Effect of ADHD on the incidence of driving infractions and accidents in young adults: cohort study

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TABLE OF CONTENTS

1 ABBREVIATIONS....2
2 CONTEXT....2
2.1 Objectives....2
3 METHODS....2
4 RESULTS....3
4.1 Study population and follow up....3
4.2 Effect of ADHD in driving infractions....9
5 OBSERVATIONS AND LIMITATIONS....13
6 CONCLUSIONS....13
7 REFERENCES....13
8 APPENDIX....14
8.1 Exploratory data analysis....14
8.2 Modeling strategy....15
8.3 Associated analyses....25
8.4 Availability....26
8.5 Analytical dataset....26

Effect of ADHD on the incidence of driving infractions and accidents in young adults: cohort study

Document version

Version	Alterations
01	Initial version

1 ABBREVIATIONS

- ADHD:
- CI: confidence interval
- LNCG:
- OR: odds ratio
- SD: standard deviation

2 CONTEXT

2.1 Objectives

To describe the impact of ADHD with the incidence of various driving infractions and accidents in young adults.

3 METHODS

The data procedures, design and analysis methods used in this report are fully described in the annex document **SAP-2023-014-RQ-v01**.

This analysis was performed using statistical software R version 4.2.3.

4 RESULTS

4.1 Study population and follow up

A total of 4565 observations were available on 856 individuals. Of those, 830 were sampled since the first assessment point, 17 first appeared in the second assessment point and 3 were only seen in the third assessment point. After applying the inclusion and exclusion criteria there were 2051 observations on 747 individuals. Of those, 678 were sampled since the first assessment point, 49 first appeared in the second assessment point and 20 were only seen in the third assessment point.

The epidemiological profile of the cohort participant has an average (SD) age of 21.19 (1.49) years at the first assessment point and 588 (79%) individuals were male (Table 1). The ADHD status was uniformly sampled, with approximately one third for each sub-group.

Table 1 *Participant epidemiological and clinical characteristics at their first assessment.*

Characteristic at first assessment	N = 747
ADHD Status, n (%)	
LNCG	268 (39%)
Desister	203 (30%)
Persister	213 (31%)
Unknown	63
Gender, n (%)	
F	159 (21%)
M	588 (79%)
Subject Age, Mean (SD)	21.19 (1.49)
Generalized Anxiety Disorder Status, n (%)	29 (4.0%)

Characteristic at first assessment	N = 747
Unknown	13
Major Depressive Disorder Status, n (%)	30 (4.1%)
Unknown	13
ADHD Medication Status, n (%)	
no	358 (88%)
some of the time	18 (4.4%)
most of the time	30 (7.4%)
Unknown	341
Marijuana Use, n (%)	
Not at All	103 (23%)
1–3 times	53 (12%)
4-7 times	36 (8.1%)
8-11 times	26 (5.9%)
Once a month	14 (3.2%)
2-3 times a month	27 (6.1%)
Once a week	12 (2.7%)
2-3 times a week	26 (5.9%)
4-6 times a week	33 (7.4%)

Characteristic at first assessment	N = 747
Once a day	27 (6.1%)
Twice a day	17 (3.8%)
Several times a day or more	70 (16%)
Unknown	303
Driving Experience, Mean (SD)	1.53 (2.26)
Unknown	149
Heavy alcohol user, n (%)	
Not at All	96 (15%)
1–3 times	143 (23%)
4-7 times	67 (11%)
8-11 times	33 (5.2%)
Once a month	67 (11%)
2-3 times a month	73 (11%)
Once a week	58 (9.1%)
2-3 times a week	68 (11%)
4-6 times a week	13 (2.0%)
Once a day	4 (0.6%)
Twice a day	4 (0.6%)

Characteristic at first assessment	N = 747
Several times a day or more	9 (1.4%)
Unknown	112

Very few participants reported mental health issues, where 29 (4.0%) participants reported Generalized Anxiety Disorder Status and 30 (4.1%) reported Major Depressive Disorder Status.

