

BLOOMBERG PHILANTHROPIES INITIATIVE FOR GLOBAL ROAD SAFETY

KAMPALA ROUND 3

TECHNICAL ANNEX APRIL 2022

SAMPLING METHODOLOGY

The Johns Hopkins International Injury Research Unit partnered with Makerere University to conduct roadside observations in April 2022.

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 18:15 p.m. on both weekend days and weekdays. The methods were designed to estimate citywide prevalence and cannot provide insights into interventions conducted at specific locations within 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
Mutungo	Biina road near radio Maria	0.309	32.657	1158.972	4.347
Kawempe 1	Bombo road near Nira kawempe division	0.375	32.557	1194.435	4.898
Kawempe 1	Dr. Ssembeguya road at UNIC motel	0.381	32.564	1192.531	4.824
Najanankumbi I	Entebbe road near Polo supermarket	0.279	32.566	1217.499	4.288
Ggaba	Ggaba bypass near chop and sizzle restaurant	0.266	32.625	1159.570	4.865
Kabalagala	Ggaba road near Rhabot brick makers (close to seroma hardware)	0.298	32.600	1169.003	3.900
Ggaba	Kalungu road near NAIA saloon	0.299	32.588	1223.735	4.502
Ggaba	Kawuku road just after the flower pot makers	0.277	32.615	1143.890	4.288
Lukuli	Kirombe road near wood selling point (there's a transformer too at that point)	0.266	32.629	1167.135	4.931

Kibuye I	Lukuli road near Harvest investments	0.297	32.595	1208.031	4.766
Kabuye I	Mbogo road as you move in the direction of Greenhill academy	0.314	32.599	1145.147	4.789
Busega	Mugema road at the storeyed building near MK international schools signpost	0.312	32.526	1193.260	4.347
Kibuye I	Namasole road	0.286	32.569	1193.160	4.288
Busega	Old Mubende road near GB. Agricultural and pesticide shop	0.311	32.522	1167.043	4.269
Kabalagala	Tankhill road just near njuki close (at the fence painted white through out and cameras by the road)	0.300	32.607	1180.985	4.502
Kawempe 1	Ttula road opposite potter's house	0.381	32.565	1195.541	4.641
Mutungo	Biina road near radio Maria	0.309	32.657	1158.972	4.347

Helmet Use (Rounds 1-5)

DIVISION	LOCATION	GPS LATITUDE	GPS LONGITUDE	GPS ALTITUDE	GPS PRECISION
Mutungo	Biina road junction with Butabika road	0.310	32.657	1196.600	4.900
Kawempe 1	Bombo road near Riham	0.375	32.557	1193.679	4.158
Kawempe 1	Dr Ssembeguya - Kawempe-Ttula junction	0.381	32.564	1190.840	4.942
Najanankumbi I	Entebbe road near king's nursery and primary sign post	0.279	32.566	1206.500	4.711
Ggaba	Ggaba bypass junction with Ggaba road opposite Oryx fuel station	0.266	32.625	1151.400	4.938
Kabalagala	Ggaba road junction with Muyenga hill road	0.298	32.601	1167.000	4.579
Kibuye I	Hanlon road near Nsambya catholic church	0.299	32.588	1192.300	4.824
Ggaba	Kalungu road at the junction with Ggaba road	0.277	32.615	1134.718	4.402
Ggaba	Kawuku road at the junction with Ggaba by pass road	0.266	32.629	1163.497	4.439

Lukuli	Kirombe road opposite interservice hotel	0.297	32.595	1185.500	4.441
Kabalagala	Mbogo road at the junction with Sixth street	0.314	32.599	1137.100	4.776
Busega	Mugema Road near Busega SS sign post	0.312	32.526	1197.601	4.946
Kibuye I	Namasole road junction with Entebbe	0.286	32.569	1174.900	4.502
Busega	Old Mubende road near Star secondary sign post	0.312	32.522	1164.713	4.938
Kawempe 1	Ttula round about	0.381	32.565	1189.000	4.881
Mutungo	Biina road junction with Butabika road	0.310	32.657	1196.600	4.900

FINDINGS

OVERALL

Table 1: Number of vehicles and occupants observed for the three risk factors

	Helmet	Speed
Vehicles observed	75,656	82,371
Occupants observed	114,702	N/A

Table 2: Number of occupants observed by type

Risk Factors	Number of Observations		
	Driver	Passenger	Total
Helmet	39,046	75,656	114,702

SPEED

Table S1: Prevalence of speeding

	n (Percentage)	Average Speed (km/h)	Median (km/h)	85th pctl (km/h)
Vehicles observed	82,371 (100)	34 ± 10	34	44
Driving above speed limit	4,452 (5)	56 ± 5	54	60
Driving within speed limit	77,919 (95)	33 ± 9	33	43
Posted speed limit of 50 km/h for all road types and vehicle types.				

Table S1 shows that 5% of the vehicles observed were speeding. However, the mean speed of speeding vehicles was 56 km/h.

