

CAFFEINE AND ROAD TRAFFIC ACCIDENTS

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ABSTRACT

Background: Results from laboratory studies show that ingestion of caffeine improves cognitive functions that are important in driving. Studies using driving simulators also show that caffeine is beneficial, especially in fatigued drivers. However, there is little literature on caffeine and road traffic accidents (RTAs), and the present study aimed to provide information on this topic. **Methods:** A secondary analysis of epidemiological data is reported in this paper. A sample of 8696 UK adults (mean age: 44.8 years; 60.8% being in paid employment; 57.4 % female; 24.6% single, 62.3% married or cohabiting, and 13.1% divorced or widowed) completed the survey, which included questions on caffeine consumption, RTAs in the last 12months, and possible demographic and psychosocial confounders. **Results:** 3.3% of the non-consumers of caffeine and 1.9% of the caffeine consumers reported RTAs. Logistic regressions showed that the effect of caffeine remained significant when demographic and psychosocial variables were included in the model. Older drivers were less likely to have an RTA, and those with poor health, high levels of stress and high risk takers were more likely to report an RTA. **Conclusion:** These results show that caffeine consumption was associated with a reduced risk of an RTA. The study also demonstrated associations with established risk factors which gives one more confidence in this initial study.

KEYWORDS: Caffeine; road traffic accidents; age; stress; health; risk-taking.

INTRODUCTION

Laboratory studies have shown that caffeine can enhance cognitive functions that are needed for safe driving.^[1-11] For example, caffeine improves the ability to sustain attention, increases the speed of encoding of new information, and leads to faster reaction times. Caffeine also reduces the effects of fatigue,^[12-20] which is a known risk factor for reduced driver safety. Indeed, taking a break and consuming caffeine are two widely recommended countermeasures to manage driver fatigue. There have been several studies of simulated driving,^[21-27] and most of these have shown that caffeine can restore driving performance that has been degraded by fatigue. Field studies have shown that caffeine consumers have a reduced risk of cognitive failures (errors of attention and action) and accidents both at work and outside the workplace.^[28,29]

When one examines the literature on caffeine consumption and road traffic accidents, one finds a lack of research. The above section suggests that it is plausible that caffeine will reduce the likelihood of accidents due to human error. A major effect of caffeine is to reduce the negative effects of fatigue. There appears to be strong evidence of an association between fatigue and driver safety. For example, in the UK, it has been

suggested that one in five road traffic accidents (RTAs) are due to fatigue, with the number increasing to one in four when one considers serious or fatal RTAs.^[30] Surveys have shown that 58% of drivers admit driving when tired.^[31] However, police reports show that only three per cent of accidents are due to fatigue.^[32]

The aim of the present study was to carry out secondary analyses of an epidemiological survey^[33,34] to examine the association between caffeine and RTAs. A key feature of the analysis was to adjust for other risk factors known to predict the frequency of RTAs.^[35,36] These include both demographic and psychosocial factors. For example, young drivers have more RTAs than older drivers. RTAs are also more prevalent in individuals who take risks and those who are stressed.

METHODS

The sample was selected from the South Wales area of the UK electoral register and sent a survey that included questions about health, lifestyle, demographics, and caffeine consumption. Caffeine consumption was calculated from the amount in different types of coffee and tea.^[28,29] RTAs, where the respondent was the driver and occurring over the last 12 months, were recorded. The study was carried out with the informed consent of

the volunteers and the approval of the ethical committee, School of Psychology, Cardiff University.

Participants

The analyses were carried out on the data from 8696 volunteers. Demographic characteristics of this sample are shown below:

- 57.4% female
- Mean age 44.8 years, sd = 17.7, range 16-97 years
- 60.8% working
- 24.6% single; 62.3% married or cohabiting; 13.1% divorced/separated/widowed
- 11.2% degree level; and 15.3% higher degree or similar professional qualification.
- The median daily caffeine consumption was 230 mg/day, s.d. = 175.2, with a range of 0-2280 mg. There were 889 non-consumers of caffeine.

Analysis strategy

Non-consumers of caffeine were compared with consumers. An initial univariate logistic regression was

carried out, followed by a multivariate analysis including demographic and psychosocial confounders.

RESULTS

The results showed that 3.3% of non-consumers of caffeine reported an RTA compared to 1.9% of caffeine consumers. A logistic regression showed that this difference was significant (OR = 0.58 CI 0.39-0.87 p = 0.009). The significant effects from the multivariate analysis are shown in Table 1. The effect of caffeine remained significant, and the other significant predictors confirmed findings in the literature. Older drivers were less likely to have an RTA, whereas those with poor health, high levels of life stress, workers and high-risk takers were more likely to report an RTA.

