

BLOOMBERG PHILANTHROPIES INITIATIVE FOR GLOBAL ROAD SAFETY

KAMPALA ROUND 2

TECHNICAL ANNEX SEPTEMBER 2021

SAMPLING METHODOLOGY

The Johns Hopkins International Injury Research Unit partnered with Makerere University to conduct roadside observations in September 2021. The methods for these findings were developed by the Johns Hopkins International Injury Research Unit and implemented in collaboration with Makerere University. This report provides results from observational surveys that represent population-level (citywide) prevalence of important road safety risk factors (speed and helmet use). Observation sites were randomly selected, conditional on the safety of observers. There were 16 observation sites per risk factor, and a standardized protocol was used with vehicles selected for observation in a systematic quasi-random fixed sequence. Observations were performed between 7:30 a.m. and 16:00 p.m. on both weekend days and weekdays. The methods were designed to estimate citywide prevalence and cannot provide insights into interventions conducted in specific locations in the city. The data management team at Johns Hopkins International Injury Research Unit reviewed and cleaned the data to perform the analyses available in this report.

OBSERVATION SITES AND GPS COORDINATES

Speed (Rounds 1-5)

DIVISION	LOCATION	GPS LATITUDE	GPS LONGITUDE	GPS ALTITUDE	GPS PRECISION
Kampala	Mbogo road	0.31327	32.5995	1141.07	4.873
Bunga	Kalungu road	0.27722	32.6167	1127.23	4.298
Ggaba bypass	Ggaba bypass next at chop sizzle spice	0.26575	32.6277	1155.65	4.808
Ggaba road	Ggaba road outside the entrance to rahbot brick makers	0.28351	32.61	1152.44	4.853
Kirombe road	Kirombe road at the transformer next to a wooden pole selling place	0.29321	32.5963	1177.5	4.33
Entebbe road	Entebbe road at Pot plaza	0.28369	32.5677	1187.99	4.839
Namasole	Namasole road	0.28971	32.5802	1215.56	4.288
Bbiina	Bbiina road before radio maria	0.30977	32.6483	1208.19	4.938
Ssembeguya	Dr. Ssembeguya road at unic motel gate	0.37977	32.5634	1215.67	4.639
Ttula	Ttula road	0.37043	32.5691	1199.48	4.985
Bombo	Bombo road	0.37277	32.5575	1195.09	4.61
Busega	Old Mubende	0.31257	32.5168	1153.95	4.263
Busega	Old Mubende road	0.31338	32.5247	1175.79	4.269
Lukuli near harvest investment before the Africa music school building	Lukuli road	0.28095	32.5958	1177.2	4.958

Kampala	Tank hill road just before njuki way	0.29495	32.6138	1243.24	4.727
Kawuku road	Kawuku road about 100 meters past MM flower pot makers moving away from Ggaba bypass	0.26674	32.6308	1144.55	4.288

Helmet Use (Round 1-5)

DIVISION	LOCATION	GPS LATITUDE	GPS LONGITUDE	GPS ALTITUDE	GPS PRECISION
Mbogo road	Raised part at the Namuwongo mbogo junction	0.31435	32.5995	1144.44	6.724
Kampala	Tank hill road	0.30009	32.6076	1206.91	4.931
Kampala	Kirombe road opposite interservice hotel	0.29744	32.5953	1187.39	4.824
Kalungu road	Kalungu road junction with Ggaba road	0.27675	32.615	1139.32	4.484
Kawuku road	Kawuku road close to the Ggaba bypass junction	0.26563	32.6289	1151.85	4.581
Ggaba road	Ggaba road at the airtel money booth (along Ggaba road opposite the police booth)	0.29774	32.6006	1177.9	4.99
Namasole road	Namasole road at Pacific car bond. Pacific car bond is just before Uganda local government association	0.2856	32.5688	1179.4	4.916
Entebbe road	Entebbe road at the junction with Kyabagu road	0.27941	32.5662	1206.37	4.628
Biina	Biina road at the junction with Butabika road	0.30954	32.657	1158.89	4.744
Ssembeguya	Dr. Ssembeguya road	0.38121	32.5638	1189.45	4.99
Ttula	Ttula road	0.38149	32.5648	1203.08	4.325
Bombo	Bombo road	0.3753	32.5568	1186.72	4.63
Busega	Old Mubend	0.31159	32.522	1162.05	4.99
Busega	Mugema road	0.31176	32.5258	1203.82	4.922
Busega	Mugema road	0.3077	32.5241	1191.68	4.062
Ggaba bypass	Ggaba bypass at HEM supermarket + pharmacy opposite oryx	0.2659	32.6247	1150.78	4.516
Hanlon road	Hanlon road at the junction with kabega road. Site in front of Uganda martyrs	0.29851	32.5879	1202.7	4.132

	university Nsambya campus gate				
Lukuli opposite Papa's restaurant	Lukuli road	0.28812	32.5849	1212.72	4.873