Most participants do not seem to be heavy users of recreational drugs, where 103 (23%) participants reported not using marijuana and 143 (23%) reported drinking around 1–3 times in the period.

Most traffic infractions seem to decrease over time, where at each assessment point the proportion of each infraction tends to get lower (Table 2). The exception seems to be DUI – Alcohol where the number (%) that reported this infraction was 167 (26%) at the third assessment point, from 86 (13%) at the first point. No accidents were reported during the study period, where 100% participants reported not being a driver in an accident regardless of time point or status group.

Figure 1 shows how these occurrences break down by ADHD status.

Table 2 *Study outcomes across all assessment points.*

Characteristic	**144**, N = 678	**168**, N = 699	**192**, N = 674
Driving without a seatbelt, n (%)	203 (31%)	203 (30%)	165 (25%)
Unknown	18	14	23
Illegally parking, n (%)	125 (19%)	133 (19%)	109 (17%)
Unknown	18	14	23
Illegally turning, n (%)	126 (19%)	157 (23%)	128 (20%)
Unknown	20	14	23
Speeding, n (%)	299 (45%)	327 (48%)	252 (39%)

Characteristic	**144**, N = 678	**168**, N = 699	**192**, N = 674
Unknown	18	14	23
Failing to stop to sign or signal, n (%)	125 (19%)	130 (19%)	99 (15%)
Unknown	18	14	23
Fail to yield right-of-way, n (%)	49 (7.4%)	47 (6.9%)	41 (6.3%)
Unknown	19	14	23
Tailgating, n (%)	75 (11%)	81 (12%)	80 (12%)
Unknown	18	14	23
Reckless driving, n (%)	80 (12%)	55 (8.0%)	47 (7.2%)
Unknown	18	14	23
DUI -- Alcohol, n (%)	86 (13%)	188 (27%)	167 (26%)
Unknown	18	14	23
DUI -- Other substances, n (%)	0 (NA%)	104 (15%)	88 (14%)
Unknown	678	14	23
Using cellphone while driving, n (%)	0 (NA%)	351 (51%)	307 (47%)
Unknown	678	14	23
I was NOT a driver in an accident in the past 2 years, n (%)	485 (100%)	527 (100%)	533 (100%)
Unknown	193	172	141