Table 1: Significant effects in the logistic regression.

Variable	OR	CI	p
Caffeine (Yes)	0.64	0.42-0.98	0.039
Age (Older)	0.51	0.35-0.72	<0.001
General Health (Poor)	1.25	1.05-1.49	0.014
Life Stress (High)	1.38	1.16-1.64	<0.001
Worker (Yes)	2.31	1.38-3.86	<0.001
Risk-taking (High)	1.13	1.01-1.28	0.039

DISCUSSION

Previous research has shown that caffeine improves the basic skills involved in driving and leads to better performance in a driving simulator. Consumption of caffeine is a recognised countermeasure for fatigued drivers, but there has been no research on whether caffeine reduces RTAs. This last issue was examined here in a secondary analysis of a large epidemiological database. The initial univariate analysis confirmed that caffeine consumers reported fewer RTAs than caffeine consumers. Multivariate analysis, including established predictors of RTAs, revealed that the effect of caffeine remained significant when demographic and psychosocial variables were included in the analyses. The analysis confirmed the effect of some established predictors, with older people reporting fewer RTAs and those who were working, having poor health, high life stress and being high risk takers reporting more RTAs. Replicating the effects of established predictors gives one more confidence in the novel effect of caffeine reported here.

CONCLUSION

A secondary analysis of a large epidemiological database showed that caffeine consumption was associated with fewer RTAs. Older drivers reported fewer RTAs, whereas workers, those with poor health, high life stress

and risk takers, were more likely to have an RTA. These results support findings from laboratory studies and research using driving simulators. They also support communications that suggest that caffeine is a good countermeasure for drivers at risk of accidents.

REFERENCES

1. Lieberman HR. Caffeine. In: Handbook of Human Performance, Vol.2: Health and performance. (eds) A. P. Smith & D. M. Jones. London: Academic Press, 1992; 49-72.
2. Smith AP. Effects of caffeine on human behavior. Food Chem Toxicol, 2002; 40: 1243-55.
3. Smith AP. Caffeine. In: Nutritional Neuroscience. Edited by H. Lieberman, R. Kanarek and C Prasad, 2005; 335-359. London: Taylor & Francis.
4. Glade MJ. Caffeine – Not just a stimulant. Nutrition, 2010; 26: 932-938.
5. Smith AP. Caffeine: Practical implications. In: Diet, Brain, Behavior: Practical Implications. Eds: R.B. Kanarek & H.R. Lieberman. Taylor & Francis, 2011; 271-292.
6. Doepker C, Lieberman H, Smith AP, Peck J, El-Sohemy A, Welsh B. Caffeine: Friend or Foe? Annual Review of Food Science and Technology, 2016; 7: 6.1 – 6.22. doi: 10.1146/annurev-food-041715-033243.

