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Attention performance among Brazilian truck drivers and its association with amphetamine use: pilot study

Desempenho da atenção entre motoristas de caminhão brasileiros e sua associação com uso de anfetaminas: estudo-piloto

ABSTRACT

The aim of this article was to describe the attention functioning of twenty-two truck drivers and its relationship with amphetamine use. Those drivers who reported using amphetamines in the twelve months previous to the interview had the best performance in a test evaluating sustained attention functioning. Although amphetamine use may initially seem advantageous to the drivers, it may actually impair safe driving. The findings suggest the importance of monitoring the laws regarding amphetamine use in this country.

DESCRIPTORS: Automobile Driving. Motor Vehicles. Amphetamines, adverse effects. Task Performance and Analysis. Transportation, manpower. Cross-Sectional Studies.

RESUMO

O objetivo deste estudo foi descrever o desempenho de atenção de motoristas de caminhão e sua relação com o uso de anfetaminas. Os motoristas que relataram usar anfetaminas nos doze meses prévios à entrevista tiveram desempenho melhor em um teste de atenção sustentada. Apesar de inicialmente representar uma vantagem para motoristas, o uso de anfetaminas pode dificultar a direção segura. Os resultados sugerem a importância de supervisionar as leis que regulamentam o uso de anfetaminas no País.

DESCRITORES: Condução de Veículo. Veículos Automotores. Anfetaminas, efeitos adversos. Análise e Desempenho de Tarefas. Transportes, recursos humanos. Estudos Transversais.

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INTRODUCTION

Road traffic injuries remain an important public health issue worldwide.[10] More than 1.24 million people die each year because of road traffic crashes and 20 to 50 million are estimated to be injured.[10] This health burden of epidemic proportions can be considered an increasing problem, particularly in middle-income countries.[10] The road traffic fatality rate in Brazil is 18.3/100,000 inhabitants.[11]

Several risk factors are associated with traffic accidents, of which drug use needs special attention.[11] The use of amphetamine-type stimulants (ATS) has been increasing in the last few years, especially for occupational purposes, due to their performance-enhancing effects.[a]

Truck drivers in Brazil have reported the illicit use of amphetamines to focus their attention and stay awake longer to maintain their extensive work schedule.[1]

Despite the amphetamine use (AU) by truck drivers being widely acknowledged in Brazil, little is known about its effects on attention functioning.

In consistency with the findings of the abovementioned studies on the underlying reasons for AU among truck drivers, it may improve the individual's attention performance.

This study aimed to describe attention functioning among truck drivers and its relationship with amphetamine use.

METHODS

This is the pilot study of an ongoing project.[b] A convenience sample consisting of 22 truck drivers was recruited in the Presidente Dutra highway at the (*Serviço Social do Transporte* – SEST; and *Serviço Nacional de Aprendizagem do Transporte* – SENAT) service station, in Sao Paulo, Southeastern Brazil, in 2011.

The sample was made up of truck drivers traveling along the Presidente Dutra highway who spontaneously stopped to use the SEST-SENAT services and agreed to participate in the study.

None of the participants reported any conditions that might interfere with attention functioning, such as previous history of neurological disease, head trauma, loss of consciousness, previous sexually transmitted disease or HIV infection, recent use of psychotropics, and difficulty visualizing colors. Drivers that reported any of these conditions were not included in the study.

Participants were requested to answer a structured, self-reported anonymous questionnaire about personal and occupational data. Drug use was measured for drugs most commonly used by truck drivers, i.e., alcohol, tobacco, amphetamines, marijuana and cocaine, regarding three periods (lifetime, past 12 months, and past 30 days).[c] The frequency and reason underlying the use of amphetamine, as well as the last day of amphetamine use, were also investigated. Participants agreed to provide a urine sample for drug screening. On-Site CupKit 501 (Varian) was used for amphetamine, cannabinoids and cocaine metabolites detection.

