Modelling public bus/minibus crash severity in Ghana

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KNOWLEDGE IN ACTION

Outline of presentation

- Introduction
- Study objective
- Method and data
- Results
- Conclusion/ The way forward

Introduction

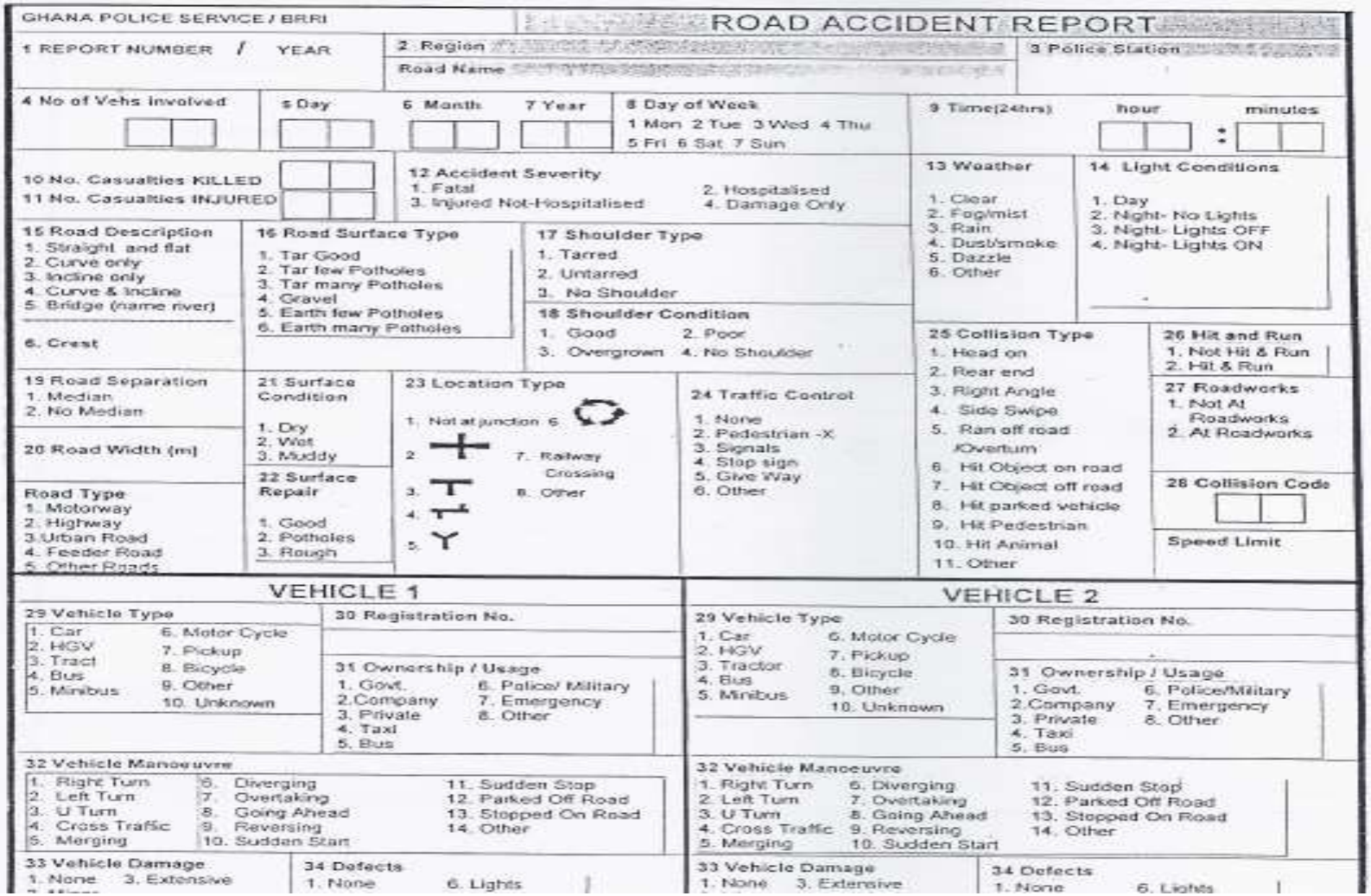
Study objective

- Examine:
  - Factors influencing bus/minibus crash severity in Ghana
  - First study, notwithstanding bus/minibus safety concerns
- Motive?
  - Create awareness on factors with injury risk for bus/minibus