7. Smith AP The psychobiological processes underpinning the behavioural effects of caffeine. In: P. Murphy (ed), *Routledge International Handbook of Psychobiology*. London New York: Routledge. ISBN: 978-1-138-18800-6 (hbk) ISBN: 978-1-315-64276-5 (ebk), 2019; 239-250.
8. Smith AP, Christopher G, Sutherland D. Acute effects of caffeine on attention: A comparison of non-consumers and withdrawn consumers. *Journal of Psychopharmacology*, 2013; 27: 77-83.
9. Smith A, Christopher C, Sutherland D. Effects of caffeine in overnight-withdrawn consumers and non-consumers. *Nutritional Neuroscience*, 2006; 9: 63-71.
10. Smith A.P, Sutherland D, Christopher G. Effects of repeated doses of caffeine on mood and performance of alert and fatigued volunteers. *Journal of Psychopharmacology*, 2005; 19(5): 620-626.
11. Smith AP. Caffeine, Breakfast Cereal and Time of Day: Effects on Alertness, Encoding and Recall. *European Journal of Pharmaceutical and Medical Research*, 2020; 7(11): 51-56.
12. Smith AP Caffeine and long hours of work: Effects on alertness and simple reaction time. *World Journal of Pharmaceutical Research*, 2021; 10(2): 79-89. DOI: 10.20959/wjpr20212-19694.
13. Smith AP, Rusted JM, Eaton-Williams P, Savory M, Leathwood, P. Effects of caffeine given before and after lunch on sustained attention. *Neuropsychobiology*, 1990; 23: 160 - 163.
14. Smith AP, Brockman P, Flynn R, Maben A, Thomas M. An investigation of the effects of coffee on alertness and performance during the day and night. *Neuropsychobiology*, 1993; 27: 217-233.
15. Killgore WDS, Kamimori G. Multiple caffeine doses maintain vigilance, attention, complex motor expression, and manual dexterity during 77 hours of total sleep deprivation. *Neurobiology of Sleep and Circadian Rhythms*, 2020. doi.org/10.1016/j.nbscr.2020.100051.
16. Smith AP, Thomas M, Perry K, Whitney H. Caffeine and the common cold. *Journal of Psychopharmacology*, 1997; 11(4): 319-324.
17. Fredholm B. Adenosine, adenosine receptors and the actions of caffeine. *Pharmacology and Toxicology*, 1995; 7: 93-101.
18. Franchetti P, Messini L, Cappellacci L, Grifantini M, Lucacchini A, Martini C, Senatore G. 8-Azaxanthine derivatives as antagonists of adenosine receptors. *Journal of Medical Chemistry*, 1994; 37: 2970-5.
19. Nehlig A, Daval JL, Debry G. Caffeine and the central nervous system: mechanisms of action, biochemical, metabolic and psychostimulant effects. *Brain Research Reviews*, 1992; 17: 139-170.
20. Smith AP, Brice CF, Nash J, Rich N, Nutt DJ. Caffeine and central noradrenaline: effects on mood and cognitive performance. *Journal of Psychopharmacology*, 2003; 17: 283-292.
21. Huffmyer JL, Kleiman AM, Moncrief M, Scalzo DC, Cox DJ, Nemerugut EC. Impact of Caffeine Ingestion on the Driving Performance of Anesthesiology Residents After 6 Consecutive Overnight Work Shifts. *Anesth Analg*, 2020; 130(1): 66-75.
22. Aidman E, Johnson K, Hoggan BL, Fidock J, Paech GM, Della Vedova CB, Pajcin M, Grant C, Kamimori G, Mitchelson E, Banks S. Synchronized drowsiness monitoring and simulated driving performance data under 50-hr sleep deprivation: A double-blind placebo-controlled caffeine intervention. *Data Brief.*, 2018; 19: 1335-1340.
23. Biggs SN, Smith A, Dorrian J, Reid K, Dawson D, van den Heuvel C, Baulk S. Perception of simulated driving performance after sleep restriction and caffeine. *J Psychosom Res*, 2007; 63(6): 573-7.
24. Bragg C, Desbrow B, Hall S, Irwin C. Effect of meal glycemic load and caffeine consumption on prolonged monotonous driving performance. *Physiol Behav*, 2017; 181: 110-116.
25. Brice C, Smith A. The effects of caffeine on simulated driving, subjective alertness and sustained attention. *Hum Psychopharmacol*, 2001; 16(7): 523-531.
26. Hartley SL, Barbot F, Machou M, Lejaille M, Moreau B, Vaugier I, Lofaso F, Quera-Salva MA. Combined caffeine and bright light reduces dangerous driving in sleep-deprived healthy volunteers: a pilot cross-over randomised controlled trial. *Neurophysiol Clin*, 2013; 43(3): 161-9.
27. Mets M, Baas D, van Boven I, Olivier B, Verster J. Effects of coffee on driving performance during prolonged simulated highway driving. *Psychopharmacology (Berl)*, 2012; 222(2): 337-42.
28. Smith AP. Caffeine at work. *Human Psychopharmacology Clinical and Experimental*, 2005; 20: 441-45.
29. Smith AP. Caffeine, cognitive failures and health in a non-working community sample. *Human Psychopharmacology: Clinical and Experimental*, 2009; 24: 29-34.
30. Department of Transport. Contributory factors for reported road accidents. 2020. www.gov.uk/government/ataistical-data-sets/ras50-contributory-factors.
31. Bolton C, Anderson A. Sleepy drivers. *Advances in clinical neuroscience and rehabilitation*. <https://acnr.co.uk/2021/03/sleepy-drivers>.
32. Royal Society for the Prevention of Accidents. Driver fatigue and road safety factsheet. www.rospa.com/media/documents/road-safety/driver-fatigue-factsheet.pdf.
33. Smith A, Wadsworth E, Moss S, Simpson S. The scale and impact of illegal drug use by workers. *HSE Research Report*, 2004; 193. HSE Books. ISBN 07176 2802.
34. Smith A, Wadsworth E, Moss S, Simpson S. The scale and impact of psychotropic medication use by

- workers. HSE Research Report, 2004; 282. HSE Books. ISBN 07176 29163.
35. Smith, A.P. A UK survey of driving behaviour, fatigue, risk-taking and road traffic accidents. *BMJ Open*, 2016; 6: e011461. doi:10.1136/bmjopen-2016-011461.
 36. Bowen L, Budden SL, Smith AP. Factors underpinning unsafe driving: A systematic literature review of car drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, 2020; 72: 184-210.