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

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From: Felipe Figueiredo **To:** Undisclosed MSc student

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Document version

Version	Alterations
01	Initial version

1 ABBREVIATIONS

- ADHD:
- CI: confidence interval
- IRR: incidence rate ratio
- LNCG:
- SD: standard deviation

2 CONTEXT

2.1 Objectives

To determine whether traffic infractions predict higher incidence rate of traffic accidents in young adults with ADHD, compared to LNCG young adults.

3 METHODS

The data procedures, design and analysis methods used in this report are fully described in the annex document **SAP-2023-015-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.

The number of cases seem to decrease over time, where at each assessment point the proportion of the study population involved in vehicle accidents tends to get lower (Table 2). These case counts will be assessed in more detail in the next section.

Table 2 *Study outcomes across all assessment points.*

Characteristic	**144**, N = 678	**168**, N = 699	**192**, N = 674
I was a driver in ___ accidents in the past 2 years, n (%)			
0	485 (73%)	527 (77%)	533 (82%)
1	119 (18%)	110 (16%)	101 (15%)
2	43 (6.5%)	37 (5.4%)	14 (2.1%)
3	11 (1.7%)	6 (0.9%)	2 (0.3%)
4	1 (0.2%)	1 (0.1%)	2 (0.3%)
5	2 (0.3%)	0 (0%)	0 (0%)
7	0 (0%)	2 (0.3%)	0 (0%)
Unknown	17	16	22

A more comprehensive description of the occurrence of the predictors can be read in the associated analysis **SAR-2023-014-RQ-v01**.

4.2 Incidence rates of vehicle accidents

The IRR of vehicle accidents for each ADHD status group compared to the controls are shown in Table 3. The details of the modeling strategy are available in the Appendix, as well as the coefficients from the full model used as a starting point (see Table A1).

ADHD status was associated with the incidence of accidents in this study, after controlling for time, age, sex and the selected traffic infractions. In particular, participants with Desister ADHD have 34% higher incidence rates compared to LNCG, where those with Persister ADHD have 45% higher incidence rates than controls.

Table 3 *Incidence rate rates of vehicle accidents.*

Characteristic	IRR[1]	95% CI[1]	p-value
ADHD Status			
LNCG	—	—	
Desister	1.34	1.03 to 1.76	**0.030**
Persister	1.45	1.11 to 1.90	**0.007**
Assessment Point			
144	—	—	
168	1.04	0.78 to 1.38	0.780
192	0.96	0.60 to 1.53	0.873
Subject Age	0.80	0.72 to 0.89	**<0.001**
Gender			
F	—	—	
M	1.26	0.94 to 1.68	0.121

Characteristic	IRR[1]	95% CI[1]	p-value
Driving without expired tags or registration	1.33	1.04 to 1.69	**0.022**
Speeding	1.51	1.22 to 1.87	**<0.001**
Reckless driving	1.54	1.18 to 2.01	**0.002**

[1]IRR = Incidence Rate Ratio, CI = Confidence Interval

Driving without expired tags or registration is a significant predictor associated with a 33% higher rate of accidents (95% CI 1.04, 1.69; p=0.022). Speeding is a significant predictor associated with a 51% higher rate of accidents (95% CI 1.22, 1.87; p<0.001). Reckless driving is a significant predictor associated with a 54% higher rate of accidents (95% CI 1.18, 2.01; p=0.002).

Figure 1 shows the rate of decrease in the adjusted incidence rate, and its CI, after averaging the predicted rates for each individual available in the study sample. Even though at each assessment point the adjusted IRR is higher than one, from one time point to the next the difference tend to decrease. Additionally, the groups appear to converge to similar rates, as shown by the overlapping CIs.