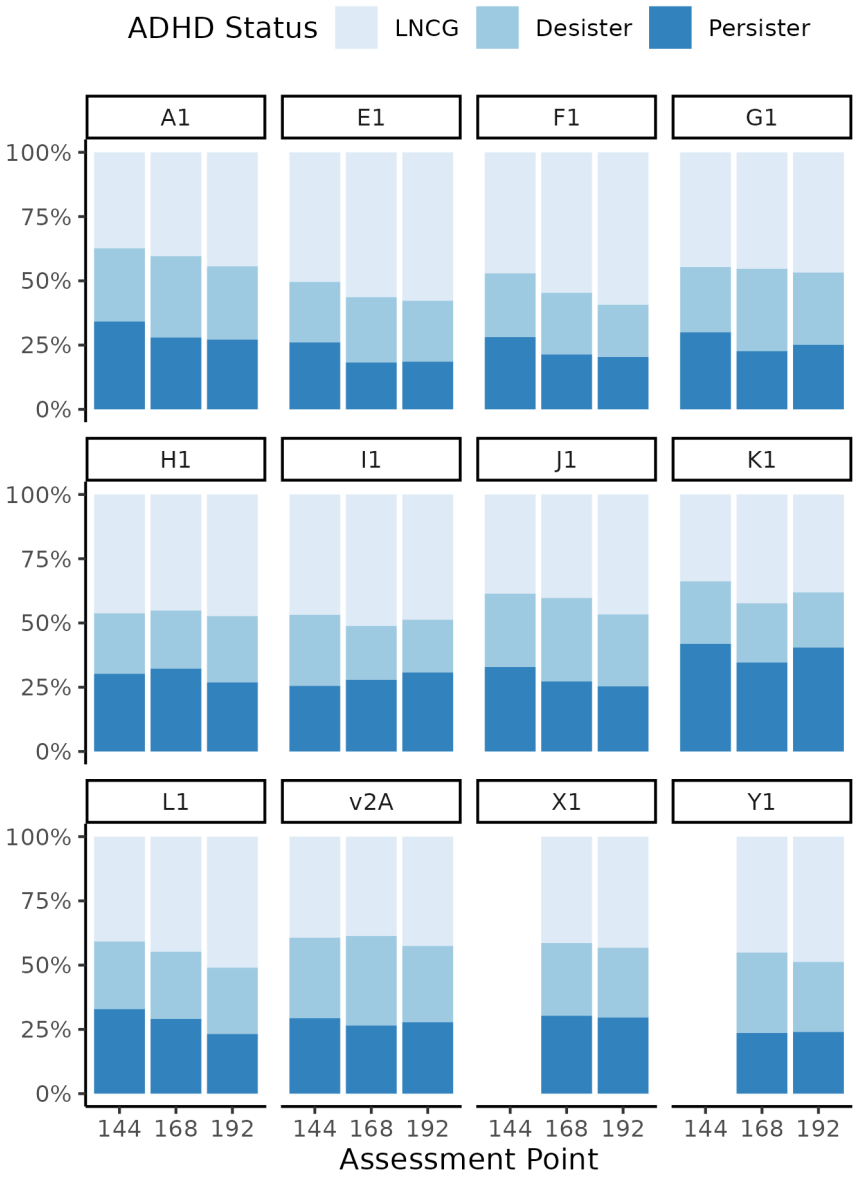

Figure 1 *Study outcomes across all assessment points.*

4.2 Effect of ADHD in driving infractions

The incidence OR of various traffic infractions for each ADHD status group are shown in Table 3. The incidence of driving accidents could not be calculated since the reported outcomes were constant (100% participants provided the same answer). The details of the modeling strategy are available in the Appendix, as well as the complete set of coefficients from the models (see Table A1).

ADHD status was associated with a most infractions evaluated in this study, after controlling for time, sex, driving experience and mental health status (occurrence of anxiety and depression). In particular, participants with ADHD appear to have lower odds of incidence compared to LNCG participants of performing Illegally parking, Illegally turning, Speeding, Failing to stop to sign or signal, Tailgating, DUI – Alcohol and Using cellphone while driving (Table 3). In the study sample it was not possible to detect an association between ADHD status and Driving without a seatbelt, Fail to yield right-of-way, Reckless driving and DUI – Other substances, where the incidence of those violations appear similar among groups.

Table 3 *Adjusted incidence odds of ADHD on driving infractions over three assessment points.*

Characteristic	OR[1]	95% CI[1]	p-value
Driving without a seatbelt			
LNCG	—	—	
Desister	0.85	0.49 to 1.49	0.576
Persister	1.24	0.70 to 2.18	0.465
Illegally parking			
LNCG	—	—	
Desister	0.39	0.24 to 0.64	**<0.001**
Persister	0.40	0.24 to 0.66	**<0.001**
Illegally turning			

Characteristic	OR[1]	95% CI[1]	p-value
LNCG	—	—	
Desister	0.38	0.25 to 0.59	**<0.001**
Persister	0.50	0.32 to 0.77	**0.002**
Speeding			
LNCG	—	—	
Desister	0.61	0.41 to 0.89	**0.010**
Persister	0.65	0.44 to 0.97	**0.033**
Failing to stop to sign or signal			
LNCG	—	—	
Desister	0.52	0.33 to 0.83	**0.006**
Persister	1.03	0.66 to 1.63	0.884
Fail to yield right-of-way			
LNCG	—	—	
Desister	0.43	0.16 to 1.10	0.078
Persister	0.83	0.33 to 2.06	0.687
Tailgating			
LNCG	—	—	
Desister	0.74	0.74 to 0.74	**<0.001**