Factors influencing bus/minibus crash severity (BCS)

- Prato & Kaplan (2014): VRUs, high speed, night hours, aged 3-party drivers, drivers crossing in yellow/red light etc.
- Barua & Tay (2010): weekends, off-peak hours, 2-way lanes; traffic controls, median etc.
- Hamed et. (1998): driver's age, accident location, surface condition, time of day, time since previous accident etc.

Method and data



GHANA POLICE SERVICE / BRRI

ROAD ACCIDENT REPORT

1 REPORT NUMBER / YEAR

2 Region

Road Name

3 Police Station

4 No of Vehs involved

5 Day

6 Month

7 Year

8 Day of Week
1 Mon 2 Tue 3 Wed 4 Thu
5 Fri 6 Sat 7 Sun

9 Time(24hrs) hour minutes

10 No. Casualties KILLED

11 No. Casualties INJURED

12 Accident Severity
1. Fatal
2. Hospitalised
3. Injured Not-Hospitalised
4. Damage Only

13 Weather
1. Clear
2. Fog/mist
3. Rain
4. Dust/smoke
5. Dazzle
6. Other

14 Light Conditions
1. Day
2. Night- No Lights
3. Night- Lights OFF
4. Night- Lights ON

15 Road Description
1. Straight and flat
2. Curve only
3. Incline only
4. Curve & Incline
5. Bridge (name river)
6. Crest

16 Road Surface Type
1. Tar Good
2. Tar few Potholes
3. Tar many Potholes
4. Gravel
5. Earth few Potholes
6. Earth many Potholes

17 Shoulder Type
1. Tarred
2. Untarred
3. No Shoulder

18 Shoulder Condition
1. Good
2. Poor
3. Overgrown
4. No Shoulder

25 Collision Type
1. Head on
2. Rear end
3. Right Angle
4. Side Swipe
5. Ran off road /Overturn
6. Hit Object on road
7. Hit Object off road
8. Hit parked vehicle
9. Hit Pedestrian
10. Hit Animal
11. Other

26 Hit and Run
1. Not Hit & Run
2. Hit & Run

27 Roadworks
1. Not At Roadworks
2. At Roadworks

28 Collision Code

Speed Limit

19 Road Separation
1. Median
2. No Median

20 Road Width (m)

Road Type
1. Motorway
2. Highway
3. Urban Road
4. Feeder Road
5. Other Roads

21 Surface Condition
1. Dry
2. Wet
3. Muddy

22 Surface Repair
1. Good
2. Potholes
3. Rough

23 Location Type
1. Not at junction
2.
3.
4.
5.
6.
7. Railway Crossing
8. Other

24 Traffic Control
1. None
2. Pedestrian -X
3. Signals
4. Stop sign
5. Give Way
6. Other

VEHICLE 1

29 Vehicle Type
1. Car
2. HGV
3. Tract
4. Bus
5. Minibus
6. Motor Cycle
7. Pickup
8. Bicycle
9. Other
10. Unknown

30 Registration No.

31 Ownership / Usage
1. Govt.
2. Company
3. Private
4. Taxi
5. Bus
6. Police/ Military
7. Emergency
8. Other

32 Vehicle Manoeuvre
1. Right Turn
2. Left Turn
3. U Turn
4. Cross Traffic
5. Merging
6. Diverging
7. Overtaking
8. Going Ahead
9. Reversing
10. Sudden Start
11. Sudden Stop
12. Parked Off Road
13. Stopped On Road
14. Other