Figure S1: Histogram of speed among all vehicles

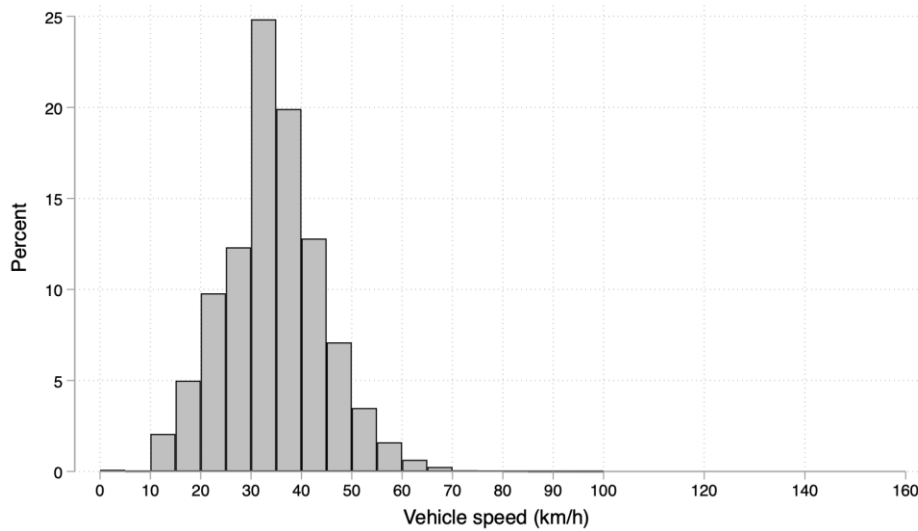
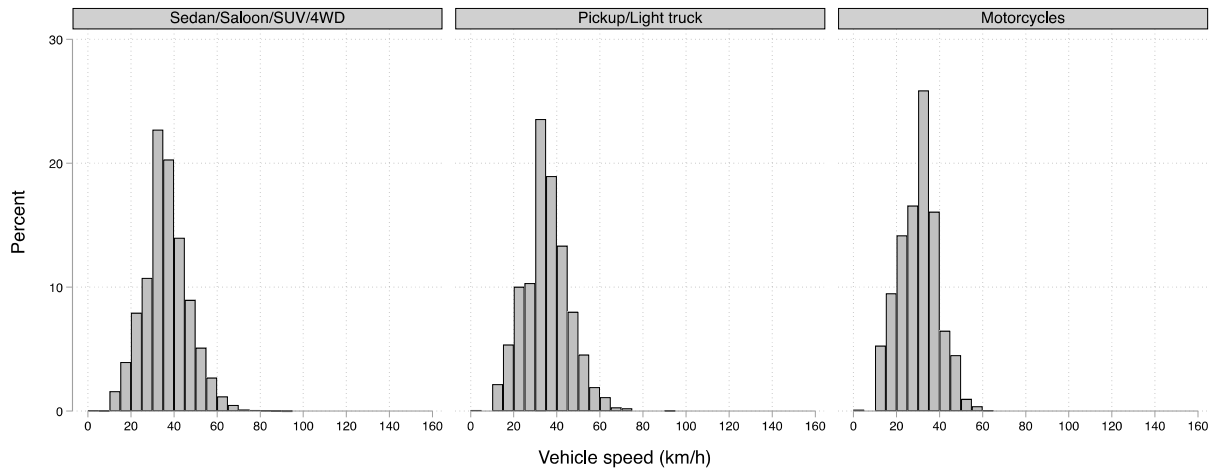


Table S2: Percentage of speeding based on type of vehicle, n (%)

Type of vehicle	Speeding					
	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Pickups/Light trucks	263 (7)	3,408 (93)	3,671 (100)	35 ± 11	34	45
Trucks/Large trucks	22 (1)	1,818 (99)	1,840 (100)	30 ± 9	30	39
Buses	5 (4)	136 (96)	141 (100)	35 ± 10	35	45
Minibuses/Minivans	263 (5)	4,626 (95)	4,889 (100)	34 ± 10	34	44
Sedan/Saloon/SUV/4WD	2,027 (9)	21,521 (91)	23,548 (100)	36 ± 10	35	46
Motorcycles	1,872 (4)	46,349 (96)	48,221 (100)	33 ± 9	33	42
Other	0 (0)	61 (100)	61 (100)	28 ± 13	27	38

Table S2 shows that the highest percentages of speeding were among sedans/SUVs (9%), pickups (7%), and minibuses/minivans (5%).

Figure S2: Histogram of speed by top 3 vehicle types with highest prevalence of speeding



Graphs by Top 3 speeding vehicle types

Table S3: 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= 48,221)	1,872 (4)	33 ± 9	33	42
Light vehicles* (n= 32,108)	2,553 (8)	35 ± 10	35	46
Heavy vehicles† (n= 1,981)	27 (1)	30 ± 9	30	39

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

Note: 61 from 'other' are excluded from this analysis, hence the total is 82,310.

When vehicle type is collapsed into three categories, Table S3 shows that light vehicles have the highest prevalence of speeding (8%) among other vehicle types.

Table S4: Percentage of speeding based on vehicle ownership, n (%)

Vehicle ownership	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Commercial	205 (4)	5,399 (96)	5,604 (100)	32 ± 10	32	42
Taxi	1,705 (4)	44,046 (96)	45,751 (100)	33 ± 9	33	42
Ride-share	124 (4)	3,084 (96)	3,208 (100)	33 ± 9	33	42
Other (including private and government)	2,418 (9)	25,390 (91)	27,808 (100)	36 ± 11	35	46

