GLOBAL HEALTH INNOVATION

OPEN UCT PUBLICATIONS

Engaging minibus taxi drivers in the quest for child safer roads

Aliasgher Janmohammed[a,b*], Ashley van Niekerk[c], Ruwayda Samuels[b], Marcella Naidoo[b], Arjan B. Van As[d]

[a] Centre for Transport Studies, University of Cape Town, Cape Town, South Africa
[b] ChildSafe, Cape Town, South Africa
[c] Violence, Injury and Peace Research Unit, South African Medical Research Council-University of South Africa, Cape Town, South Africa
[d] Division of Paediatric Surgery, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa

Received 11 March 2019; Accepted 22 May 2019; Published online 30 May 2019

Abstract

South Africa has double the world average child road fatality rate, with at least 1 300 children killed every year. A leading contributor to this public health challenge is the lack of safe public transport that enables children to reach schools easily. Minibus Taxis (MBTs), South Africa's incarnation of paratransit services, have aimed to fill this gap by providing transport at a reasonably priced fare and a relatively higher frequency, compared with other modes of public transport. However, the informal nature of MBTs means that this form of transport places passengers at a relatively higher risk of road accidents due to the use of unroadworthy vehicles, reckless driving and speeding. This paper provides an overview of the Safe Travel To School (STTS) programme, which was initiated in 2014 with a view to providing a localised intervention that would potentially strengthen the safety of MBTs for scholar transport in South Africa. The programme aims to provide safer travel for child passengers by monitoring driver performance through a tracking device installed in each vehicle and rewarding good driver performance each quarter. A driver recruited into the programme also undergoes health tests and training that covers first aid, defensive driving and road safety training. The literature review that each of these components improves driver performance. A previous evaluation of the programme found that since inception, drivers in the programme have shown better driving performance than general motorists. Thus, the STTS programme potentially provides an implementable practice model for safe scholar transport that is oriented towards a developing country like South Africa.

Keywords: child road safety; minibus taxis; scholar transport; driver behaviour

Background

The World Health Organisation (WHO) reported in the 2018 Global Status Report on Road Safety that 1.35 million deaths are caused by road traffic injuries (RTIs) every year (WHO, 2018). This number of fatalities has remained stable since 2007 suggesting that the situation is improving globally, given the increases in the world population of people and vehicles. However, the United Nations (UN) Sustainable Development Goal (SDG) 3, target 3.6, aimed to halve road fatalities worldwide by 2020 (UNDP, 2015), and the current situation appears to be far from this goal. The target has been updated recently to halving road fatalities and injuries by 2030.

In the last 15 years, RTIs have consistently featured in the top 10 leading causes of death, occupying the 9th leading cause of death in 2013 (WHO, 2015) and rising to the 8th leading cause of death in recent years (WHO, 2018). The UN (2011) has identified five pillars for achieving SDG 3 in the Global Plan for the Decade of Action for Road Safety 2011-2020. These five pillars are: road safety management (Pillar 1), infrastructure (Pillar 2), safe vehicles (Pillar 3), road user behaviour (Pillar 4) and post-crash care (Pillar 5). Evidence-based interventions would aid these pillars.

The challenge of road traffic crashes seems to be mostly concentrated in developing countries with 90% of road traffic fatalities occurring in these countries (WHO, 2018). Kopits & Cropper (2005) predicted that by 2020, road fatalities would increase by 80% in developing countries and decrease by 28% in high-income countries. The financial burden of these injuries is felt across a variety of spheres of a developing country. At the government level, road traffic crashes cost a developing country anywhere between 1% to 3% of its gross domestic product (GDP) (WHO, 2015; Wegman, 2017). On the individual level, low-income families bear the brunt of road traffic crashes mainly because they rely on vulnerable modes of transport (Janmohammed, 2018). A study in Dar es Salaam, Tanzania, found that hospital costs can average US$ 50 to

*Corresponding author: aliasgher.janmohammed@uct.ac.za

http://Journals.uct.ac.za/index.php/GHI

US$ 100 per week for traumatic RTIs (FIA Foundation & UNICEF, 2016). This is extremely high for 70% of the urban poor population and can rob them of several weeks' worth of wages (Amend & FIA Foundation, 2016).