33 Vehicle Damage
1. None
3. Extensive

34 Defects
1. None
6. Lights

VEHICLE 2

29 Vehicle Type
1. Car
2. HGV
3. Tractor
4. Bus
5. Minibus
6. Motor Cycle
7. Pickup
8. Bicycle
9. Other
10. Unknown

30 Registration No.

31 Ownership / Usage
1. Govt.
2. Company
3. Private
4. Taxi
5. Bus
6. Police/Military
7. Emergency
8. Other

32 Vehicle Manoeuvre
1. Right Turn
2. Left Turn
3. U Turn
4. Cross Traffic
5. Merging
6. Diverging
7. Overtaking
8. Going Ahead
9. Reversing
10. Sudden Start
11. Sudden Stop
12. Parked Off Road
13. Stopped On Road
14. Other

33 Vehicle Damage
1. None
3. Extensive

34 Defects
1. None
6. Lights

Model estimation

Statistical technique: Generalised ordered logit

- **Final model**: significant factors from 3 parsimonious models
- Model fitted using GENLIN procedure in IBM SPSS v24; Dataset: 33,693 valid cases
- Crash outcomes: *fatal*; *hospitalised*; *injured but not hospitalised;* and *damage only= categorical ordinal*

Model estimation cont'd

- An ordered logit model can be specified in terms of the probability of injury severity *j* for a given crash *i* as (see Long, 1997; Prato & Kaplan, 2014):

$$P(y_i > j) = \frac{exp(X_i\beta - \phi_j)}{1 + exp(X_i\beta - \phi_j)} \qquad j = 1, 2, ..., M-1 \qquad (1)$$

Model estimation cont'd

- The generalised ordered logit model expresses the probability of injury severity *j* for a given crash *i* as (see Long, 1997; Prato & Kaplan, 2014):

$$P(y_i > j) = \frac{exp(X_{1i}\beta_1 + X_{2i}\beta_{2j} - \phi_j)}{1 + exp(X_{1i}\beta_1 + X_{2i}\beta_{2j} - \phi_j)} \qquad j = 1, 2, ..., M-1 \quad (2)$$

Model estimation cont'd

- The probability of injury severity has a closed-form expression and the parameters β_1, β_{2j} and φ_j are estimated through the maximisation of the log-likelihood function *LL*:

$$LL = \sum_{n=1}^{N} \sum_{j=1}^{J} d_{nj} ln P(y_i > j) \qquad (3)$$

where N is the number of accidents,
and

$$d_{nj} = \begin{cases} 1, & \text{if accident n results in severity category j} \\ 0, & \text{Otherwise} \end{cases}$$

Model estimation results (Note. *p<.001; **p<.05; ***p<.01; N=33693)