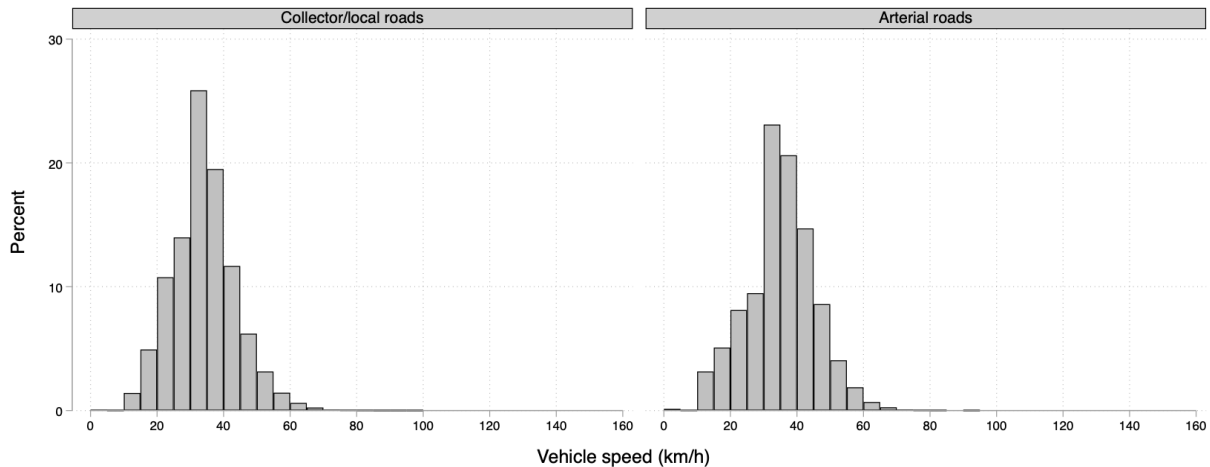
Table S4 shows that private and government vehicles had the highest prevalence of speeding (9%) compared to other vehicle ownership types.

Table S5: Percentage of speeding based on the road type, n (%)

Road type	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Collector/Distributor/Local Road	2,580 (5)	49,309 (95)	51,889 (100)	33 ± 10	33	43
Arterial Road	1,872 (6)	28,610 (94)	30,482 (100)	33 ± 10	35	45

Table S5 shows that the prevalence of speeding was similar on collector/distributor/local roads and arterial roads.

Figure S3: Histogram of speed by road type



Graphs by Road type

Table S6: 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)	62%
Arterial Road (Speed ≥ 50 km/h)	6%

Table S6 shows that 62% of the vehicles observed on collector/distributor/local roads were driving above the globally recommended speed limit of 30 km/h.

Table S7: Prevalence of speeding based on pedestrian access, n (%)

Level of pedestrian access	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Partially controlled ¹	357 (5)	6,258 (95)	6,615 (100)	34 ± 10	34	44
No access control	4,095 (5)	71,661 (95)	75,756 (100)	34 ± 10	34	44

¹Partially controlled roads are those where pedestrians can have limited access to the road. For example, limited number of direct accesses, such as main roadways with frontage or service roads running parallel.

Table S7 shows that the prevalence of speeding is 5% on roads with partially controlled pedestrian access as well as roads with no access control.

Table S8: Percentage of speeding based on weekday, n (%)

Day	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Weekday	2,827 (5)	51,396 (95)	54,223 (100)	34 ± 10	34	44
Weekend	26,523 (94)	1,625 (6)	28,148 (100)	34 ± 10	34	44

* The weekend is Saturday and Sunday.

Table S8 shows that speeding was more common on weekends (94%) than on weekdays (5%).

Table S9: Prevalence of speeding and mean, median, and 85th percentile speed by day of the week, n (%)

Day of the week	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Sunday	812 (8)	9,751 (92)	10,563 (100)	35 ± 11	35	45
Monday	701 (4)	16,258 (96)	16,959 (100)	33 ± 9	33	43
Tuesday	n/a	n/a	n/a	n/a	n/a	n/a
Wednesday	704 (4)	17,075 (96)	17,779 (100)	32 ± 10	32	42
Thursday	670 (7)	8,328 (93)	8,998 (100)	37 ± 10	36	46
Friday	752 (7)	9,735 (93)	10,487 (100)	36 ± 10	36	45
Saturday	813 (5)	16,772 (95)	17,585 (100)	33 ± 10	33	43

* There was no observation session on Tuesday.

Table S9 shows that speeding was highest on Sunday (8%).

Table S10: Percentage of speeding based on observation session interval*, n (%)

Observation session interval	Yes (n=4,452)	No (n=77,919)	Total (n=82,371)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Early morning (07:45 - 09:15)	909 (6)	15,370 (94)	16,279 (100)	35 ± 10	34	44
Late morning (10:00 - 11:30)	863 (5)	15,981 (95)	16,844 (100)	34 ± 10	34	44
Afternoon (12:15 - 13:45)	757 (5)	15,081 (95)	15,838 (100)	33 ± 10	33	43
Late Afternoon (14:30 - 16:00)	880 (6)	15,057 (94)	15,937 (100)	34 ± 10	34	44

Evening (16:45 - 18:15)	1,043 (6)	16,430 (94)	17,473 (100)	34 ± 10	33	44
-------------------------	-----------	-------------	--------------	---------	----	----

*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 should last about 90 minutes.

Early morning (07:45 - 09:15) includes observations made between 7:45 – 9:15, 8:00 – 9:30, 8:15 – 9:15; 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, 14:45 – 16:00; Evening (16:45 – 18:15) includes observations made between 16:45 – 18:15.

Table S10 shows that speeding prevalence were similar across different times of the day.

Table S11: Extent of speeding

A) Percentage of speeding by extent of speed and vehicle type (using the number of vehicles that were speeding as the denominator, n =4,452)

Type of vehicle	>5 km/h ¹	>10 km/h	>15 km/h	>20 km/h
Overall speeding vehicles (n =4,452)	1,657 (37)²	635 (14)	248 (6)	83 (2)
Pickups/Light trucks (n = 263)	108 (41)	45 (17)	13 (5)	5 (2)
Trucks/Large trucks (n = 22)	2 (9)	1 (5)	0 (0)	0 (0)
Buses (n = 5)	3 (60)	0 (0)	0 (0)	0 (0)
Minibuses/Minivans (n = 263)	93 (35)	33 (13)	14 (5)	3 (1)
Sedans/Saloons/SUVs/4WDs (n = 2,027)	856 (42)	344 (17)	152 (7)	55 (3)
Motorcycles (n = 1,872)	595 (32)	212 (11)	69 (4)	20 (1)
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.