FINDINGS

OVERALL

Number of vehicles and occupants observed for speed and helmet use

	Speed	Helmet use
Vehicles observed	67,251	62,665
Occupants observed	N/A	90,341

Number of occupants observed by type

Risk Factors	Number of Observations		
	Driver	Passenger	Total
Helmet	62,665	27,676	90,341

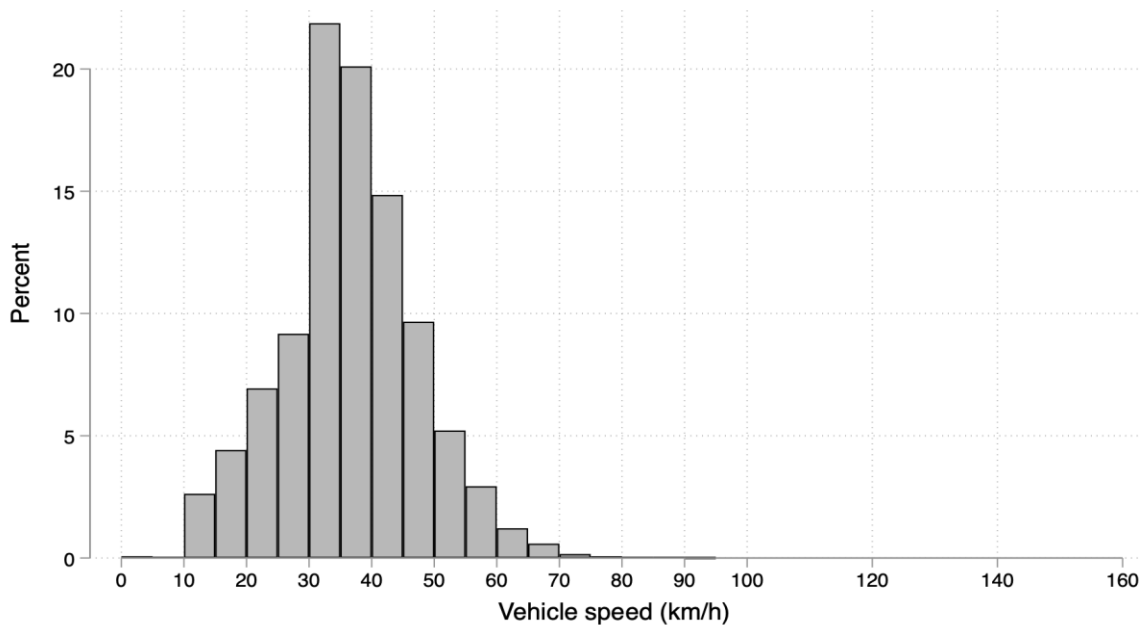
SPEED

Prevalence of speeding

	n (Percentage)	Average Speed (km/h)	Median (km/h)	85th pctl (km/h)
Vehicles observed	67,251 (100)	36 ± 11	36	46
Driving above speed limit	6,064 (9)	57 ± 6	55	62
Driving within speed limit	61,187 (91)	34 ± 9	35	44

Posted speed limit of 50 km/h for all road types and vehicles.

