with a multi-component intervention approach, the survey also found that law enforcement officers are sometimes included in educational programme workshops and have also been included in scholar patrol programmes, where they are encouraged to collaborate with the teachers supervising these programmes. A Ugandan school road safety
programme included first aid training for traffic police who are oftentimes first on the scene of traffic accidents.

Intervention efforts were formally evaluated and findings documented in many instances, in keeping with the fifth international success criterion. Formative research was often conducted to assess the needs of particular settings and to decide on appropriate intervention approaches. Programmes were monitored throughout their inception and development processes and in some instances their outcomes and impact were measured. Participatory research methods were employed to gauge the reaction of targeted communities to programmes. The survey reported, however, that few reports were easily accessible to the public and most reports took the form of internal publications. The full scope of published research on pedestrian safety in Africa is thus difficult to ascertain.

MacKenzie et al.'s review of pedestrian safety efforts in South African and other African countries made several recommendations for further action. One of these was that educational intervention efforts need to consider that research has found the highest number of South African pedestrian deaths to be among young adults. They also acknowledged the importance of inclusive intervention approaches and noted that while cost may be a limitation in developing interventions, it is important to ensure that available budget is appropriately allocated.

The review also pointed out that the broader South African context must be considered, drawing on socioeconomic factors that affect the traffic environment. For example, they referred to research that describes the development of informal settlements alongside main roads (Sukhai et al. 2004). Also, they noted that high levels of crime and violence in South African challenge pedestrians and affect their safety in other ways, calling for collaboration between all organisations in private and public sectors that have a vested interested in broader safety issues.

DISCUSSION
Broadly speaking, the conclusions drawn from the analysis of pedestrian fatality data (Mabunda et al. 2007) and the review of pedestrian safety programmes (MacKenzie et al. 2006) point to two main areas requiring attention: 1) defining target groups for intervention, and 2) adapting intervention for the South African environment. Both areas are underpinned by the imperative to expand into multi-component intervention efforts in terms of whom they should target and where they should focus. It now
becomes important to determine the synthesis between the findings of these two contributions, with regard to whether existing pedestrian safety programmes are appropriately targeted to those most at risk, and to determine what more needs to be done in future prevention efforts.

**PEDESTRIAN SAFETY INITIATIVES IN SOUTH AFRICA AND CHARACTERISTICS OF FATALLY INJURED PEDESTRIANS: WHOM SHOULD THEY TARGET?**

It is apparent that, as is the case overseas, educational programmes predominate in South Africa. There is little doubt that introducing some form of road safety education is important for all road users. However, picking up on the limitations of translating training into actual behavioural changes, international research has recommended passive protection methods, particularly for children who are more limited in terms of their physical and cognitive abilities (Dupperex et al. 2003). Acknowledging international research that shows the shortcomings of relying on interventions based solely on teaching pedestrians road safety skills, both Mabunda et al. (2007) and MacKenzie et al. (2006) have realised that this approach should be reassessed and shifted from being the sole focus of pedestrian safety initiatives.

This said, both reports showed an understanding that it is also the target groups of pedestrian safety interventions that need to be examined. It emerged that children are the primary target groups for educational programmes, also imitating international trends. However, the profile of fatally injured pedestrians by Mabunda et al. (2007) revealed that South African pedestrian deaths are highest among young adults, aged between 20-39 years, a finding similar to other research in low- to middle-income countries. Both Mabunda et al. (2007) and MacKenzie et al. (2006) agreed that intervention efforts should target young adults, particularly males, for reasons pertaining not only to the psychological trauma to the families resulting from such loss, but also because of the detrimental impact on the broader social context and economy. It has to be considered that these young men are in many cases the breadwinners of families and the mainstay of the labour force.

The typology of fatally injured pedestrians delineated three main categories, namely: 1) Children, adolescents and young adult pedestrians; 2) Female and elderly pedestrians; and 3) Male pedestrians with high BAC levels involved in a night accident. In view of these categories, it is evident that pedestrian safety interventions should essentially target all members of the community. Some of the surveyed pedestrian safety programmes targeted
adults through community workshops, although these were in the minority. More of these types of interventions are clearly needed, provided their current methods are proved effective through thorough evaluation.