²37% (n=1,657) of the total number of vehicles that were speeding (n=4,452) were exceeding the posted speed limit by >5 km/h

B) Percentage of speeding by extent of speed and vehicle type (using all vehicles observed as the denominator, N=82,371)

Type of vehicle	> speed limit	>5 km/h ¹	>10 km/h	>15 km/h	>20 km/h
Overall speeding vehicles (N =82,371)	4,452 (5)²	1,657 (2)	635 (1)	248 (0)	83 (0)
Pickups/Light trucks (n = 3,671)	263 (7)	108 (3)	45 (1)	13 (0)	5 (0)
Trucks/Large trucks (n = 1,840)	22 (1)	2 (0)	1 (0)	0 (0)	0 (0)
Buses (n = 141)	5 (4)	3 (2)	0 (0)	0 (0)	0 (0)
Minibuses/Minivans (n = 4,889)	263 (5)	93 (2)	33 (1)	14 (0)	3 (0)
Sedans/Saloons/SUVs/4WDs (n = 23,548)	2,027 (9)	856 (4)	344 (1)	152 (1)	55 (0)
Motorcycles (n = 48,221)	1,872 (4)	595 (1)	212 (0)	69 (0)	20 (0)
Other (n = 61)	0 (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.

²5% (n=4,452) of the total number of vehicles observed (N=82,371) 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.

Table S12: Mean, median, and 85th percentile among vehicles in free flow speed

n	Mean (km/h)	Median (km/h)	85th pctl (km/h)
4,322	56 ± 5	54	60

Table S13: 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)
Motorcycles	1,844	55 ± 5	53	59
Light vehicles*	2,452	56 ± 6	55	61
Heavy vehicles†	26	54 ± 3	53	57

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

† Heavy vehicles include buses and trucks/large trucks.

Table S14: 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	2,485	56 ± 5	54	61
Arterial	1,837	56 ± 5	54	60

Table S15: 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	4,322	56 ± 5	54	60

Table S16: 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	198	55 ± 4	54	59
Taxi	1,681	55 ± 4	53	59
Ride-share	120	55 ± 5	53	61
Other (incl private and govt)	2,323	56 ± 6	55	62

Table S17: 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	701	55 ± 5	54	60
Tuesday	n/a	n/a	n/a	n/a
Wednesday	703	56 ± 5	54	60
Thursday	670	56 ± 6	54	61
Friday	752	56 ± 5	55	60
Saturday	736	56 ± 5	54	61
Sunday	760	56 ± 5	54	60

Table S18: 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)	832	56 ± 5	54	60
Late morning (10:00 - 11:30)	862	55 ± 5	54	59
Afternoon (12:15 - 13:45)	705	56 ± 5	54	60
Late Afternoon (14:30 - 16:00)	880	56 ± 5	54	60
Evening (16:45 - 18:15)	1,043	56 ± 5	55	62

*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 should last about 90 minutes.

Early morning (07:45 - 09:15) includes observations made between 7:45 - 9:15, 8:00 - 9:30, 8:15 - 9:15; 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, 14:45 - 16:00; Evening (16:45 - 18:15) includes observations made between 16:45 - 18:15.

REGRESSION ANALYSIS FOR SPEED

Table S19: 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	0.6 (0.5 - 0.7)	0.6 (0.5 - 0.6)
- Rain	0.8 (0.7 - 1.0)	0.6 (0.5 - 0.8)
Observation session interval		
- Early morning (07:45 - 09:15)	Ref	Ref
- Late morning (10:00 - 11:30)	0.9 (0.8 - 1.0)	0.9 (0.8 - 1.0)
- Afternoon (12:15 - 13:45)	0.8 (0.8 - 0.9)	0.8 (0.7 - 0.8)
- Late Afternoon (14:30 - 16:00)	1.0 (1.0 - 1.1)	0.9 (0.8 - 0.9)
- Evening (16:45 - 18:15)	1.1 (1.0 - 1.2)	0.9 (0.8 - 1.0)
Day of week		

- Weekday	Ref	Ref
- Weekend	1.1 (1.0 – 1.2)	1.1 (1.1 -1.2)
Road type		
- Collector/Distributor/Local roads	Ref	Ref
- Arterial roads	1.3 (1.2 – 1.3)	1.4 (1.3 – 1.5)
Level of pedestrian access		
- No access control	Ref	Ref
- Partially controlled	1.0 (0.9 – 1.1)	0.8 (0.7 – 0.9)
Vehicle type		
- Pickups/Light trucks	Ref	Ref
- Trucks/Large trucks	0.2 (0.1 – 0.2)	0.2 (0.1 – 0.3)
- Buses	0.5 (0.2 – 1.2)	0.6 (0.2 – 1.4)
- Minibuses/Minivans	0.7 (0.6 – 0.9)	0.8 (0.7 – 1.0)
- Sedan/Saloon/SUV/4WD	1.2 (1.1 – 1.4)	0.9 (0.8 – 1.0)
- Motorcycles	0.5 (0.5 – 0.6)	0.8 (0.7 – 1.0)
Vehicle ownership		
- Commercial (with company logo)	Ref	Ref
- Taxi	1.0 (0.9 – 1.2)	0.9 (0.7 – 1.0)
- Ride-share (with company sticker of Grab, Lyft, Uber, etc.)	1.1 (0.8 – 1.3)	0.9 (0.7 – 1.2)
- Other (private, government, etc.)	2.5 (2.2 – 3.0)	2.0 (1.6 -2.3)

Table S19 shows the following:

- Speeding was 40% less likely in light rain and rainy weather compared to dry weather.
- Speeding percentages were similar across different times of the day.
- Speeding was 1.1 times higher on weekends.
- Speeding was 1.4 times more common on arterial roads compared to collector/distributor/local roads.
- Speeding was 20% less common on roads with partially controlled pedestrian access compared to freely accessible roads.
- Compared to pickups/light trucks, speeding was less common among buses and trucks.
- Speeding was twice as likely among private and government vehicles compared to commercial ones.