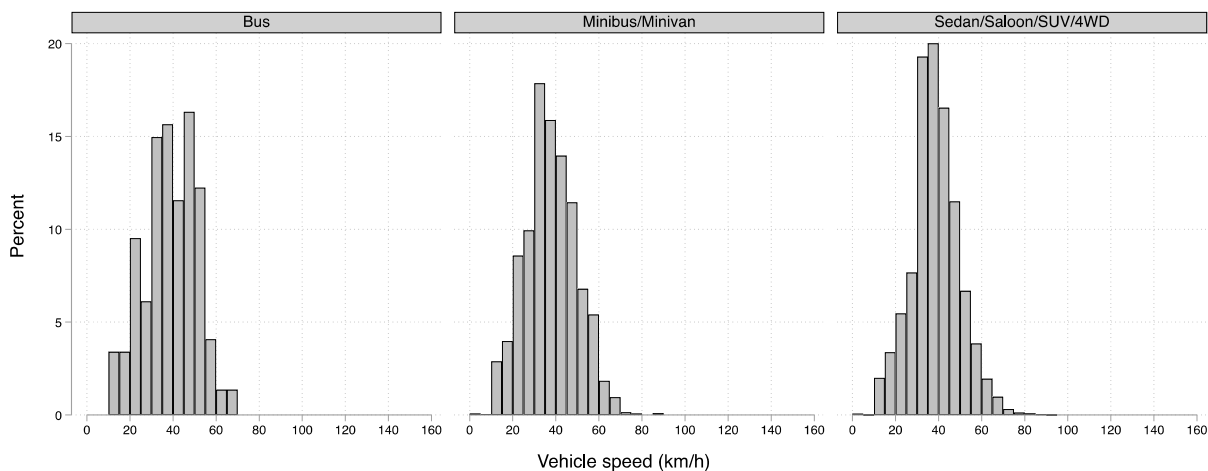
Histogram of speed among all vehicles



Percentage of speeding based on type of vehicle, n (%)

Type of vehicle	Speeding					
	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Pickups/Light trucks	348 (9)	3,463 (91)	3,811	35 ± 11	35	46
Trucks/Large trucks	48 (3)	1,511 (97)	1,559	32 ± 10	31	42
Buses	24 (16)	123 (84)	147	38 ± 12	39	51
Minibuses/Minivans	556 (14)	3,418 (86)	3,974	37 ± 12	37	50
Sedans/Saloons/SUVs/4WDs	2,560 (12)	18,028 (88)	20,588	38 ± 11	38	49
Motorcycles	2,528 (7)	34,632 (93)	37,160	35 ± 10	35	45
Other	0 (0)	12 (100)	12	25 ± 14	22	34

Histogram of speed by top 3 vehicle types with highest prevalence of speeding



Graphs by Top 3 speeding vehicle types

Prevalence of speeding and mean, median, and 85th percentile speed by vehicle

Vehicle type	Prevalence n (%)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Motorcycles (n= 37,160)	2,528 (7)	35 ± 10	35	45
Light vehicles* (n= 28,373)	3,464 (12)	37 ± 11	37	48
Heavy vehicles† (n=1,706)	72 (4)	32 ± 11	32	44

* Light vehicles include sedans/saloons/SUVs/4WDs, minibuses/minivans, and pickups/light trucks.
† Heavy vehicles include buses and trucks/large trucks.

Note: 12 from "other" category are excluded from this analysis, hence the total is 67,239.

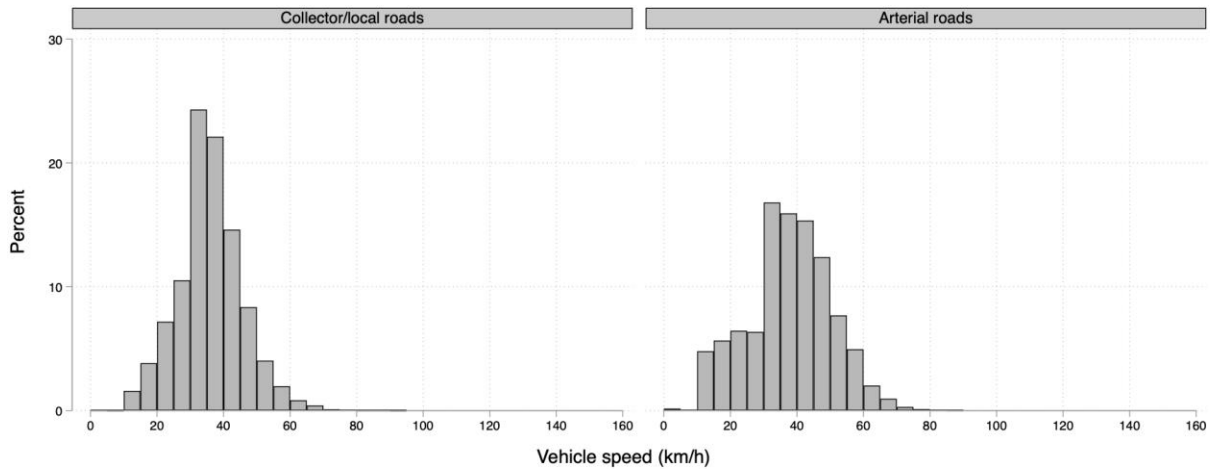
Percentage of speeding based on vehicle ownership, n (%)

