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Modelling public bus/minibus transport accident severity in Ghana

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ABSTRACT

The current safety concerns with buses/minibuses (public transport) in both developed and developing countries have warranted a renewed interest in bus/minibus safety research. Prior to this, there was a paucity of research in this domain especially in developed countries where the safety associated with buses was deemed adequate. In this study, we examined the factors that influence bus/minibus accident severity in Ghana using bus/minibus accident data from 2011–2015. We estimated the severity of bus/minibus accidents by fitting generalised ordered logit models. Our findings revealed that weekends, the absence of road median, night-time conditions, bad road terrain (curved, wet and rough roads), hit-pedestrian collisions, and drunk driving are associated with more severe bus/minibus accident outcomes. Conversely, minibuses, the absence of road shoulder, accidents in intersections, the presence of traffic control and collision types (except hit-pedestrian) are associated with less severe bus/minibus accidents.

1. Introduction

Public bus/minibus transport is deemed a relatively safe mode of transport in developed countries, especially in the United States (US) and Europe. In these areas, the safety associated with this mode is considered adequate (Kaplan and Prato, 2012; Barua and Tay, 2010; Berntman et al., 2010). In addition, bus travel is considered the safest per distance travelled. For instance, studies using the number of fatalities per 100 million person-kilometres travelled have revealed that travelling by car entails eight times more risk compared to taking the bus; while walking is associated with 50 times more risk than taking the bus (Albertsson and Falkmer, 2005; Evans, 1994). The safety with public bus transport, especially in the developed countries, explains the paucity of empirical studies on bus accidents as well as the limited public interest in bus accidents relative to other transport modes (Cafiso et al., 2013; Chimba et al., 2010). The general perception is that public transport use reduces traffic congestion and pollution, and improves road safety (Brenac and Clabaux, 2005).

Conversely, the situation in developing countries is quite different, where public bus/minibus transport has serious safety concerns as a result of frequent involvement in severe accidents (Barua and Tay, 2010; Iles, 2005; Hamed et al., 1998). In these countries, bus/minibus accidents are rampant with alarming consequences (Kaplan and Prato, 2012; Chimba et al., 2010).

In the book "*Public transport in developing countries*", Iles (2005) observed that public transport vehicles (buses and minibuses) in developing countries are frequently involved in fatal accidents. Iles maintains that speed is the underlying cause of most of the accidents in these countries.

Based on recent developments in both developed and developing countries, research interest in bus and bus passengers' safety has emerged strongly. A couple of studies and interventions have been implemented in the bid to identify and tackle emerging challenges, and thus improve bus safety. Kaplan and Prato (2012) for example, reports that in the United States (US) the renewed interest in bus safety resulted in the new Motorcoach Enhanced Safety Act of 2011 and the prioritisation of research on bus safety, and the subsequent creation of a new training curriculum for bus operators.

2. Magnitude and severity of public bus/minibus accidents in Ghana

Public bus/minibus transport form the backbone of mobility in Ghana, as in other low- and middle-income countries (Mohan, 2016). Unfortunately, bus/minibus passengers are a significant road user group at risk of road traffic accidents (Odero et al., 2003). In Ghana, bus/minibus occupants are the third road users with the highest fatality risk (National Road Safety Commission, NRSC, 2014). For the period

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1991–2014, public buses/minibuses constituted 23.9% (n = 90,206) of the total number of vehicles involved in accidents in Ghana producing 35.7% of the total recorded casualties (n = 327,994).

Generally, road traffic accidents cost 1.6% of Ghana's gross domestic product (GDP) (Ackaah et al., 2008). Intuitively, the contribution of public buses/minibuses (as a higher occupancy mode) to the total cost of road traffic accidents in Ghana is expected to be higher (exact figures are not available). Addressing the public bus/minibus safety concerns through evidence-based interventions will increase PT passengers' confidence and patronage and hence promote sustainable PT use (Khoo and Ahmed, 2018). In Ghana, PT has a positive impact on road space occupancy; buses/minibuses utilise about 30% of road space but convey over 70% of person-trips (Amoo-Gottfried, 2012).

The government through the Metropolitan, Municipal and District Assemblies (MMDAs) regulate public transportation in their areas of jurisdiction. However, public transportation operations are deregulated (with both government, quasi-government, and private ownership and operations) (Sam and Abane, 2017; Yobo, 2013; Salifu, 2004).

2.1. Study objective

In this study, we examine the factors that influence public bus/minibus accident severity in Ghana using the national bus/minibus accident data from 2011 to 2015. Unlike previous studies, this study considers both bus and minibus accidents for this reason: minibuses are also important transport modes in developing countries and are associated with a relatively higher accident risk (see Hamed et al., 1998). As Kaplan and Prato (2012) argue, examining the factors that are associated with bus accident severity can alert PT operators of the circumstances that are associated with injury risk for bus accidents. This knowledge can serve as the basis for bus safety improvement strategies.