MOTORCYCLE-SPECIFIC ANALYSIS FOR SPEED

Table S20: Prevalence of motorcycle speeding

	n (Percentage)	Average Speed (km/h)	Median (km/h)	85 th pctl (km/h)
Motorcycle observed	48,221 (100)	33 ± 9	33	42
Driving above speed limit	1,872 (4)	55 ± 5	54	59
Driving within speed limit	46,349 (96)	32 ± 8	33	41
Posted speed limit of 50 km/h for all road types.				

Table S20 shows that 4% of the motorcycles observed were driving above the speed limit with a mean overall speed of 55 km/h.

The following tables and figures show the prevalence of speeding of **all motorcycles observed** (not just the motorcycles that were speeding).

Figure S5: Histogram of speed of motorcycles

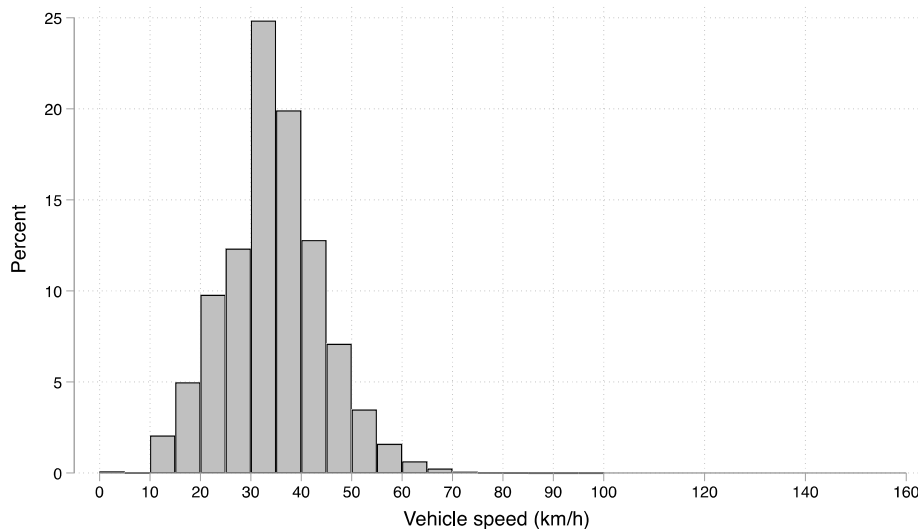


Table S21: Percentage of speeding based on motorcycle ownership type, n (%)

Vehicle ownership	Number speeding (n=1,872)	Mean (km/h)	Median (km/h)	85 th pctl (km/h)
Commercial (with company logo) (n=937)	43 (5)	32 ± 10	32	43
Taxi (n=42,357)	1,553 (4)	33 ± 9	33	42
Ride-share (with company sticker of Grab, Lyft, Uber, etc.) (n=3,007)	105 (3)	33 ± 9	32	41
Other (private, government, etc.) (n=1,920)	171 (9)	35 ± 11	34	46

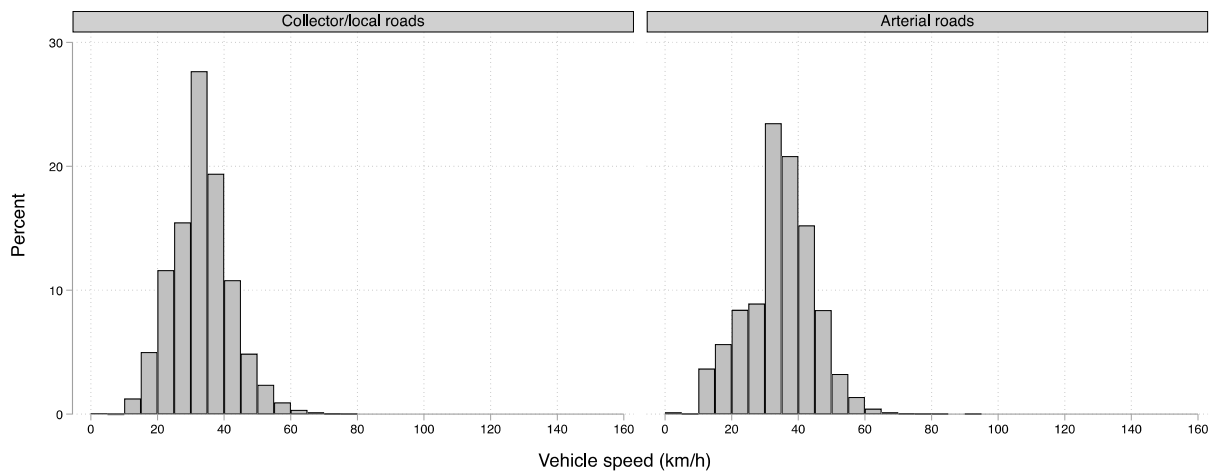
Table S21 shows the numbers and percentages of commercial, taxi, ride-share and other (including private and government) types of motorcycles that were speeding among the total number of each type of motorcycles observed. Speeding was highest among 'other' (private and government) types of motorcycles.

Table S22: Percentage of motorcycle speeding based on the road type, n (%)

Road type	Number speeding (n=1,872)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Collector/Distributor/Local Road (n=30,643)	1,059 (3)	33 ± 9	32	41
Arterial Road (n=17,578)	813 (5)	34 ± 10	34	44

Table S22 shows that 3% of the motorcycles observed on collector/distributor/local roads were speeding while 5% of the motorcycles seen on arterial roads were speeding.