Characteristic	OR[1]	95% CI[1]	p-value
Persister	1.11	1.10 to 1.11	**<0.001**
Reckless driving			
LNCG	—	—	
Desister	0.96	0.31 to 2.93	0.942
Persister	2.82	0.97 to 8.23	0.058
DUI -- Alcohol			
LNCG	—	—	
Desister	0.58	0.37 to 0.93	**0.023**
Persister	0.94	0.59 to 1.50	0.795
DUI -- Other substances			
LNCG	—	—	
Desister	1.27	0.37 to 4.40	0.704
Persister	0.76	0.19 to 3.07	0.703
Using cellphone while driving			
LNCG	—	—	
Desister	0.50	0.33 to 0.77	**0.002**
Persister	0.53	0.34 to 0.84	**0.006**

[1]OR = Odds Ratio, CI = Confidence Interval

Participants with Desister ADHD had a 61% lower chance of incurring in Illegally parking (95% CI 0.24, 0.64; p<0.001), while Persister had a 60% lower chance (95% CI 0.24, 0.66; p<0.001).

Participants with Desister ADHD had 62% lower Illegally turning chance of incurring in (95% CI 0.25, 0.59; p<0.001), while Persister had a 50% lower chance (95% CI 0.32, 0.77; p=0.002).

Desister ADHD had a 39% lower chance of incurring in Speeding (95% CI 0.41, 0.89; p=0.010), while Persister had a 35% lower chance (95% CI 0.44, 0.97; p=0.033).

Desister ADHD had 48% lower chance of incurring in Failing to stop to sign or signal (95% CI 0.33, 0.83; p=0.006), while Persister had a similar chance compared to controls (95% CI 0.66, 1.63; p=0.884).

Desister ADHD had a 26% lower chance of incurring in Tailgating (95% CI 0.74, 0.74; p<0.001), while Persister had a 11% higher chance (95% CI 1.10, 1.11; p<0.001).

Desister ADHD had a 42% lower DUI – Alcohol chance of incurring in (95% CI 0.37, 0.93; p=0.023), while Persister had a 6.0% lower a similar chance compared to controls (95% CI 0.59, 1.50; p=0.795).

Desister ADHD had a 50% lower chance of incurring in Using cellphone while driving (95% CI 0.33, 0.77; p=0.002), while Persister had a 53% lower chance (95% CI 0.34, 0.84; p=0.006).

It is worth noting that, although Persisters did not have an association with Reckless driving, its confidence interval has a much higher center towards higher chances (95% CI 0.97, 8.23; p=0.058).

The infractions evaluated in this report are associated with the incidence rate of accidents. For more details, read the associated analysis **SAR-2023-015-RQ-v01**

5 OBSERVATIONS AND LIMITATIONS

Recommended reporting guideline

The adoption of the EQUATOR network (http://www.equator-network.org/) reporting guidelines have seen increasing adoption by scientific journals. All observational studies are recommended to be reported following the STROBE guideline (von Elm et al, 2014).

6 CONCLUSIONS

Overall, participants with ADHD had a lower chance of having incurred in most infractions in the study, when compared with controls. Among those, Desisters had the lowest chance, followed by Persisters.

7 REFERENCES

- **SAP-2023-014-RQ-v01** – Analytical Plan for Effect of ADHD on the incidence of driving infractions and accidents in young adults: cohort study
- **SAR-2023-015-RQ-v01** – Impact of traffic infractions on the incidence of vehicle accidents in young adults with ADHD: cohort study
- von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. Int J Surg. 2014 Dec;12(12):1495-9 (https://doi.org/10.1016/j.ijsu.2014.07.013).