Children are particularly vulnerable on the road globally. Road crashes are the leading cause of death for children and young breadwinners aged 5-29, and the majority (93%) of global child road deaths occur in developing countries (WHO, 2018). Even though child road injury rates are not available by country income, it would be safe to conclude that most such injuries also occur in developing countries based on the proportion of deaths. One of the major repercussions of these injuries is the psychological impact on a child when he/she is involved, or even when a loved one is injured, in a road crash (WHO, 2008). One study showed that 44 % of children suffered from posttraumatic symptoms 12 months after an injury (Rusch et al., 2000). Some of the symptoms included flashbacks of the event, anxiety, fear of re-injury and mood disorders.

Most child road deaths occur in sub-Saharan Africa; Li et al. (2016) found that in 1990, 18.8% of child road deaths had occurred in the region, with the proportion of deaths almost doubling to 35.2% by 2016. South Africa is one of the leading contributors to this public health concern. The country has double the world average road fatality rate impacting children (Matzopoulos et al., 2008), with at least 1 300 children killed on the road every year (Janmohammed et al., 2018). A key challenge that South Africa faces in addressing the need for safer cities for children is the lack of non-motorised infrastructure to accommodate approximately 70% of children that walk all the way to school every day (Statistics SA, 2014). There is also a challenge to provide adequate public transport to the other 30% of children that travel as passengers. These challenges have mostly stemmed from previous apartheid practices which ensured that the majority of the society lived in areas of limited accessibility.

Minibus Taxis in Scholar Transport

In the Basic Education Rights book, it is reported that the South African Department of Basic Education (DBE) met learners who face considerable difficulties reaching schools every day (DBE, 2017). Some learners in the KwaZulu-Natal Province stated that they walked 26 km to and from school every day. In fact, 64% of children aged 0-17 in South Africa face a similar challenge and walk more than 15 minutes daily to access education (Janmohammed et al., 2018). These challenges present a risk to children's personal safety, while the effort of walking long distances potentially impacts their concentration in class and, in turn, affects their academic performance.

In order to address the accessibility burden, the South African Department of Transport (DOT), in collaboration with the DBE and other stakeholders, introduced the scholar transport programme to reduce the walking distances to school through motorised transport. The National Scholar Transport Policy was introduced in 2015, providing the required guidelines to ensure the introduction of the programme across the country. The DOT and DBE set the target of ensuring that the programme forms part of the public transport system and provides learners with "safe, secure, reliable and affordable" transport services (DOT, 2015). However, the policy does not provide key performance indicators for implementation (Neville, 2018), nor does it address budgeting constraints that have led to insufficient funding for the programme (Masinga, 2018).

The minibus taxi (MBT) industry has been a major player in providing scholar transport services, mostly as private vehicle owners with no subsidy from the government, i.e. drivers are not part of the scholar transport programme described above. MBTs are South Africa's incarnation of paratransit services that offer an informal mode of public transport (Behrens et al., 2016). These services are termed "informal" because the majority are unregistered, cash-based business that do not follow a scheduled timetable. However, in cases where paratransit services are embedded within the formal sector and fully regulated, they usually first emerged as unregulated and informal. Similar services can be seen in other African cities, albeit with different names — examples include daladalas in Dar es Salaam, danfos in Lagos and matatus in Kenya. Currently, MBTs, also referred to in South Africa as taxis, serve 69.8% of pupils who use public transport for their journey to school (Statistics SA, 2014). The popularity of MBTs, compared with other modes of public transport, can be attributed to the accessibility that they offer to destinations at a reasonable fare, and their relative frequency.

Despite the advantages to passengers, a number of disadvantages are also associated with the MBT industry, such as the use of unroadworthy vehicles, reckless driving and speeding (Sukhai and Seedat, 2008). These challenges exist because MBT owners provide these services with the main purpose of making a profit and not necessarily supplying reliable public transport (Van Zyl and Labuschagne, 2008). In a study that investigated the type of vehicles involved in crashes and the crash risk per registered vehicle, it was found that MBTs were involved in 6.2% of road crashes, but had higher crash rates per registered vehicle than for other vehicle types (Jungu-Omara and Vanderschuren, 2006). In the absence of more recent studies, these results provide an indication of the risk posed by MBTs.

Because MBT owners mostly provide scholar transport in a private capacity, the services remain unregulated by a government body that would ensure public management (Schalekamp et al., 2010). Therefore, solving the public safety problem with MBTs remains complex and difficult. Over the past few years, the city of Cape Town, together with various cities across South Africa, have aimed to regulate the industry by integrating them with formal public transport services such as the Bus Rapid Transit system. The aim is eventually to develop a hybrid system of formal and informal paratransit services (Del Mistro & Behrens, 2014).