Figure S6: Histogram of motorcycle speed by road type



Graphs by Road type

Figure S6 shows that the percentage of motorcycles driving above 50 km/h is similar on collector/distributor/local roads and arterial roads.

Table S23: Percentage of motorcycle 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)	59%
Arterial Road (Speed ≥ 50 km/h)	5%

Table S23 shows that that 59% of the motorcycles observed on collector/distributor/local roads were speeding above the globally recommended speed limit of 30 km/h.

Table S24: Prevalence of motorcycle speeding based on pedestrian access, n (%)

Level of pedestrian access	Number speeding (n=1,872)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Partially controlled ¹ (n=3,663)	102 (3)	32 ± 10	32	41
No access control (n=44,558)	1,770 (4)	33 ± 9	33	42

¹Partially controlled roads are those where pedestrians can have limited access to the road. For example, limited number of direct accesses, such as main roadways with frontage or service roads running parallel.

Table S24 shows that 3% of the motorcycles observed on roads with partially controlled pedestrian access were driving above the posted speed limit.

Table S25: Prevalence of motorcycle by weekday (weekday and weekend), n (%)

Day of the week	Motorcycle speeding (n=1,872)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Weekday (n=31,977)	1,216 (4)	33 ± 9	33	42
Weekend (n=16,244)	656 (4)	33 ± 10	33	43

Table S25 shows that the percentages, mean and median speeds of motorcycles speeding on weekdays and weekends were similar.

Table S26: Prevalence of speeding and mean, median, and 85th percentile speed by day of the week, n (%)

Day of the week	Motorcycle speeding (n=1,872)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Sunday (n=6,129)	348 (6)	34 ± 11	34	44
Monday (n=9,784)	260 (3)	32 ± 9	32	41
Tuesday (n=0)*	n/a	n/a	n/a	n/a
Wednesday (n=10,502)	309 (3)	32 ± 9	32	41
Thursday (n=5,485)	323 (6)	36 ± 9	36	44
Friday (n=6,206)	324 (5)	35 ± 9	35	44
Saturday (n=10,115)	308 (3)	32 ± 9	32	41

*No observations were conducted on Tuesday.

Table S26 shows the numbers and percentages of motorcycles found to be speeding by days of the week among those observed per day.

Table S27: Percentage of speeding based on observation session interval, n (%)

Observation session interval*	Motorcycle speeding (n=1,872)	Mean (km/h)	Median (km/h)	85th pctl (km/h)
Early morning (n=9,766)	321 (3)	34 ± 9	34	43
Late morning (n=10,159)	397 (4)	33 ± 9	33	42
Afternoon (n=9,290)	302 (3)	33 ± 9	33	42
Late Afternoon (n=9,111)	359 (4)	33 ± 10	33	43
Evening (n=9,895)	493 (5)	33 ± 10	32	43

*The session intervals for observation were early morning (7:45 – 9:15), late morning (10:00 – 11:30), afternoon (12:15 – 13:45), late afternoon (14:30 – 16:00) and evening (16:45 – 18:15).

Table S27 shows that 5% of the motorcycles were speeding in the evening observation session.

Figure S7: Extent of speeding

A) Percentage of motorcycle speeding by extent of speed (using the number of motorcycles that were speeding as the denominator)

Type of vehicle	>5 km/h	>10 km/h	>15 km/h	>20 km/h
Overall speeding motorcycles (n =1,871)	595 (32)	212 (11)	69 (4)	20 (1)

Figure S7 (a) shows that 32% (n=595) of the total number of motorcycles that were speeding (n=1,871) were exceeding the posted speed limit by >5 km/h.

Of note, the number of vehicles speeding > 5km/h includes all vehicles speeding > 5km/h, > 10 km/h, > 15 km/h and > 20 km/h.

B) Percentage of speeding by extent of speed (using all motorcycles observed as the denominator)

Type of vehicle	>5 km/h	>10 km/h	>15 km/h	>20 km/h
All motorcycles observed (n= 48,221)	595 (1)	212 (0)	69 (0)	20 (0)

Figure S7 (b) shows that about 1% (n=595) of the total number of motorcycles observed (n=48,221), were exceeding the posted speed limit by >5 km/h.

REGRESSION ANALYSIS FOR MOTORCYCLE SPEEDING

Table 9: Multivariate logistic regression model based on motorcycle speeding

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Weather condition		
- Dry/no rain	Ref	Ref
- Light rain/drizzle	0.5 (0.4 – 0.6)	0.5 (0.4 – 0.7)
- Rain	0.5 (0.3 – 0.7)	0.4 (0.3 – 0.7)
Observation session interval		
- Early morning (07:30 - 09:00)	Ref	Ref
- Late morning (10:00 – 11:30)	1.2 (1.0 – 1.4)	1.1 (1.0 – 1.3)
- Afternoon (12:30 - 14:00)	1.0 (0.8 – 1.2)	0.9 (0.7 – 1.1)
- Late Afternoon (15:00 - 16:30)	1.2 (1.0 – 1.4)	1.1 (0.9 – 1.3)
- Evening (17:30 - 19:00)	1.5 (1.3 - 1.8)	1.3 (1.1 – 1.5)
Day of week (weekend/weekday)		
- Weekday	Ref	Ref
- Weekend	1.1 (1.0 – 1.2)	1.1 (1.0 – 1.2)
Road type		
- Collector/Distributor/Local roads	Ref	Ref
- Arterial roads	1.4 (1.2 – 1.5)	1.5 (0.4 – 0.6)
Level of pedestrian access		
- No access control	Ref	Ref
- Partially controlled	0.7 (0.6 – 0.8)	0.5 (0.4 – 0.6)
Vehicle ownership		
- Commercial (with company logo)	Ref	Ref
- Taxi	0.8 (0.6 – 1.1)	0.8 (0.6 – 1.1)
- Ride-share	0.8 (0.5 – 1.1)	0.8 (0.5 – 1.1)