8 APPENDIX

8.1 Exploratory data analysis

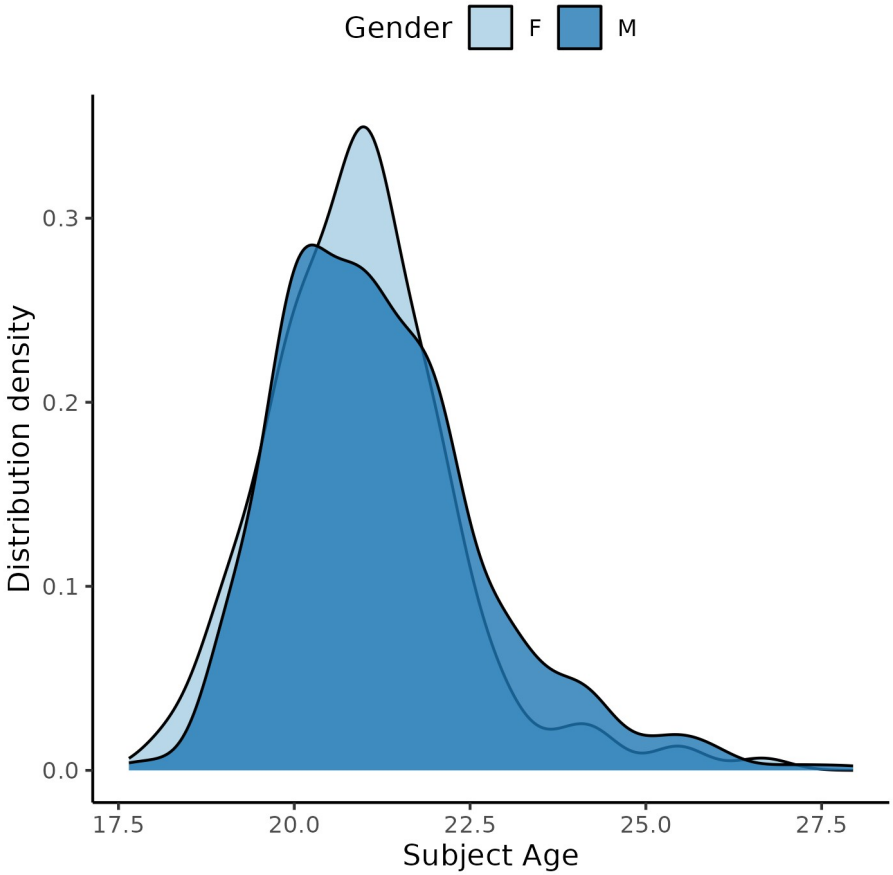

Figure A1 *Distribution of age in the study population.*

8.2 Modeling strategy

In the search for a maximal set of variables that produce convergence in all models, the following covariates were dropped:

1. ADHD Medication Status
2. Marijuana Use
3. Heavy alcohol user

Additionally, the outcome “I was NOT a driver in an accident in the past 2 years” only had a constant value for all valid responses (100% “yes” across all assessments, see table 2), so a model could not be fitted for this outcome.

Table A1 shows all coefficients from all models.

Table A1 *Alternate version of table 3, with all coefficients from all models.*

Group	Characteristic	OR[1]	95% CI[1]	p-value
Driving without a seatbelt	ADHD Status			
	LNCG	—	—	
	Desister	0.85	0.49 to 1.49	0.576
	Persister	1.24	0.70 to 2.18	0.465
	Assessment Point			
	144	—	—	
	168	0.90	0.60 to 1.36	0.624
	192	0.52	0.30 to 0.90	**0.020**
	Driving Experience	1.06	0.95 to 1.17	0.293
	Gender			
	F	—	—	

Group	Characteristic	OR[1]	95% CI[1]	p-value
	M	2.35	1.26 to 4.39	**0.007**
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	0.96	0.36 to 2.54	0.936
	Major Depressive Disorder Status			
	no	—	—	
	yes	1.00	0.37 to 2.69	0.999
Illegally parking	ADHD Status			
	LNCG	—	—	
	Desister	0.39	0.24 to 0.64	**<0.001**
	Persister	0.40	0.24 to 0.66	**<0.001**
	Assessment Point			
	144	—	—	
	168	0.89	0.61 to 1.32	0.571
	192	0.52	0.31 to 0.87	**0.013**
	Driving Experience	1.08	0.99 to 1.19	0.078
	Gender			
	F	—	—	
	M	2.64	1.53 to 4.56	**<0.001**