Formalisation will introduce public management for the services, which has the potential of resulting in a positive outcome in improving public and road safety in the case of MBTs. However, currently, and until the formalisation process is complete, MBTs remain unregulated. This has a significant road safety impact on a large number of children that depend on these services as scholar transport, and also on pedestrian children who share the road space with motorised transport.

Addressing Paratransit Road Safety Challenges

In response to the various challenges with scholar transport, ChildSafe South Africa, a national not-for-profit child safety organisation, and Discovery Limited, a financial services company, partnered in 2014 with the goal of improving road safety and ultimately providing a safer home-school journey for children. This partnership led to the development of a practical and localised intervention in the form the Safe Travel To School (STTS) programme.

The STTS programme aims to improve the safety of MBTs by maintaining their accessibility, reasonable prices and frequency, while ensuring improved driver behaviour. This is done with the use of a vehicle tracking device implanted in each vehicle, and an incentive pay-out system that rewards good driver behaviour.

This paper introduces the STTS programme, providing an overview on (i) implementation of the programme, (ii) the current reach of the programme in terms of drivers recruited, (iii) the lessons learnt since inception and (iv) the implications of the current programme on the management of scholar transport and potentially MBTs in South Africa.

STTS Programme Overview

The main aim of the STTS programme is changing driver behaviour to promote safer driving that can protect children who are passengers in the vehicle. Consequently, STTS aims to develop better drivers as road users, contributing to UN Pillar 4 – improved road user behaviour. Two interventions are key to changing driver behaviour in the programme. The first intervention is monitoring of the driver's behaviour to ensure that the driver does not harshly accelerate, brake or corner, while also abiding by the speed limits. To achieve this objective, a vehicle-tracking device is installed. Discovery provided these devices and uses similar devices to monitor and reward good driver behaviour among clients of their vehicle insurance programme.

Tracking devices installed on MBTs have been piloted before (Van Zyl and Labuschagne, 2008). In fact, the Public Transport Strategy and Action Plan (2007) envisions all MBTs having electronic equipment installed, which would be monitored by a public transport authority. The main functions of these devices would be vehicle location, electronic fare collection and management, and traffic signal priority. STTS, however, uses these trackers for a different reason, namely improving driver behaviour, as explained above. There is no cost to the driver during their affiliation to the programme.

The second intervention rewards drivers for good driver performance. In this regard, a driver only competes with other drivers within the same programme, and not with Discovery's private insurance clients. These incentives are paid out across four quarters each year, rewarding drivers with the best performances and those who have improved their driving during the 3-month period. In the first three quarters, drivers are paid rewards ranging from ZAR 500 (approximately US$ 35) to ZAR 3 000 (approximately US$ 210), depending on relative driver performance.

In the last quarter, the driver with the best relative performance is rewarded with their own vehicle, which has substantial benefit to the business of the driver. Generally, scholar transport drivers lease their vehicles from owners, who require the drivers to pay a pre-agreed amount weekly from their earnings (Behrens et al., 2015). If a driver wins a vehicle, they save these earnings, consequently increasing their take-home profits. In the 4th quarter, the value of other rewards is also higher, ranging ZAR 5 000 (approximately US$ 350) to ZAR 25 000 (approximately US$ 1 750).

STTS Implementation

Driver recruitment relies mainly on "word of mouth", whereby the project team connects with a driver referred by another driver. However, the project also develops direct relationships with schools to recruit drivers that serve their learners. Currently, the project team is experimenting with using meetings with school principals to reach more drivers.

The STTS programme's new driver induction takes between 2 weeks and 1 month. This duration is variable because the project team generally waits to recruit a substantial number of drivers before initiating the induction, in order to minimise costs. The induction comprises four components: (i) recruitment, (ii) tracking device installation, (iii) defensive driving training, and (iv) child safety training. The aim is to introduce drivers to the programme and equip them with skills to ensure that road safety is prioritised in their driving.

On the same day as the installation of the tracking device, drivers are provided with basic 7-hour first aid training that equips them to be first responders in the case of an injury on the road. A basic health screening by first aid trainers is conducted on the same day to establish the initial health status of a driver. Drivers are also shown how to perform personal health checks so that they can ensure that their health status is suitable for driving.