Another important aspect is the content of pedestrian safety education programmes. From the review the focus of these programmes is on teaching pedestrians road crossing and other traffic safety skills, adopting various formats, such as lectures, manuals, traffic models, simulations or real-life training exercises. In view of the third category of fatally injured pedestrians, however, there is little evidence that the risks of alcohol consumption and pedestrian behaviour are communicated in these programmes. This type of information would be a valuable component of education programmes. Taking on a more inclusive approach it would also be important to incorporate pedestrians in awareness campaigns which currently focus primarily on drivers. Similarly, whereas laws are directed at controlling driver alcohol impairment, international research has suggested that the enforcement of legal alcohol limits for pedestrians should be introduced (Oestroem & Eriksson 2001). Picking up on Mabunda et al.’s (2007) suggestion that more research needs to identify the social determinants of pedestrian fatalities, such investigations may be able to explore behaviours, such as problem drinking and the socioeconomic factors that may relate to such behaviour, for example, unemployment and poverty. In turn, this research could help to identify specific communities and areas where intervention efforts should be targeted. Again, intervention efforts can be broad, reaching beyond pedestrian safety into campaigns that encompass community upliftment.

The category of educational interventions ranges from focused training sessions to broad public awareness campaigns. General awareness campaigns play a vital role in stimulating the broader consciousness of road users. It is important that these campaigns are underpinned by informed strategies. The website for the South African Department of Transport’s initiative, Arrive Alive (www.arrivealive.co.za) reports that they draw on fatality data to determine the major contributory factors for road crashes. For example, a report during the Easter 2005 period described two major contributory factors to crashes, namely: road user factors and vehicle factors. Road user factors listed included pedestrian jay-walking, speeding, drivers and pedestrians under the influence of alcohol, unsafe overtaking, and turning in front of oncoming traffic (Arrive Alive, date of article). Evidently these factors help to inform Arrive Alive’s awareness campaigns and other interventions. When we return to the analysis of pedestrian fatality data by Mabunda et al. (2007) it is encouraging to see some indication that
these awareness campaigns are playing role in preventing accidents. This is evident in the early months of the year following Arrive Alive’s well-known December holiday campaign, where the lowest number of pedestrian fatalities is recorded. Thus to some degree, Arrive Alive’s target groups of drivers and pedestrians alike are heeding the warnings promulgated by the campaign’s message.

SPECIFIC ENVIRONMENTAL FACTORS: WHERE SHOULD PEDESTRIAN SAFETY INTERVENTIONS FOCUS?

International research recommends that, rather than relying on pedestrians to make the safest decisions, the traffic environment should be modified through passive protection methods, such as engineering interventions (Dupperex et al. 2003). Both environmental and design interventions are included here. Mabunda et al.’s (2007) analysis of pedestrian fatality data emphasised the importance of taking spatiotemporal factors into account in interventions. The fact that fatalities occur mainly in the evenings and during the winter months, indicates that decreased visibility may be a significant factor in fatal road traffic crashes (Sukhai et al. 2004). The distribution of visibility aids reported in MacKenzie et al.’s (2006) survey of pedestrian safety programmes clearly showed the uptake of this information into intervention action.

In terms of environmental interventions, the case for both segregation and integration approaches was made in MacKenzie et al.’s (2006) review. South African research reiterates the importance of separating pedestrians from the traffic through physical barriers, overpasses and underpasses, in view of the rapid urbanisation occurring in this context, where informal developments are often set up close to major roads (Sukhai et al. 2004). Although segregation approaches are limited by factors, such as cost, it is recommended that resources currently invested in educational interventions are reallocated to more inclusive approaches. The review by MacKenzie et al. (2006) identified the growth needed in integration approaches, such as traffic calming measures (encapsulated by the third international success criterion). This view is reiterated in the emphasis placed on the need by Bunn et al. (2003), the relative underdevelopment of this approach as identified by Ribbens (1996), as well as the findings of the survey of pedestrian safety programmes. Moreover, when introducing any type of environmental intervention, the broader socioeconomic context needs to be considered. For instance, the residents of the informal settlements may be unfamiliar with the modern traffic environment and thus may need to be educated with pedestrian skills for this context (Sukhai et al. 2004). Inclusive intervention efforts can thus contribute to the upliftment of these communities.
through the provision of both better infrastructure and education.