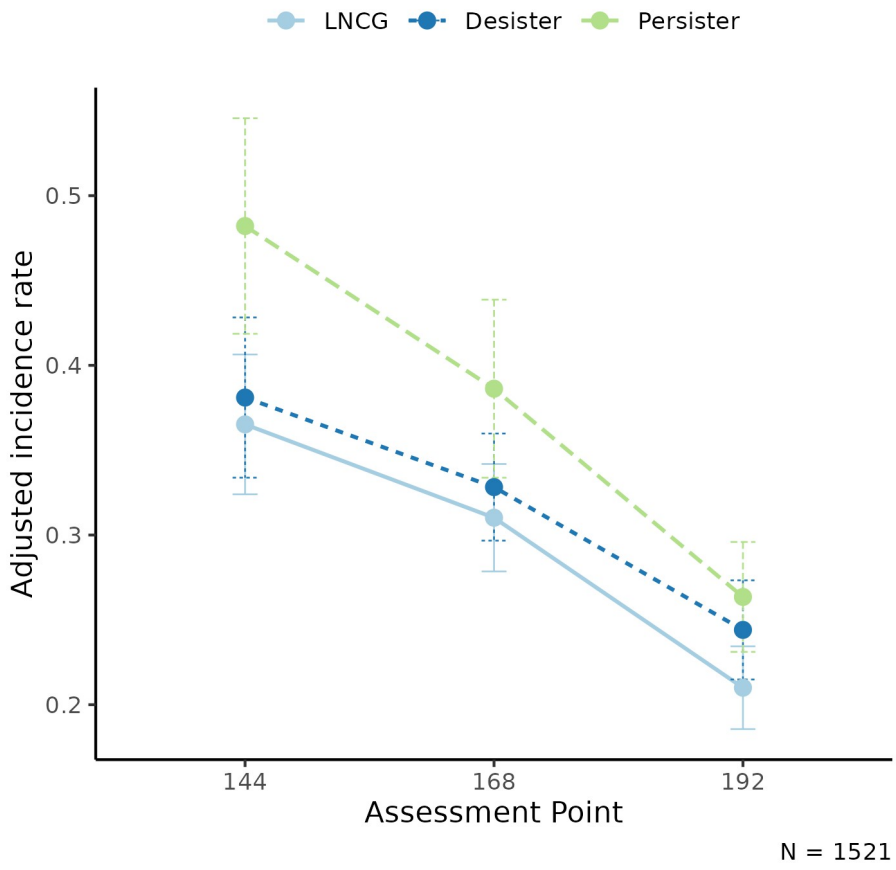

Figure 1 *Incidence rate rates of vehicle accidents. Error bars are 95% confidence intervals.*

Finally it is worth noting that the ADHD status is negatively associated with several of the predictors considered in this analysis. For more details, refer to **SAR-2023-014-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 higher incidence rate of vehicle accidents, when compared with controls. Three predictors were associated with the incidence rates: Driving without expired tags or registration, Speeding and Reckless driving. The difference in this effect decreases over time, being negligible at the third assessment point.

7 REFERENCES

- **SAP-2023-015-RQ-v01** – Analytical Plan for Impact of traffic infractions on the incidence of vehicle accidents in young adults with ADHD: cohort study
- **SAR-2023-014-RQ-v01** – Effect of ADHD on the incidence of driving infractions and accidents in young adults: 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