After device installation and first aid training, drivers participate in defensive driving theory and practical training, which introduces the concept of safe driving by controlling the speed and position of vehicles when braking, cornering, speeding and accelerating. Finally, drivers are educated on the importance of personal wellbeing, road safety and ensuring child safety at home and on the road.

The initial development and concept planning of this project began in August 2014 and ended in December 2014. During this period, the scope of the project was developed, project staff were recruited to assist in achieving project aims and objectives and initial contact was made with potential stakeholders and drivers.

The programme started with 78 drivers recruited in 2015. Since its inception, the programme has recruited 800 drivers from 16 districts of Cape Town (see Figure 1). Drivers have been recruited from all districts except for Durbanville, Oostenberg and Somerset West. Cape Town is the most populous city in the Western Cape Province of South Africa, with 69% of the Western Cape population (NHTS, 2013). The city is also home to approximately the same percentage (68%) of children in the Province, i.e. 1.2 million children. The districts with the greatest number of children include Mitchells Plain, Blue Downs, Khayelitsha and Atlantis (NHTS, 2013).

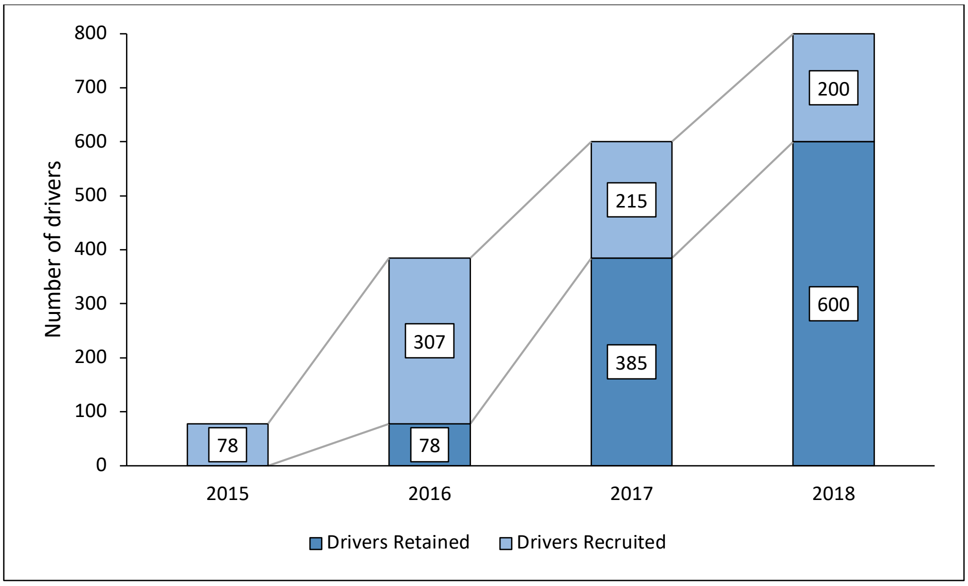

Figure 1. Total number of drivers in the STTS programme by year.

Discussion

Studies that discuss the impact of tracking driver behaviour, or the use of driver training, on road safety in sub-Saharan Africa or Africa in general, are limited. Van Zyl and Labuschagne (2008) provided findings on a pilot project that used tracking devices on MBTs for reasons other than improving driver behaviour for road safety. Simsek et al. (2011) argued that such driver performance appraisals are vital but are rarely conducted in a methodologically sound manner.

Another programme in South Africa is running an incentive-based scheme similar to STTS, called the Moja Cruise, which is funded by the eThekwini Municipality. Moja Cruise tracks MBT drivers, not scholar drivers, using vehicle-tracking devices. Feedback on driver performance is provided by both rank marshals and taxi associations, while journey reviews from customers are also incorporated in the incentive scheme. A monthly reward is given to MBT drivers and operators based on their performance. The difference between STTS and Moja Cruise, however, comes in STTS's focus on improving learner safety on their journey to school. Moja Cruise is currently a pilot project (STTS precedes it by four years) and no evidence has been found in the literature of an evaluation of that programme.

Other existing studies that have evaluated the impact of driver training have shown no or minimal impact on road safety (Potvin & Champagne, 1988; Mayhew, 2007). These studies also mainly focus on the training of young drivers with limited driving experience. Therefore, it is difficult to compare the STTS programme's driver behaviour tracking or driver training outcomes with those published studies, since the STTS project focuses on changing the driving behaviour of experienced public transport drivers.