Group	Characteristic	OR[1]	95% CI[1]	p-value
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	2.44	1.02 to 5.81	**0.044**
	Major Depressive Disorder Status			
	no	—	—	
	yes	0.89	0.35 to 2.25	0.803
Illegally turning	ADHD Status			
	LNCG	—	—	
	Desister	0.38	0.25 to 0.59	**<0.001**
	Persister	0.50	0.32 to 0.77	**0.002**
	Assessment Point			
	144	—	—	
	168	1.35	0.94 to 1.93	0.106
	192	0.83	0.52 to 1.31	0.416
	Driving Experience	1.04	0.96 to 1.12	0.379
	Gender			
	F	—	—	
	M	1.90	1.19 to 3.03	**0.007**
	Generalized Anxiety Disorder Status			

Group	Characteristic	OR[1]	95% CI[1]	p-value
	no	—	—	
	yes	1.91	0.85 to 4.29	0.114
	Major Depressive Disorder Status			
	no	—	—	
	yes	0.90	0.38 to 2.13	0.812
Speeding	ADHD Status			
	LNCG	—	—	
	Desister	0.61	0.41 to 0.89	**0.010**
	Persister	0.65	0.44 to 0.97	**0.033**
	Assessment Point			
	144	—	—	
	168	0.87	0.63 to 1.21	0.410
	192	0.32	0.21 to 0.49	**<0.001**
	Driving Experience	1.21	1.13 to 1.31	**<0.001**
	Gender			
	F	—	—	
	M	1.82	1.21 to 2.72	**0.004**
	Generalized Anxiety Disorder Status			
	no	—	—	

Group	Characteristic	OR[1]	95% CI[1]	p-value
	yes	0.97	0.46 to 2.05	0.945
	Major Depressive Disorder Status			
	no	—	—	
	yes	1.07	0.48 to 2.36	0.867
Failing to stop to sign or signal	ADHD Status			
	LNCG	—	—	
	Desister	0.52	0.33 to 0.83	**0.006**
	Persister	1.03	0.66 to 1.63	0.884
	Assessment Point			
	144	—	—	
	168	0.82	0.56 to 1.20	0.305
	192	0.49	0.30 to 0.81	**0.005**
	Driving Experience	1.09	1.00 to 1.18	0.056
	Gender			
	F	—	—	
	M	1.94	1.17 to 3.21	**0.010**
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	0.62	0.25 to 1.53	0.296

Group	Characteristic	OR[1]	95% CI[1]	p-value
	Major Depressive Disorder Status			
	no	—	—	
	yes	1.28	0.53 to 3.12	0.583
Fail to yield right-of-way	ADHD Status			
	LNCG	—	—	
	Desister	0.43	0.16 to 1.10	0.078
	Persister	0.83	0.33 to 2.06	0.687
	Assessment Point			
	144	—	—	
	168	0.60	0.31 to 1.17	0.134
	192	0.48	0.19 to 1.20	0.117
	Driving Experience	1.07	0.90 to 1.27	0.453
	Gender			
	F	—	—	
	M	2.49	0.84 to 7.36	0.099
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	0.86	0.17 to 4.21	0.848
	Major Depressive Disorder Status			

Group	Characteristic	OR[1]	95% CI[1]	p-value
	no	—	—	
	yes	1.34	0.30 to 6.02	0.700
Tailgating	ADHD Status			
	LNCG	—	—	
	Desister	0.74	0.74 to 0.74	**<0.001**
	Persister	1.11	1.10 to 1.11	**<0.001**
	Assessment Point			
	144	—	—	
	168	0.73	0.73 to 0.73	**<0.001**
	192	0.54	0.54 to 0.54	**<0.001**
	Driving Experience	1.20	1.20 to 1.20	**<0.001**
	Gender			
	F	—	—	
	M	0.98	0.98 to 0.98	**<0.001**
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	0.87	0.87 to 0.87	**<0.001**
	Major Depressive Disorder Status			
	no	—	—	