In this study, we applied the following definition to a public bus and minibus transport: a commercial vehicle with a seating capacity of more than 25, and 10–25 seating capacity respectively. To the best of our knowledge, this study is the first work to examine the factors that bear injury risk for buses/minibuses (public transport) in Ghana. This is regardless of their enormous safety concerns in the country. Obviously, addressing the safety concerns of the buses and minibuses in the country needs a "local context" for it to be sustainable. At best previously established significant bus/minibus accident severity predictors can be used for probing purposes and a benchmark in the search for, and explanation of significant local factors.

3. Descriptive statistics

Public bus/minibus accidents in Ghana are basically high and severe. But for the period 2011–2015, the situation followed a downward trend specifically from the year 2012. The 2012 figure constituted 23% of the total bus/minibus accidents for this period (N = 33,694). Perhaps, the downward trend is an indication of the effectiveness of the road safety interventions, particularly those targeting buses/minibuses, in the country. This period under investigation witnessed the launch of the UN Decade of Action for Road Safety 2011–2020, and subsequently Ghana's adoption of this global action plan. In accordance with this global action plan, a number of traffic safety interventions have been implemented nationwide especially targeting the road users with high fatality risks. Towards bus/minibus safety, the measures include increased educational campaigns and training for bus/minibus drivers, safety audits of the transport operators' operations, and traffic police highway visibility (especially on accident-prone roads). In a recent study, Sam and Abane (2017) observed that the bus operators have equally adopted a number of measures to enhance bus/minibus safety: strict adherence to routine bus maintenance schedules, periodic driver training and retraining, and medical screening. In addition, the following have also been implemented: mandatory rest stops for drivers on long distance journeys, driver awards schemes (awarding drivers who record no road accident for a specified period), driver behaviour tracking in real time, and surcharging of at-fault drivers with the cost of repairs on damaged buses and property.

The data revealed that there were more male bus/minibus drivers (99.7%) than their female counterparts involved in road accidents over the period. This may be explained by the male dominance in the industry (commercial bus/minibus driving) and also driving in general in Ghana. The majority (64.8%) of these drivers could be classified as young (≤35 years), fully licensed to drive (94.8%), even though 5.2% of them were either unlicensed or at best partially licensed. Nearly 83% of the drivers involved in the accidents were uninjured. Interestingly, about 70% of the accidents could be attributed to driver errors in the form of lapses and errors (inexperience and inattention), and traffic violations (improper overtaking, improper turning, over-speeding, fatigued driving and tailgating). On this phenomena, the national road safety commission (NRSC, 2014) revealed that driver indiscretion and poor judgement is a major cause of road fatalities among public transport users in the country. We admit that this should be prioritised for training and remedial action by the public transport operators and the other relevant road safety stakeholders. Addressing these issues will help improve public bus/minibus safety in the country. We further observed that in many of the instances, the buses/minibuses were going ahead (84%) than otherwise (turning, reversing etc) at the time of their accidents.

Table 1 details the explanatory variables used in estimating bus/minibus accident severity. For the 5-year period, there were more buses (72.1%) than minibuses (27.9%) involved in accidents, resulting in more property-damage-only (33.2%) accident outcomes. Fatal accidents constituted 15.6% of the accident outcomes. Nearly 70% of the

Table 1
Explanatory variables used in the model (N = 33,694).

Variable	Categories	N	%
Accident severity	Fatal	5250	15.6
	Hospitalised	8748	26.0
	Injured not hospitalised	8497	25.2
	Damage only	11199	33.2
Day of week	Weekdays	23447	69.6
	Weekends	10247	30.4
Road separation	Median	10295	30.6
	No median	23399	69.4
Vehicle type	Bus	24296	72.1
	Minibus	9398	27.9
Light condition	Day	22563	67.0
	Night (no light or light off)	7056	20.9
	Night (light on)	4075	12.1
Road description	Straight and flat	30106	89.4
	Curved/ inclined/ bridge	3588	10.6
Road surface	Dry	28430	84.4
	Slippery	5264	15.6
Shoulder condition	Good	15441	45.8
	Poor	4088	12.1
	No shoulder	14165	42.0
Location	Section	25117	74.5
	Intersection	8577	25.5
Traffic control	None	19733	58.6
	Present (Signals, stop sign, give way,	4519	13.4
	pedestrian-X)	9442	28.0
	Others (e.g. speed hump/ rumble strips)		
Collision type	Head-on	3242	9.6
	Rear end	7692	22.8
	Right angle	2408	7.1
	Sideswipe	4777	14.2
	Overturn	4302	12.8
	Hit object	2621	7.8
	Hit pedestrian	8652	25.7
Drunk driving	Tested negative	33064	98.1
	Tested positive	630	1.9
Surface repair	Good	31139	92.4
	Rough with potholes	2555	7.6