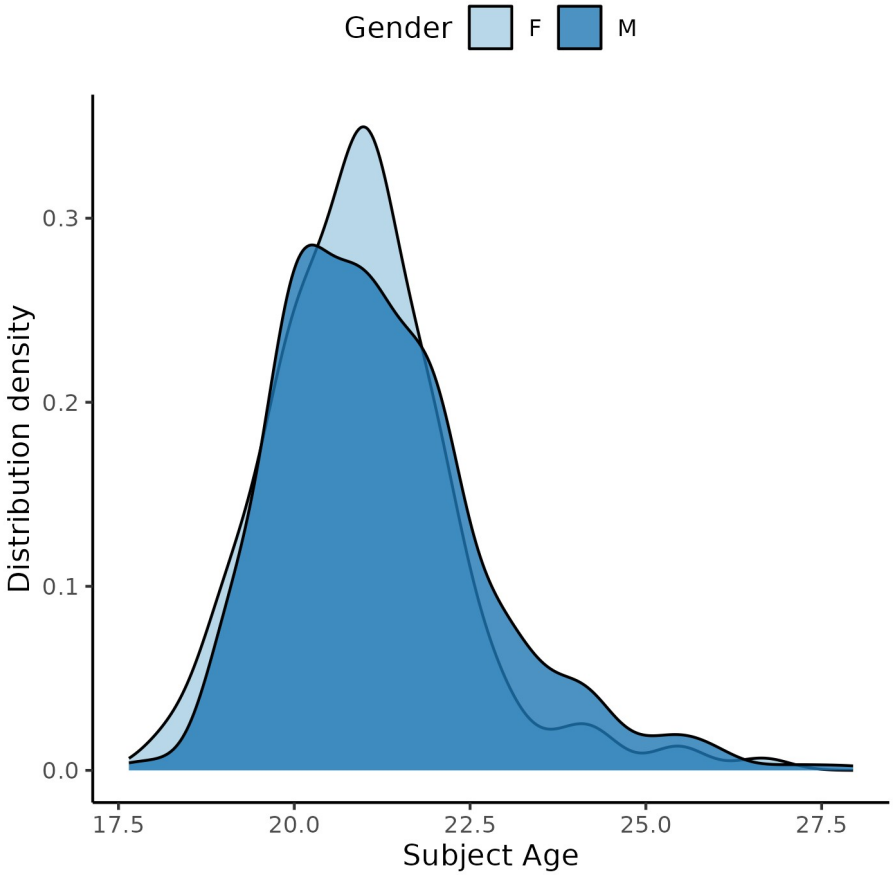

Figure A1 *Distribution of age in the study population.*

8.2 Modeling strategy

- minimum EXP observed: -5.199
- shift in EXP (added before using as offset): 5.2

Table A1 shows the coefficients from the maximal model, which included all covariates. All non-significant predictors were dropped before finding the model described in section 4.2. This mixed model did not converge, and had an AIC of 1,472.96. After dropping the dummy predictors not associated with the outcome, the AIC raised to 2,323.16. For reference, the null model (which only tracks the incidence of individuals over the assessment points) had AIC of 2,565.47.

Table A1 *Full model, starting point of the model specification.*

Characteristic	IRR[1]	95% CI[1]	p-value
ADHD Status			
LNCG	—	—	
Desister	1.45	1.03 to 2.05	**0.035**
Persister	1.44	1.00 to 2.07	0.051
ASS			
168	—	—	
192	0.92	0.64 to 1.31	0.628
Subject Age	0.80	0.70 to 0.92	**0.001**
Gender			
F	—	—	
M	1.26	0.87 to 1.84	0.221
Driving without a seatbelt	1.00	0.73 to 1.37	0.992
Driving without expired tags or registration	1.23	0.87 to 1.75	0.240

Characteristic	IRR[1]	95% CI[1]	p-value
Driving without a valid license	0.74	0.45 to 1.22	0.239
Driving without insurance	1.10	0.65 to 1.87	0.713
Illegally parking	1.15	0.82 to 1.62	0.406
Illegally turning	1.12	0.79 to 1.60	0.519
Speeding	1.40	1.03 to 1.91	**0.032**
Failing to stop to sign or signal	0.93	0.65 to 1.35	0.715
Fail to yield right-of-way	1.26	0.79 to 2.00	0.329
Tailgating	0.85	0.57 to 1.26	0.406
Reckless driving	1.54	0.99 to 2.37	0.053
DUI -- Alcohol	0.96	0.69 to 1.33	0.816
DUI -- Other substances	1.09	0.74 to 1.59	0.661
Using cellphone while driving	1.10	0.80 to 1.50	0.572

[1]IRR = Incidence Rate Ratio, CI = Confidence Interval

8.3 Associated analyses

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

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

https://philsf-biostat.github.io/SAR-2023-014-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-2023-015-RQ/

8.5 Analytical dataset

Table A2 shows the structure of the analytical dataset.

Table A2 *Analytical dataset structure*

ID	STATUS	ASS	outcome	EXP	AGE	SEXMF	A1	B1	C1	D1	E1	F1	G1	H1	I1	J1	K1	L1	X1	Y1
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.