Vehicle ownership	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Commercial	263 (6)	4,113 (94)	4,376	34 ± 11	34	45
Taxi	2,832 (7)	36,135 (93)	38,967	35 ± 10	35	45
Ride-share	150 (6)	2,434 (94)	2,584	35 ± 10	36	45
Other (including private and government)	2,819 (13)	18,505 (87)	21,324	38 ± 12	38	49

Percentage of speeding based on the road type, n (%)

Road type	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Collector/Distributor/Local Road	2,953 (6)	42,487 (94)	45,440	35 ± 10	35	45
Arterial Road	3,111 (14)	18,700 (86)	21,811	37 ± 13	38	50

Histogram of speed by road type



Graphs by Road type

Percentage of speeding when the speed limit is set to 50 km/h for arterial roads and to 30/h for collector/distributor/local roads, according to global standards

Road type	Speeding
Collector/Distributor/Local Road (Speed ≥ 30 km/h)	71%
Arterial Road (Speed ≥ 50 km/h)	14%

Percentage of speeding based on law enforcement, n (%)

Law enforcement	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
None	5,760 (9)	60,407 (91)	66,167	36 ± 11	36	46
Police only	99 (27)	263 (73)	362	46 ± 9	45	55
Camera only	205 (28)	517 (72)	722	46 ± 8	45	55

Percentage of speeding based on weekday, n (%)

Day	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Weekday	3,679 (8)	39,750 (92)	43,429	36 ± 11	36	46
Weekend	2,385 (10)	21,437 (90)	23,822	36 ± 11	36	47

* The weekend is Saturday and Sunday.

Prevalence of speeding and mean, median, and 85th percentile speed by day of the week, n (%)

Day of the week	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Sunday	1,277 (10)	11,432 (90)	12,709	36 ± 11	36	47
Monday	778 (8)	8,818 (92)	9,596	36 ± 10	36	46
Tuesday	1,116 (8)	13,717 (92)	14,833	35 ± 11	35	46
Wednesday	498 (8)	6,070 (92)	6,568	36 ± 11	36	46
Thursday	763 (12)	5,409 (88)	6,172	37 ± 12	37	49
Friday	524 (8)	5,736 (92)	6,260	35 ± 12	35	45
Saturday	1,108 (10)	10,005 (90)	11,113	36 ± 11	35	47

Percentage of speeding based on observation session interval, n (%)

Observation session interval	Yes (n=6,064)	No (n=61,187)	Total (n=67,251)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Early morning (07:45 - 09:15)	1,335 (8)	15,686 (92)	17,021	36±11	36	46
Late morning (10:00 – 11:30)	1,519 (9)	15,877 (91)	17,396	36±11	36	46
Afternoon (12:15 - 13:45)	1,558 (9)	15,076 (91)	16,634	36±11	36	47
Late Afternoon (14:30 - 16:00)	1,652 (10)	14,548 (90)	16,200	36±11	36	47

* The observation session time intervals vary slightly across days of the week. The observational intervals for the majority of observations are used to categorize time differences. Each session last about 90 minutes.

Early morning (07:45 - 09:15) includes observations made between 7:30 – 9:15, 7:45 – 9:15, 7:30 – 9:45; Late morning (10:00–11:30) includes observations made between 9:45 – 11:30, 10:00 - 11:15, and 10:00-11:30; Afternoon (12:15-13:45) includes observations made between 12:15 – 13:45; Late Afternoon (14:30-16:00) includes observations made between 14:15- 16:00, 14:30- 16:00.

* Data during “Evening” sessions were not collected in Round 2.