- Other (private, government, etc.)	2.0 (1.4 – 2.9)	2.2 (1.5 – 3.0)
-------------------------------------	-----------------	-----------------

Table 15 shows the following:

- Motorcycle speeding was 60% less likely during rain.
- Motorcycle speeding was 30% more likely in the evenings and 10% more likely in the late mornings and late afternoons compared to early mornings.
- Motorcycle speeding was 1.1 times more likely on weekends compared to weekdays.
- Motorcycles speeding was about 50% more common on arterial roads, compared to collector/distributor/local roads.
- Motorcycle speeding was about 50% less likely on roads with partially controlled pedestrian access compared to roads with no pedestrian access control.
- Speeding was less common among taxi and ride-share motorcycles but twice as common among private and government motorcycles, compared to commercial ones.

HELMET USE

Table H1: Percentage of helmet use among motorcycle occupants

Helmet use	n (Percentage)
Total occupants observed* (N=114,702)	
Overall helmet use¹	47,611 (42)
- Correct helmet use ²	36,264 (32)
- Incorrect helmet use	10,962 (10)
- Unobservable (Correctness) 3	385 (0)
No helmet use	67,091 (58)

*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.

Table H1 shows that correct helmet use was observed among 32% of all occupants observed.

Table H2: Percentage of helmet use by type of motorcycle occupants

Helmet use by occupant type	n (Percentage)
Total occupants observed (N=114,702)	N/A
- Drivers observed (n=75,656)	
- Passengers observed (n=39,046)	
Helmet use among occupants observed	
- Drivers	46,321 (61)
- Passengers	1,290 (3)
Correct helmet use among occupants observed	
- Drivers	35,208 (47)
- Passengers	1,056 (3)

Table H2 shows that while 61% of the drivers observed used helmets, 47% used helmets correctly. Overall helmet use and correct helmet use are both very low (3%) among passengers.

Table H3: Percentage of helmet use by type of motorcycle occupants and sex, n (%)

	Drivers observed (n=75,656)			Passengers observed (n=39,046)		
	Males (n=74,736; 99%)	Females (n=525; 1%)	Sex unobservable (n=395; 1%)	Males (n=24,609; 63%)	Females (n=14,081; 36%)	Sex unobservable (n=356; 1%)
Overall helmet use	45,736 (61)	319 (61)	266 (67)	1,106 (4)	178 (1)	6 (2)
Correct helmet use	34,736 (46)	269 (51)	203 (51)	893 (4)	160 (1)	3 (1)

Table H3 shows that correct helmet use was 46% among male drivers and 51% among female drivers. However, correct helmet use among both male (4%) and female (1%) passengers was rare.

Table H4: Percentage of helmet use among passengers by age and sex*, n (%)

	Adult passengers observed (n=36,132)			Child passengers observed (n=2,865)		
	Males (n=23,171; 64%)	Females (n=12,923; 36%)	Sex unobservable (n=38; 0.1%)	Males (n=1,409; 49%)	Females (n=1,144; 40%)	Sex unobservable (n=312; 11%)
Overall helmet use	1,059 (5)	166 (1)	4 (11)	47 (3)	12 (1)	2 (1)
Correct helmet use	849 (4)	149 (1)	2 (5)	44 (3)	11 (1)	1 (0)

*Age was not observable for 49 passengers

Table H4 shows that correct helmet use was very low irrespective of age and sex.

Table H5: Percentage of helmet use by motorcycle occupants and day of the week, n (%)

	Weekday (n=76,958)		Weekend (n=37,744)	
	Drivers (n=50,293; 65%)	Passengers (n=26,665; 35%)	Drivers (n=25,363; 67%)	Passengers (n=12,381; 33%)
Overall helmet use	32,037 (64)	987 (4)	14,284 (56)	303 (2)
Correct helmet use	24,255 (48)	809 (3)	10,953 (43)	247 (2)

Table H5 shows that correct helmet use among drivers was low at 48% on weekdays and 43% on weekends, while that of passengers was rare on both weekdays (3%) and weekends (2%).

Table H6: Prevalence of overall and correct helmet use by day of the week, n (%)

Day of week	N (n= 114,702)	Overall Helmet Use (n=47,611)	Correct Helmet Use (n=36,264)
Monday	14,346	5,343 (37)	3,724 (26)
Tuesday	23,653	9,833 (42)	7,105 (30)
Wednesday	24,300	10,729 (44)	8,400 (35)
Thursday	14,659	7,119 (49)	5,835 (40)
Friday*	n/a	n/a	n/a
Saturday	19,105	7,895 (41)	5,929 (31)
Sunday	18,639	6,692 (36)	5,271 (28)

*No observations were conducted on Friday.

Table H6 shows that both overall and correct helmet use were low across all days of the week.

Table H7: Helmet use by motorcycle occupants based on time of day, n (%)

Time of day	Drivers observed			Passengers observed		
	N (n=75,656) ¹	Overall Helmet Use (n=46,321)	Correct Helmet Use (n=35,208)	N (n=39,046) ²	Overall Helmet Use (n=1,290)	Correct Helmet Use (n=1,056)
Early morning (07:45 - 09:15)	15,089	10,241 (68)	7,654 (51)	7,358	205 (3)	170 (2)
Late morning (10:00 – 11:30)	15,154	9,655 (64)	7,448 (49)	7,042	264 (4)	201 (3)
Afternoon (12:15 - 13:45)	15,226	8,993 (59)	6,800 (45)	7,978	273 (3)	221 (3)
Late Afternoon (14:30 - 16:00)	14,926	8,653 (58)	6,589 (44)	8,073	295 (4)	248 (3)
Evening (16:45 - 18:15)	15,261	8,779 (58)	6,717 (44)	8,595	253 (3)	216 (3)

¹ indicates the total number of drivers observed

² indicates the total number of passengers observed

Table H7 shows that correct helmet use was rare among passengers irrespective of the time of day.