With regard to experienced drivers, one study concluded that, as drivers become more experienced at driving, the task of driving becomes habitual (Summala, 1988). This finding suggests that continuous driver monitoring that is rewarded by periodic incentives depending on good performance may serve as a reminder to be conscious of driving behaviour.

An evaluation of the STTS programme provided a trend analysis of the safety behaviour of an initial cohort of scholar transport drivers, comparing the performance of scholar transport drivers to that of general motorists insured by Discovery (Van Niekerk et al., 2017). The evaluation used key driving performance indicators that included speeding, acceleration, braking and cornering. The study found that STTS drivers performed better than general motorists even though both are awarded incentives for their driving, although the incentives differ in nature.

Studies have shown that each of the components of STTS may have an impact in terms of the UN road safety pillars. First aid training, for instance, contributes to UN Pillar 5 improving post-crash response. A study in Nigeria found that equipping drivers with first aid knowledge resulted in practical application when presented with a road crash victim (Sangowawa & Owoaje, 2012). This skill is critical in developing countries like South Africa, since emergency medical services are often limited in the country and may not be able to provide critical care that is required within the 'golden hour' after an injury (Vanderschuren and McKune, 2015).

The Road Traffic Management Corporation, a South African government body mandated to improve road safety and to capture, validate and improve all road fatality and injury statistics, reports that the majority of road fatalities occur because of human factors (RTMC, 2015), with fatigue playing a role. Although no single definition of fatigue exists, the international literature concurs that fatigue results from a combination of causes that may influence vigilance and reduce attention or awareness (Nelson et al., 1997; Brookhuis et al., 2003; Schutte & Maldondo, 2003). A number of factors affect driver fatigue, including health status, hours of driving and time-on-task, and amount or quality of sleep before starting the journey (Venter et al., 2013).

The nature of a scholar driver's work means they spend long hours sitting and waiting for learners in their vehicles. This may be because, for instance, a driver lives far away from the site at which he or she drops off the learner, and it may not make financial sense to return home after dropping off the children at school in the morning. Consequently, the prolonged sitting may cause driver fatigue, which is affected by conditions such as high blood pressure, hypertension and diabetes (Venter et al., 2013; Uren, 2015). Fatigue could lead to impaired driving performance (Thiffault & Bergeron, 2003). Furthermore, drivers with poor health have higher risk of fatigue and also of being involved in a crash (Dionne et al., 2007). STTS drivers are trained to be aware of these risks and to monitor their own health for better driving performance. The avoidance of fatigue contributes to UN Pillar 3, safer road users.

The literature also provides insight into the positive impact of two other components of the STTS programme, namely promoting road safety knowledge among drivers (which contributes to UN Pillar 4) and the use of roadworthy vehicles (which contributes to UN Pillar 3). Drivers who have taken defensive driving courses have been found to be more likely to maintain their speed and lane positioning (Dorn & Barker, 2005). The use of roadworthy vehicles also tackles a major challenge with MBTs, as indicated by Sukhai & Seedat (2008).

Way Forward

The success of the STTS programme developed in Cape Town suggests that STTS is an achievable model in an urban context. However, introducing the same model in the rural context may bring about a different set of challenges. For instance, rural areas in South Africa are more likely to have schools on highways that make dropping off children at safe locations difficult (Janmohammed et al., 2018). Introducing such a programme on a larger national scale may also bring about other challenges such as coordination with minibus-taxi associations that are governed by private bodies.

While the STTS monitoring is quite comprehensive in terms of ensuring good driving behaviour, there is a limitation in preventing overloading and the use of appropriate restraints for learners. There is no evidence currently that suggests that STTS drivers overload their vehicles or do not use restraints for children. However, the monitoring and incentivising model can be expanded to incorporate both variables. The National Road Traffic Regulation 233 currently enables overloading of children in MBT vehicles; depending on the child's age, the number of children that can be loaded onto a 14-seater bus ranges from 14 to 28 children. This law was introduced to reduce the fare for children, and while it has achieved this goal, the trade-off has been to compromise the children's safety.