Percentage of speeding by extent of speed and vehicle type (using the number of vehicles that were speeding as the denominator)

Type of vehicle	>5 km/h ¹	>10 km/h	>15 km/h	>20 km/h
Overall speeding vehicles (n = 6,064)	2,732 (45)²	1,112 (18)	446 (7)	161 (3)
Pickups/Light trucks (n = 348)	170 (49)	57 (16)	26 (7)	7 (2)
Trucks/Large trucks (n = 48)	21 (44)	2 (4)	1 (2)	0 (0)
Buses (n = 24)	9 (38)	4 (17)	1 (4)	0 (0)
Minibuses/Minivans (n = 556)	270 (49)	92 (17)	33 (6)	11 (2)
Sedans/Saloons/SUVs/4WDs (n = 2,560)	1,253 (49)	578 (23)	258 (10)	94 (4)
Motorcycles (n = 2,528)	1,009 (40)	379 (15)	127 (5)	49 (2)
Other (n = 0)	0 (0)	0 (0)	0 (0)	0 (0)

¹The number of vehicles speeding > 5km/h includes all vehicles speeding > 5km/h, > 10 km/h, > 15 km/h and > 20 km/h.

²45% (n=2,732) of the total number of vehicles that were speeding (n=6,064) were exceeding the posted speed limit by >5 km/h

Percentage of speeding by extent of speed and vehicle type (using all vehicles as the denominator)

Type of vehicle	>5 km/h ¹	>10 km/h	>15 km/h	>20 km/h
All vehicles (n = 67,251)	2,732 (4)²	1,112 (2)	446 (1)	161 (0)
Pickups/Light trucks (n = 3,811)	170 (4)	57 (1)	26 (1)	7 (0)
Trucks/Large trucks (n = 1,559)	21 (1)	2 (1)	1 (0)	0 (0)
Buses (n = 147)	9 (6)	4 (3)	1 (1)	0 (0)
Minibuses/Minivans (n = 3,974)	270 (7)	92 (2)	33 (1)	11 (0)
Sedans/Saloons/SUVs/4WDs (n = 20,588)	1,253 (6)	578 (3)	258 (1)	94 (0)
Motorcycles (n = 37,160)	1,009 (3)	379 (1)	127 (0)	49 (0)
Other (n = 12)	0 (0)	0 (0)	0 (0)	0 (0)

¹The number of vehicles speeding > 5km/h includes all vehicles speeding > 5km/h, > 10 km/h, > 15 km/h and > 20 km/h.

²4% (n=2,732) of the total number of vehicles observed (n=67,251) were exceeding the posted speed limit by >5 km/h

FREE FLOW SPEED

The following analyses on speeding are restricted to vehicles in free flow speed, which are defined as those traveling faster than the speed limit when/where there is no impedance for drivers to speed freely, such as bad weather, a junction, tight bend, speed bump, stop sign, crosswalk, and law enforcement activities nearby.

Mean, median, and 85th percentile among vehicles in free flow speed

n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
5,728	57 ± 6	55	62

Mean, median, and 85th percentile among vehicles in free flow speed by vehicle type

Vehicle type	n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Motorcycle	2,392	56 ± 5	55	61
Light vehicles*	3,274	57 ± 6	55	63
Heavy vehicles†	62	55 ± 4	55	58

* Light vehicles include sedans/saloons/SUVs/4WDs, minibuses/minivans, and pickups/light trucks.

† Heavy vehicles include buses and trucks/large trucks.

Mean, median, and 85th percentile among vehicles in free flow speed by road type

Road type	n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Collector/distributor/local	2,921	56 ± 6	55	62
Arterial	2,807	57 ± 6	55	62

Mean, median, and 85th percentile among vehicles in free flow speed by speed limit

Speed limit (km/h)	n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
50	5,728	57 ± 6	55	62

Mean, median, and 85th percentile among vehicles in free flow speed by vehicle ownership

Vehicle ownership type	n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Commercial	237	55 ± 5	54	60
Taxi	2,644	56 ± 5	55	61
Ride-share	139	56 ± 4	55	59
Other (incl private and govt)	2,708	57 ± 6	56	63

Mean, median, and 85th percentile among vehicles in free flow speed by day of the week

Day of the week	n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Monday	658	56 ± 5	55	62
Tuesday	932	56 ± 5	55	60
Wednesday	498	57 ± 6	56	61
Thursday	763	57 ± 6	56	63
Friday	494	58 ± 7	56	63
Saturday	1,106	57 ± 5	55	64
Sunday	1,277	56 ± 5	55	62

Mean, median, and 85th percentile among vehicles in free flow speed by observation session interval

Observation session interval	n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Early morning (07:45 - 09:15)	1,236	57 ± 5	55	62
Late morning (10:00 - 11:30)	1,519	56 ± 5	55	61
Afternoon (12:15 - 13:45)	1,441	57 ± 6	55	62
Late Afternoon (14:30 - 16:00)	1,532	57 ± 6	55	63

* The observation session time intervals vary slightly across days of the week. The observational intervals for the majority of observations are used to categorize time differences. Each session last about 90 minutes.