Table H8: Prevalence of overall and correct helmet use by road type, n (%)

Road type	N (n=114,702)	Overall Helmet Use (n=47,611)	Correct Helmet Use (n=36,264)
Collector/distributor/local roads	80,176	32,394 (40)	25,716 (32)
Arterial roads	34,526	15,217 (44)	10,548 (31)

Table H8 shows that overall and correct helmet use were similar on collector/distributor/local roads and arterial roads.

Table H9: Prevalence of overall and correct helmet use based on law enforcement, n (%)

Law enforcement	Drivers observed			Passengers observed		
	N (n=75,656)	Overall Helmet Use (n=46,321)	Correct Helmet Use (n=35,208)	N (n=39,046)	Overall Helmet Use (n=1,290)	Correct Helmet Use (n=1,056)
None	71,278	43,188 (61)	32,905 (46)	36,304	1,234 (3)	1,014 (3)
Police only	4,378	3,133 (72)	2,303 (53)	2,742	56 (2)	42 (2)

Table H9 shows that overall and correct helmet use was higher among drivers in the presence of police. However, the prevalence of overall and correct helmet use among passengers were similar irrespective of the presence of law enforcement.

Table H10: Prevalence of overall and correct helmet use by vehicle ownership and by type of occupant, n (%)

Vehicle ownership	Drivers observed			Passengers observed		
	N (n=75,656)	Overall Helmet Use (n=46,321)	Correct Helmet Use (n=35,208)	N (n=39,046)	Overall Helmet Use (n=1,290)	Correct Helmet Use (n=1,056)
Commercial	1,258	680 (54)	564 (45)	228	25 (11)	10 (4)
Taxi	66,484	39,302 (59)	29,133 (44)	35,132	953 (3)	803 (2)
Ride-share	4,832	4,470 (93)	4,012 (83)	2,962	206 (7)	190 (6)
Other (incl private and govt)	3,082	1,869 (61)	1,499 (49)	724	106 (15)	53 (7)

Table H10 shows that correct helmet use was the highest among drivers of ride-share vehicles. Correct helmet use among passengers was low irrespective of vehicle ownership type.

REGRESSION ANALYSIS FOR HELMET USE

Table H11: 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	14.3 (11.6 – 17.5)	1.5 (1.2 – 1.9)
- Unobservable	17.4 (12.6 – 24.1)	1.4 (1.0 – 2.0)
Sex		
- Female	Ref	Ref
- Male	18.5 (16.8 – 20.3)	1.9 (1.7 – 2.1)
- Unobservable	12.5 (10.4 – 15.1)	2.1 (1.7 – 2.6)
Occupant type		
- Driver	Ref	Ref
- Passenger	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)*
Weather condition		
- Dry/no rain	Ref	Ref
- Light rain/drizzle	1.3 (1.3 – 1.4)	1.3 (1.2 – 1.3)
- Rain	1.7 (1.6 – 1.8)	1.6 (1.5 – 1.8)
Observation session interval		
- Early morning (07:45 - 09:15)	Ref	Ref
- Late morning (10:00 – 11:30)	1.0 (0.9 – 1.0)	0.9 (0.9 -1.0)
- Afternoon (12:15 - 13:45)	0.8 (0.8 – 0.8)	0.8 (0.8 – 0.9)
- Late Afternoon (14:30 - 16:00)	0.8 (0.8 – 0.8)	0.8 (0.8 – 0.9)
- Evening (16:45 - 18:15)	0.8 (0.7 – 0.8)	0.8 (0.8 – 0.9)
Day of week		
- Weekday	Ref	Ref
- Weekend	0.9 (0.9 – 0.9)	0.8 (0.8 – 0.9)
Road type		
- Collector/Distributor/Local roads	Ref	Ref
- Arterial roads	0.9 (0.9 – 1.0)	0.9 (0.9 – 1.0)
Law enforcement		

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
- None	Ref	Ref
- Police only	1.1 (1.0 – 1.1)	1.3 (1.2 – 1.4)
Vehicle ownership		
- Commercial (with company logo)	Ref	Ref
- Taxi	0.7 (0.6 – 0.7)	0.9 (0.8 – 1.1)
- Ride-share (with company sticker of Grab, Lyft, Uber, etc.)	1.9 (1.7 – 2.1)	5.1 (4.5 – 5.8)
- Other (private, government, etc.)	1.1 (1.0 – 1.2)	1.2 (1.1 – 1.4)

Table H10 shows the following:

- Correct helmet use was 1.5 times more likely among occupants 18 years or older.
- Correct helmet use was 1.9 times more common in males compared to females.
- Passengers were unlikely to wear helmets correctly compared to drivers.
- Correct helmet use was 1.6 times more common in rainy weather compared to dry weather.
- Correct helmet use was 10% more common in late mornings compared to early mornings.
- Correct helmet use was 20% less likely on weekends.
- Correct helmet use was 10% less likely on arterial roads compared to collector/distributor/local roads.
- Correct helmet use was 1.3 times more common in the presence of police compared to the absence of law enforcement.
- Correct helmet use was 5.1 times more common among riders of ride-share motorcycles than those among commercial motorcycles.