The above challenges or limitations can be addressed by developing government and private stakeholder relationships, improving the existing monitoring technology and lobbying policy change for curbing overloading of scholar vehicles. Overall, however, the STTS programme has introduced an implementable localised model for improving the safety of scholar transport in South Africa. Such a model has the potential to be expanded nationally to improve the safety of MTBs. Because MBTs are mainly privately owned, government subsidies are not awarded to owners. However, a tracking or monitoring system may enable the subsidisation of MBTs so that they can be managed publicly and incorporated into the integrated public transport system. If MBTs could achieve the goal of being a safe mode of public transport in South Africa, they would be a template for paratransit services in similar contexts across the world.

Acknowledgements

The authors would like to thank Discovery Limited for enabling them to develop this paper on the Safe Travel To School programme.

References

Amend & FIA Foundation. 2016. *Step Change: An Action Agenda on Safe Walking for Africa's Children*. Amend and FIA Foundation

Behrens, R., McCormick, D. & Mfinanga, D. 2015. An introduction to paratransit in Sub-Saharan African cities. In Paratransit in African Cities (pp. 17-41). Routledge.

Brookhuis, K.A., De Waard, D.S., Kraaij, J.H. and Bekiaris, E. 2003. How important is driver fatigue and what can we do about it. *Human factors in the age of virtual reality*. Maastricht Netherlands: Shaker Publishing, p. 193-207.

Del Mistro, R. & Behrens, R., 2015. Integrating the informal with the formal: An estimation of the impacts of a shift from paratransit line-haul to feeder service provision in Cape Town. *Case Studies on Transport Policy* 3(2):271-277.

DBE. 2017. Scholar Transport. *Basic Education Rights Handbook: Education Rights in South Africa*. Department of Basic Education, South Africa. 275–291.

DOT. 2015. *National Scholar Transport Policy*. Department of Transport, South Africa.

Dionne, G., Maag, U., Hamet, P., Ekoe, J.M., Messier, S., Desjardins, D. & Laberge-Nadeau, C. 2007. Impact of diabetes on crash risks of truck-permit holders and commercial drivers. *Diabetes Care* 23(5):612–617. DOI: 10.2337/diacare.23.5.612.

Dorn, L. & Barker, D. 2005. The effects of driver training on simulated driving performance. *Accident Analysis and Prevention* 37(1):63–69. DOI: 10.1016/j.aap.2004.06.005.

FIA Foundation & UNICEF.2016. *Rights of Way: Poverty & Road Traffic Injury in the SDGs.* FIA Foundation and UNICEF.

Janmohammed, A. 2018. *Unpacking Road Safety at a District Level – the case of Cape Town, South Africa*. Masters Dissertation. University of Cape Town.

Janmohammed, A., Vanderschuren M. & Clay, C. 2019. Analysis of Current Child Road Injury and Fatality Data. *Prevention of Road Injuries Impacting Children in South Africa (PRICSA) project*. Developed for ChildSafe South Africa and United Nations Children Fund (UNICEF).

Jungu-Omara, I. & Vanderschuren, M. 2006. Ways of Reducing Accidents on South African Roads. *Proceedings of the 25th Southern African Transport Conference* 454–464.

Kopits, E. & Cropper, M. 2005. Traffic fatalities and economic growth. *Accident Analysis and Prevention* 37(1):169–178. DOI: 10.1016/j.aap.2004.04.006.

Li, Q., Alonge, O. & Hyder, A. 2016. Children and road traffic injuries: Can't the world do better? *Archives of Disease in Childhood* 101(11):1063–1070. DOI: 10.1136/archdischild-2015-309586.

Masinga, L. 2019. Lack of funding a challenge for scholar transport, says Basic Education | IOL News. Available: https://www.iol.co.za/news/politics/lack-of-funding-a-challenge-for-learner-transport-says-basic-education-13645482

Matzopoulos, R., Du Toit, N., Dawad, S. & van As, A.B. 2008. Assessing the prevention response to child road traffic injuries. *Crime, Violence and Injury Prevention in South Africa: Data to Action*. Tygerberg: Medical Research Council–University of South Africa Crime, Violence and Injury Lead Programme. 10–25.

Mayhew, D. 2007. Driver education and graduated licensing in North America: Past, present, and future. *Journal of Safety Research* 38(2):229–235. DOI: 10.1016/j.jsr.2007.03.001.

NHTS. 2013. *South African Wide Database*. National Household Travel Survey. Statistics South Africa.

Nelson, T. 1997. Fatigue, mindset and ecology in the hazard dominant environment. *Accident Analysis and Prevention*, 29(4):409-415. DOI: https://doi.org/10.1016/S0001-4575(97)00020-1.