Early morning (07:45 - 09:15) includes observations made between 7:30 - 9:15, 7:45 - 9:15, 7:30 - 9:45; Late morning (10:00-11:30) includes observations made between 9:45 - 11:30, 10:00 - 11:15, and 10:00-11:30; Afternoon (12:15-13:45) includes observations made between 12:15 - 13:45; Late Afternoon (14:30-16:00) includes observations made between 14:15- 16:00, 14:30- 16:00.

* Data during "Evening" sessions were not collected in Round 2 due to the Covid-19 pandemic.

REGRESSION ANALYSIS FOR SPEED

Multivariate logistic regression model based on speeding

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Weather condition		
- Dry/no rain	Ref	Ref
- Light rain/drizzle	0.9 (0.8 – 0.9)	0.9 (0.8 – 1.0)
- Rain	0.2 (0.1 – 0.3)	0.3 (0.2 – 0.4)
Observation interval		
- Early morning (07:45 - 09:15)	Ref	Ref
- Late morning (10:00 – 11:30)	1.1 (1.1 – 1.2)	1.1 (1.1 – 1.2)
- Afternoon (12:15 - 13:45)	1.2 (1.1 – 1.3)	1.1 (1.0 – 1.2)
- Late Afternoon (14:30 - 16:00)	1.3 (1.2 – 1.4)	1.3 (1.2 – 1.4)
Day of week		
- Weekday	Ref	Ref
- Weekend	1.2 (1.1 – 1.3)	1.3 (1.2 – 1.4)
Road type		
- Collector/Distributor/Local roads	Ref	Ref
- Arterial roads	2.4 (2.3 – 2.5)	2.1 (2.0 – 2.2)
Law enforcement		
- None	Ref	Ref
- Police only	3.9 (3.1 – 5.0)	3.0 (2.4 – 3.9)
- Camera only	4.1 (3.5 – 4.9)	3.1 (2.6 – 3.7)
Vehicle type		
- Pickups/Light trucks	Ref	Ref
- Trucks/Large trucks	0.3 (0.2 – 0.4)	0.4 (0.3 – 0.5)
- Buses	1.9 (1.2 – 3.0)	1.7 (1.1 – 2.7)
- Minibuses/Minivans	1.6 (1.4 – 1.9)	1.4 (1.2 – 1.6)
- Sedans/Saloons/SUVs/4WDs	1.4 (1.3 – 1.6)	1.2 (1.0 – 1.3)
- Motorcycles	0.7 (0.6 – 0.8)	0.8 (0.7 – 1.0)
Vehicle ownership		
- Commercial (with company logo)	Ref	Ref
- Taxi	1.2 (1.1 – 1.4)	1.4 (1.2 – 1.6)
- Ride-share (with company sticker of Grab, Lyft, Uber, etc.)	1.0 (0.8 – 1.2)	1.1 (0.9 – 1.4)
- Other (private, government, etc.)	2.4 (2.1 – 2.7)	2.1 (1.8 – 2.4)

HELMET USE

Percentage of helmet use among motorcycle occupants

Helmet use	n (Percentage)
Total occupants observed* (N=90,341)	
Overall helmet use¹	42,369 (47)
- Correct helmet use ²	32,872 (36)
- Incorrect helmet use	8,947 (10)
- Unobservable (Correctness) ³	550 (1)
No helmet use	47,972 (53)

*Occupants include drivers and passengers

¹Overall helmet use is defined as strapped or unstrapped use of a helmet of any type.

²Correct helmet use is defined as strapped use of a full-face or non-full-face helmet (but not cap helmet).

³Correct helmet use is unobservable when helmet use, strap use, or helmet type is unobservable.