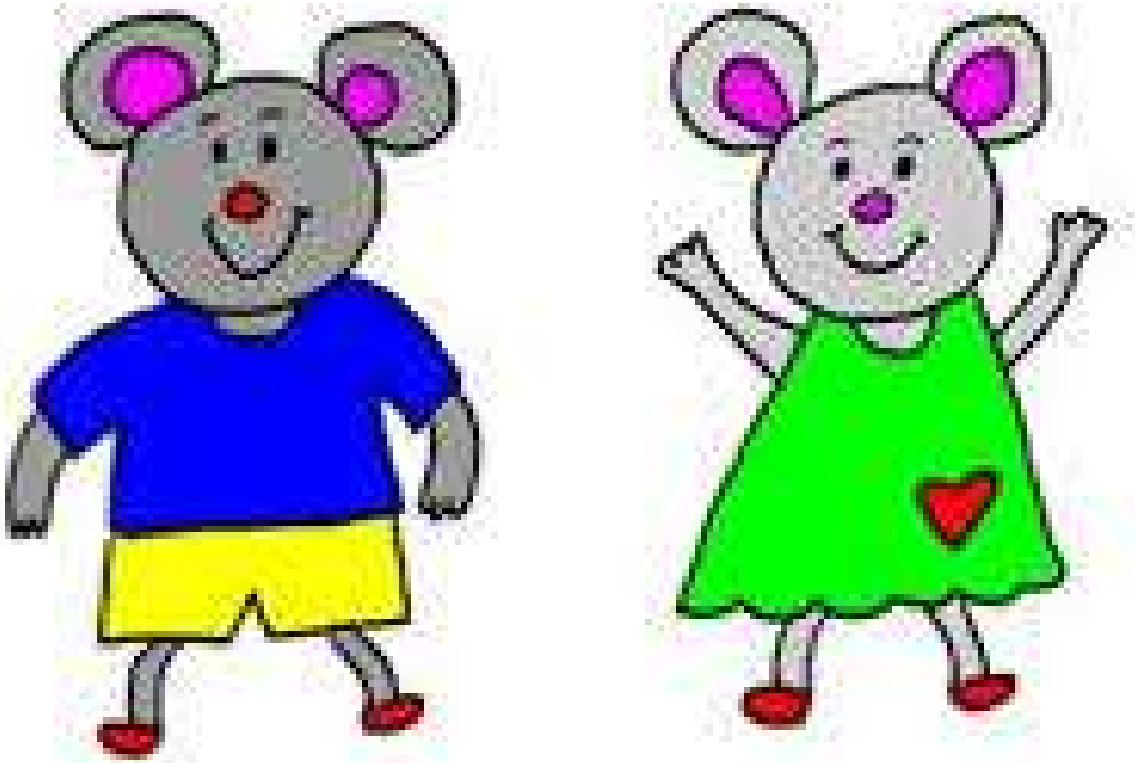
Variable	B	Std. Error	Exp(B)
Day of week (Reference category: Sunday)			
Monday	.150	.0386	1.161*
Tuesday	.166	.0392	1.180*
Wednesday	.152	.0393	1.164*
Thursday	.051	.0390	1.052
Friday	.082	.0379	1.085**
Saturday	.053	.0372	1.055
Road separation (Reference: No median)			
Median	.256	.0253	1.292*
Vehicle type (Reference: Minibus)			
Bus	-.081	.0231	0.922*
Weather condition (Reference: Clear)			
Adverse	.112	.0351	1.119***

Model estimation results cont'd

Light condition (Reference: Night-Light ON)			
Day	**.147**	**.0330**	**1.158***
Night-Light OFF	**-.023**	**.0389**	**0.977**
Road description (Reference: Curved/inclined)			
Straight and flat	**.389**	**.0341**	**1.476***
Road surface (Reference: Wet)			
Dry	**.097**	**.0374**	**1.102****
Shoulder condition (Reference: No shoulder)			
Good	**-.457**	**.0227**	**0.633***
Poor	**-.431**	**.0364**	**0.650***
Location (Reference: Intersection)			
Section	**-.190**	**.0280**	**0.827***
Traffic control (Reference: Speed humps/rumble strips)			
None	**-.204**	**.0240**	**0.816***
Present	**.196**	**.0388**	**1.217***
Collision type (Reference: Hit pedestrian)			
Head on	**.907**	**.0383**	**2.478***
Rear end	**2.529**	**.0323**	**12.545***
Right angle	**1.766**	**.0457**	**5.849***
Sideswipe	**2.425**	**.0359**	**11.307***
Overturn	**1.562**	**.0355**	**4.767***
Hit object	**2.173**	**.0442**	**8.781***
Drunk driving (Reference: Positive)			
Negative	**.215**	**.0753**	**1.240*****
Surface repair (Reference: Rough with potholes)			
Good	**.108**	**.0469**	**1.114****

Conclusion

- Day of the week, road median, adverse weather, daylight, good road terrain, traffic controls etc increase BCS
- Vehicle type, road shoulder, accident location and absence of traffic control reduce BCS
- Implications/ The way forward (**3Es**)
  - Education: road hazard detection and management, driver behaviour monitoring in real time
  - Enforcement: speed limits, vehicle standards, increased police surveillance
  - Engineering: road shoulders, road curves
  - Further research: traffic control, median



Thank you, thank you, thank you!