Neville, D. 2018. Review Policy, Legislation, Guidelines, and Standards Applicable to Children on the Road*.* *Prevention of Road Injuries Impacting Children in South Africa (PRICSA) project*. Developed for ChildSafe South Africa and United Nations Children Fund (UNICEF).

Potvin, L. & Champagne, F. 1988. Mandatory Driver Training and Road Safety: The Quebec Experience. *American Journal of Public Health* 78(9):1–4. DOI: 10.2105/AJPH.78.9.1206.

RTMC. 2015. Road Traffic Report. Road Traffic Management Corporation.

Rusch, M., Grunert, B., Sanger, J., Dzwierzynski, W. & Matloub, H. 2000. Psychological adjustment in children after traumatic disfiguring injuries: a 12-month follow-up. *Plastic and Reconstructive Surgery*. 106(7):1451–1458. DOI: 10.1097/00006534-200012000-00001.

Sangowawa, A. & Owoaje, E. 2012. Building capacity of drivers in Nigeria to provide first aid for road crash victims. *Injury Prevention* 18(1):62–65. DOI: 10.1136/injuryprev-2011-040134.

Schalekamp, H., Behrens, R. & Wilkinson, P. 2010. Regulating minibus-taxis: a critical review of progress and a possible way forward. *Proceedings of the 29th Southern African Transport Conference*.

Schutte, P.C. & Maldondo, C.C. 2003. *Factors affecting driver alertness during the operation of long-haul trucks in the South African mining industry.* Contract Research Report. Pretoria: CSIR Mining Technology.

Şimşek, B., Pakdil, F., Dengiz, B. & Testik, M.C., 2013. Driver performance appraisal using GPS terminal measurements: A conceptual framework. *Transportation Research Part C: Emerging Technologies* 26:49-60.

Statistics SA, 2014. 2013 National Household Travel Survey. Government Printers, Pretoria.

Sukhai, A. & Seedat, M. 2008. Adverse driving behaviours: the case of aggression, excessive speed and alcohol impairment. In *Crime, Violence and Injury Prevention in South Africa: Data to Action*. Tygerberg: Medical Research Council-University of South Africa Crime, Violence and Injury Lead Programme 77-103..

Summala, H. 1988. Risk control is not risk adjustment: the zero-risk theory of driver behaviour and its implications. *Ergonomics* 31(4):491–506. DOI: 10.1080/00140138808966694.

Thiffault, P. & Bergeron, J. 2003. Monotony of road environment and driver fatigue: a simulator study. *Accident Analysis and Prevention* 35: 381-391. https://doi.org/10.1016/S0001-4575(02)00014-3.

UNDP 2.015. *Sustainable Development Goals.* United Nations Development Programme.

UN. 2011. *Global Plan for the Decade of Action for Road Safety* 2011-2020. UN Road Safety Collaboration.

Uren, C. 2015. Truck driver health: the hidden factor in road safety. *Occupational Health Southern Africa* 21(5):438.

Vanderschuren, M. & McKune, D. 2015. Emergency care facility access in rural areas within the golden hour?: Western Cape case study. *International Journal of Health Geographics* 14(1):5. https://doi.org/10.1186/1476-072X-14-5.

Van Niekerk, A., Govender, R., Jacobs, R. & van As, A.B. 2017. Schoolbus driver performance can be improved with driver training, safety incentivisation, and vehicle roadworthy modifications. *South African Medical Journal* 107(3):188–191. http://dx.doi.org/10.7196/SAMJ.2017.v107i3.12363.

Van Zyl, J.E. & Labuschagne, F.J.J. 2008. Attractive methods for tracking minibus taxis for public transport regulatory purposes. *27th Annual Southern African Transport Conference*.

Venter, K., Labuschagne, F., Roux, M. & Cloete, G. 2013. An Investigation Into Driver Fatigue on the N3 Between Villiers and Warden. *Proceedings of the 32nd South African Transport Conference* 417–426.

Wegman, F. 2017. The future of road safety: A worldwide perspective. *IATSS Research* 40(2):66–71. https://doi.org/10.1016/j.iatssr.2016.05.003.

WHO. 2008. *Millennium Development Goals* (Annexure 1). Geneva: World Health Organization.

WHO. 2015. *Global Status Report on Road Safety 2015*. Geneva: World Health Organization.

WHO. 2018. *Global Status Report on Road Safety* 2018. Geneva: World Health Organization.