Percentage of helmet use by type of motorcycle occupants

Helmet use by occupant type	n (Percentage)
Total occupants observed (N=90,341)	N/A
- Drivers observed (n=62,665)	
- Passengers observed (n=27,676)	
Helmet use among occupants observed	
- Drivers	41,665 (66)
- Passengers	704 (3)
Correct helmet use among occupants observed	
- Drivers	32,331 (52)
- Passengers	541 (2)

Percentage of helmet use by type of motorcycle occupants and sex, n (%)

	Drivers observed (n=62,665)			Passengers observed (n=27,676)		
	Males (n=62,152; 99%)	Females (n=272; 0%)	Sex unobservable (n=241; 0%)	Males (n=16,902; 61%)	Females (n=10,526; 38%)	Sex unobservable (n=248; 1%)
Overall helmet use	41,343 (67)	163 (60)	159 (66)	590 (3)	113 (1)	1 (0)
Correct helmet use	32,089 (52)	123 (45)	119 (49)	438 (3)	102 (1)	1 (0)

- About 99% of motorcycle drivers using helmets are male; about 61% of passengers are male while 38% of passengers are female.
- Both overall and correct helmet use are higher in male drivers, while both are almost non-existent in female passengers

Percentage of helmet use among passengers by age and sex, n (%)

	Adult passengers observed (n=25,532)			Child passengers observed (n=2,083)		
	Males (n=15,791; 62%)	Females (n=9,710; 38%)	Sex unobservable (n=31; 0.12%)	Males (n=1,067; 51%)	Females (n=803; 39%)	Sex unobservable (n=213; 10%)
Overall helmet use	556 (4)	108 (1)	0 (0)	33 (3)	5 (1)	1 (0)
Correct helmet use	410 (3)	98 (1)	0 (0)	27 (3)	4 (0)	1 (0)

*Age was not observable for 61 passengers

Percentage of helmet use by motorcycle occupants and day of the week, n (%)

	Weekday (n=59,190)		Weekend (n=31,151)	
	Drivers (n=41,188; 70%)	Passengers (n=18,002; 30%)	Drivers (n=21,477; 69%)	Passengers (n=9,674; 31%)
Overall helmet use	27,705 (67)	454 (3)	13,960 (65)	250 (3)
Correct helmet use	21,449 (52)	336 (2)	10,882 (51)	205 (2)

Prevalence of overall and correct helmet use by day of the week, n (%)

Day of week	n (n= 90,341)	Overall Helmet Use (n=42,369)	Correct Helmet Use (n=32,872)
Monday	9,352	4,377 (47)	3,407 (36)
Tuesday	10,448	5,086 (49)	4,042 (39)
Wednesday	20,015	9,406 (47)	7,207 (36)
Thursday	8,213	4,354 (53)	3,210 (39)
Friday	11,162	4,936 (44)	3,919 (35)
Saturday	19,438	9,944 (51)	7,661 (39)
Sunday	11,713	4,266 (36)	3,426 (29)

Helmet use by motorcycle occupants based on time of day, n (%)

Time of day	Drivers observed			Passengers observed		
	n (n= 62,665) ¹	Overall Helmet Use (n=41,665)	Correct Helmet Use (n=32,331)	n (n=27,676) ²	Overall Helmet Use (n=704)	Correct Helmet Use (n=541)
Early morning (07:45 - 09:15)	16,186	11,382 (70)	8,720 (54)	6,523	163 (3)	121 (2)
Late morning (10:00 – 11:30)	15,840	10,586 (67)	8,266 (52)	6,556	154 (2)	118 (2)
Afternoon (12:15 - 13:45)	15,480	10,050 (65)	7,865 (51)	7,337	171 (2)	135 (2)
Late Afternoon (14:30 - 16:00)	15,159	9,647 (64)	7,480 (49)	7,260	216 (3)	167 (2)

¹ indicates the total number of drivers observed

* The observation session time intervals vary slightly across days of the week. The observational intervals for the majority of observations are used to categorize time differences. Each session last about 90 minutes.

Early morning (07:45 - 09:15) includes observations made between 7:45 – 9:15, 7:50 – 9:35, 7:45 – 9:45; Late morning (10:00–11:30) includes observations made between 10:00-11:30; Afternoon (12:15-13:45) includes observations made between 12:15 – 13:45; Late Afternoon (14:30-16:00) includes observations made between 14:30- 16:00.
* Data during “Evening” sessions were not collected in Round 2.