Group	Characteristic	OR[1]	95% CI[1]	p-value
	yes	0.68	0.68 to 0.68	**<0.001**
Reckless driving	ADHD Status			
	LNCG	—	—	
	Desister	0.96	0.31 to 2.93	0.942
	Persister	2.82	0.97 to 8.23	0.058
	Assessment Point			
	144	—	—	
	168	0.25	0.11 to 0.54	**<0.001**
	192	0.14	0.05 to 0.42	**<0.001**
	Driving Experience	1.10	0.89 to 1.36	0.383
	Gender			
	F	—	—	
	M	3.59	0.88 to 14.6	0.074
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	3.15	0.65 to 15.3	0.153
	Major Depressive Disorder Status			
	no	—	—	
	yes	0.25	0.04 to 1.73	0.160

Group	Characteristic	OR[1]	95% CI[1]	p-value
DUI -- Alcohol	ADHD Status			
	LNCG	—	—	
	Desister	0.58	0.37 to 0.93	**0.023**
	Persister	0.94	0.59 to 1.50	0.795
	Assessment Point			
	144	—	—	
	168	2.94	1.95 to 4.43	**<0.001**
	192	2.03	1.23 to 3.36	**0.006**
	Driving Experience	1.21	1.10 to 1.32	**<0.001**
	Gender			
	F	—	—	
	M	2.18	1.31 to 3.63	**0.003**
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	1.18	0.50 to 2.79	0.703
	Major Depressive Disorder Status			
	no	—	—	
	yes	2.67	1.12 to 6.39	**0.027**
DUI -- Other substances	ADHD Status			

Group	Characteristic	OR[1]	95% CI[1]	p-value
	LNCG	—	—	
	Desister	1.27	0.37 to 4.40	0.704
	Persister	0.76	0.19 to 3.07	0.703
	ASS			
	168	—	—	
	192	0.79	0.35 to 1.80	0.581
	Driving Experience	0.99	0.78 to 1.26	0.954
	Gender			
	F	—	—	
	M	3.80	0.68 to 21.2	0.128
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	2.65	0.39 to 17.9	0.316
	Major Depressive Disorder Status			
	no	—	—	
	yes	1.65	0.18 to 14.9	0.657
Using cellphone while driving	ADHD Status			
	LNCG	—	—	
	Desister	0.50	0.33 to 0.77	**0.002**

Group	Characteristic	OR[1]	95% CI[1]	p-value
	Persister	0.53	0.34 to 0.84	**0.006**
	ASS			
	168	—	—	
	192	0.57	0.40 to 0.80	**0.001**
	Driving Experience	1.19	1.10 to 1.29	**<0.001**
	Gender			
	F	—	—	
	M	0.84	0.54 to 1.30	0.428
	Generalized Anxiety Disorder Status			
	no	—	—	
	yes	0.74	0.32 to 1.71	0.478
	Major Depressive Disorder Status			
	no	—	—	
	yes	1.49	0.60 to 3.69	0.392

[1]OR = Odds Ratio, CI = Confidence Interval

8.3 Associated analyses

This analysis is part of a larger project and is supported by other analyses, linked below.

Impact of traffic infractions on the incidence of traffic accidents in young adults with ADHD: cohort study

https://philsf-biostat.github.io/SAR-2023-015-RQ/

8.4 Availability

All documents from this consultation were included in the consultant's Portfolio.

The portfolio is available at:

https://philsf-biostat.github.io/SAR-2023-014-RQ/

8.5 Analytical dataset

Table A2 shows the structure of the analytical dataset.

Table A2 *Analytical dataset structure*

ID	STATUS	ASS	SEXMF	AGE	HI_16E	HI_18A	HI_25	SM_4C	EXP	HEV	A1	E1	F1	G1	H1	I1	J1	K1	L1	X1	Y1	v2A
1																						
2																						
3																						
…																						
N																						

Due to confidentiality the data-set used in this analysis cannot be shared online in the public version of this report.