What is not clear, however, is whether existing environmental interventions are supported by a complete analysis of the environment and hazards faced by vulnerable pedestrians in South Africa. Mohan (2002) described the relationship between motorisation and pedestrian fatalities, where the proportion of pedestrians killed in traffic crashes is much higher in less motorised countries. Like other low motorised, low- to middle income countries pedestrians are thus at high risk in South Africa. With little public transport and infrastructure for pedestrians, it can be surmised that the primary contributing factor to pedestrian injury is increased exposure to traffic. International research has examined the extent to which pedestrians have to navigate the road environment. For example, the Canadian study by MacPherson et al. (1998) studied children's road crossing behaviour and found a positive correlation between the number of streets crossed by children and the likelihood of injury. But, it is also the precise nature of the pedestrians' interaction with the traffic environment that will determine their risk. Some international research has detailed the locations of where traffic injuries occur. For example, a study from Seattle showed that 66% of the fatal injuries occurred on city or residential streets, and 29% occurred on major thoroughfares, while a single urban highway accounted for 12% of pedestrian fatalities and represented a particularly hazardous traffic environment (Harruff et al. 1998).

MacKenzie et al.'s (2006) review of pedestrian safety programmes reported that much of the work in engineering-environmental interventions is preceded by research. This research identifies hazardous locations where pedestrians are most at risk and determines the most appropriate engineering intervention to improve existing infrastructure. And yet, Mabunda et al.’s (2007) research noted an absence of the localities of accidents in pedestrian fatality data. It was found that one item delineates whether the accident took place on a road, street or highway, but no other information relating to the scene and circumstances of injury is recorded. Arrive Alive (www.arrivealive.co.za) has reported that its intervention strategy is based on information from accident statistics. These statistics report on the number of fatal crashes across road user groups (drivers, passengers and pedestrians) in South Africa by province (see, e.g. Arrive Alive 2005; 2006). Similar to the NIMMS report, the statistics include temporal demographics, such as day of the week and time of day. But this is where it seems to stop, indicating a gap in terms of information pertaining to the specific environmental circumstances of pedestrian injuries. In this light, it seems
that analyses involving accident data, such as the 21 items of the NIMMS and those of the Arrive Alive reports, should endeavour to expand their items. This data should include examinations of police reports that identify particular environmental descriptors, such as whether accidents occurred at intersections and what type of intersection (traffic light, stop street). Other observational methods of the traffic and road user behaviour at these sites could help determine the appropriate intervention method, for example, whether an intersection needs a pedestrian crossing or bridge. Therefore, it is recommended that these research efforts need to be refined in order to determine conclusively the precise nature of hazardous environments and circumstances for pedestrians.

It would also be interesting to know more about other features pertaining to the exact locations of accidents, such as whether there was a pedestrian safety facility (e.g. a pedestrian crossing or bridge) in the vicinity or whether it was near a residential area (e.g. an informal settlement). If, for example, it were shown that a pedestrian safety facility was nearby, this would suggest that there might be reasons as to why that facility was not being used. International research in low- to middle-income countries such as Pakistan and Brazil has shown that pedestrian safety interventions are under-utilised (Khan et al. 1999). In Karachi, for example, pedestrians do not always use the available zebra crossings and motorists often ignore them (Khan et al. 1999). In a study in Rio de Janeiro, footbridges were not used because pedestrians preferred to take the quicker albeit hazardous option of directly crossing the busy street (Khan et al. 1999). Increasing public awareness through publicity campaigns and pedestrian education in addition to regulation enforcement by the relevant authorities has been recommended as ways of addressing these types of problems (Khan et al. 1999).

Similarly, in South Africa, pedestrians are sometimes reluctant to use footbridges if they are not well situated and take more time to cross the road than at grade level. The reasons for such under utilisation may lie, however, beyond mere pedestrian apathy or lack of safety education. In a context of high levels of violence and crime, pedestrians are vulnerable to victimisation. Any environment that is perceived to be dangerous impedes pedestrian movement, hence fear of victimisation may affect where pedestrians choose to walk (Robertson 1994). An article in a local South African newspaper highlighted the problem of crime on pedestrian footbridges where armed robbers sealed off both ends of the bridge in order to trap and rob those using the bridge (Handfield-Jones 2004). Pedestrian safety interventions need to take these risks into consideration, and this again reiterates the need for the involvement of other organisations interested in the safety and security of South Africans.