Prevalence of overall and correct helmet use by road type, n (%)

Road type	n (n=90,341)	Overall Helmet Use (n=42,369)	Correct Helmet Use (n=32,872)
Collector/distributor/local roads	64,377	29,276 (45)	23,370 (36)
Arterial roads	25,964	13,093 (50)	9,502 (37)

Prevalence of overall and correct helmet use based on law enforcement and type of occupant, n (%)

Law enforcement	Drivers observed			Passengers observed		
	N (n=62,665)	Overall Helmet Use (n=34,523)	Correct Helmet Use (n=32,331)	N (n=27,676)	Overall Helmet Use (n=1,359)	Correct Helmet Use (n=1,178)
None	55,779	36,028 (65)	28,307 (51)	24,011	655 (3)	505 (2)
Police only	6,886	5,637 (82)	4,024 (58)	3,665	49 (1)	36 (1)

Prevalence of overall and correct helmet use by vehicle ownership and by type of occupant, n (%)

Vehicle ownership	Drivers observed			Passengers observed		
	n (n=62,665)	Overall Helmet Use (n=41,665)	Correct Helmet Use (n=32,331)	n (n=27,676)	Overall Helmet Use (n=704)	Correct Helmet Use (n=541)
Commercial	1,068	615 (58)	507 (48)	203	13 (6)	7 (3)
Taxi	54,120	34,878 (64)	26,471 (49)	24,319	530 (2)	420 (2)
Ride-share	5,117	4,703 (92)	4,180 (82)	2,618	95 (4)	83 (3)
Other (incl private and govt)	2,360	1,469 (62)	1,173 (50)	536	66 (12)	31 (6)

*Private, government, etc.

REGRESSION ANALYSIS FOR HELMET USE

Multivariate logistic regression model for correct helmet use

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age		
- Under 18 years	Ref	Ref
- 18 years and older	26.1 (19.8 – 34.4)	4.1 (3.0 – 5.6)
- Unobservable	22.7 (15.9 – 32.4)	2.7 (1.8 – 4.0)
Sex		
- Female	Ref	Ref
- Male	32.9 (28.8 – 37.5)	2.0 (1.7 – 2.3)
- Unobservable	15.3 (12.0 – 19.5)	1.9 (1.4 – 2.6)
Occupant type		
- Driver	Ref	Ref

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
- Passenger	0.02 (0.02 – 0.02)	0.02 (0.02 – 0.02)
Weather condition		
- Dry/no rain	Ref	Ref
- Light rain/drizzle	1.0 (0.9 – 1.0)	1.0 (0.9 – 1.1)
- Rain	1.1 (1.0 – 1.1)	1.2 (1.1 – 1.4)
Observation start time		
- Early morning (07:45 - 09:15)	Ref	Ref
- Late morning (10:00 – 11:30)	0.9 (0.9 – 1.0)	0.9 (0.9 – 1.0)
- Afternoon (12:15 - 13:45)	0.8 (0.8 – 0.9)	0.9 (0.8 – 0.9)
- Late Afternoon (14:30 - 16:00)	0.8 (0.8 – 0.8)	0.8 (0.8 – 0.9)
Day of week		
- Weekday	Ref	Ref
- Weekend	0.9 (0.9 – 1.0)	1.0 (1.0 – 1.0)
Road type		
- Collector/Distributor/Local roads	Ref	Ref
- Arterial roads	1.0 (1.0 – 1.0)	1.0 (1.0 – 1.0)
Law enforcement		
- None	Ref	Ref
- Police only	1.0 (0.9 – 1.0)	0.9 (0.9 – 1.0)
- Camera only	1.4 (1.3 – 1.4)	1.6 (1.5 – 1.6)
- Police and camera	1.4 (1.3 – 1.5)	1.9 (1.8 – 2.1)
Vehicle ownership		
- Commercial (with company logo)	Ref	Ref
- Taxi	0.8 (0.7 – 0.9)	1.0 (0.9 – 1.2)
- Ride-share (with company sticker of Grab, Lyft, Uber, etc.)	1.8 (1.6 – 2.0)	4.2 (3.7 – 4.9)
- Other (private, government, etc.)	1.0 (0.9 – 1.2)	1.2 (1.0 – 1.3)