Tests that measure selective and sustained attention performance were adopted. Selective attention is defined as the readiness to selectively identify and respond to stimuli to the exclusion of others (irrelevant stimuli), while sustained attention refers to the capacity to maintain it over a certain period.[2]

Selective attention functioning was assessed through participants' performance in the Stroop Color Word Test, Controlled Oral Word Association Test (COWAT; letters F, A and S) and Digit Symbol Substitution Test (DSST), described in detail elsewhere.[7] Sustained attention functioning was assessed by participants' performance in the Sustained Attention Test (TACOM),[8] an educational-level test standardized for Brazilian licensed drivers, which includes the most commonly used traffic signs on Brazilian roads as stimuli. Participants were instructed to focus their attention on specific target stimuli for 90 seconds.[8] Participants' performance was measured according to the number of hits (COWAT, DSST and TACOM) or time (Stroop) for all tests. The final score on TACOM was individually compared with normative data.[8]

Participants were also evaluated according to their quality of sleep through the Pittsburgh Sleep Quality Index (PSQI), since sleep deprivation is a common outcome in such professionals.[6]

The 12-month drug use was the measure chosen for this study. Truck drivers were divided into two groups according to their responses regarding the illicit use of amphetamines in the last 12 months preceding the interview: group AU (amphetamine users) and group NAU (non-amphetamine users). These groups were compared for agreement with personal and occupational data, alcohol and other drug use, performance in selective and sustained attention tests and according to their performance in PSQI. Such comparisons were performed by

[a] United Nations Office on Drugs and Crime. Amphetamines and Ecstasy. 2008 Global ATS Assessment. Viena; 2008.
[b] Project approved by the *Fundação de Amparo à Pesquisa do Estado de São Paulo* (FAPESP – Research support, Young Researcher Program) entitled: "Estudo sobre o uso múltiplo de drogas, funcionamento cognitivo, psíquico, emocional e transtornos do sono entre motoristas de caminhão no Estado de São Paulo", in 2011.
[c] United Nations Office on Drugs and Crime. World Drug Report 2012. New York: United Nations, 2012.

Table. Personal and occupational information, drug use, quality of sleep and selective and sustained attention performance of truck drivers recruited on an interstate highway. Sao Paulo, Southeastern Brazil, 2011.[a] (N = 22)

12-month amphetamine use	NAU (N = 14)		AU (N = 8)		Total (N = 22)		
Categorical variables	%	95%CI	%	95%CI	%	95%CI	p[b]
Formal education (years)							0.184
4	7.1	0.0;20.6	12.5	0.0;35.4	9.1	0.0;21.1	
8	28.6	4.9;52.2	62.5	29.0;96.0	40.9	20.4;61.5	
8 to 11	57.1	31.2;83.1	12.5	0.0;35.4	40.9	20.4;61.5	
> 11	7.1	0.0;20.6	12.5	0.0;35.4	9.1	0.00;21.1	
Civil status							0.669
Single	21.4	0.0;42.9	25.0	0.0;55.0	22.7	5.2;40.2	
Married	50.0	23.8;76.2	75.0	44.9;100.0	59.1	38.6;79.6	
Living together	14.3	0.0;32.6	0.0	0.0;0.0	9.1	0.0;21.1	
Divorced	14.3	0.0;32.6	0.0	0.0;0.0	9.1	0.0;21.1	
Ethnicity							0.613
White	64.3	39.2;89.4	83.3	57.5;100.0	70.0	5.9;89.2	
Black or Mulatto	35.7	10.6;60.8	16.7	0.0;42.5	30.0	10.9;49.2	
12-month alcohol use	64.3	39.2;89.4	87.5	64.6;100.0	72.7	24.1;91.3	0.351
12-month tobacco use	14.3	0.0;32.6	37.5	4.0;71.1	22.3	4.9;39.7	0.309
12-month marijuana use	0.0	0.0;0.0	0.0	0.0;0.0	0.0	0.0;0.0	–
12-month cocaine use	0.0	0.0;0.0	0.0	0.0;0.0	0.0	0.0;0.0	–
12-month crack-cocaine use	0.0	0.0;0.0	12.5	0.0;35.4	4.5	0.0;13.3	0.364
Frequency of amphetamine use							0.150
Rarely	–	–	0.0	0.0;0.0	–	–	
Less than once a week	–	–	28.6	0.6;56.6	–	–	
Once a week and more	–	–	42.9	12.2;73.5	–	–	
Daily	–	–	28.6	0.6;56.6	–	–	
Reason for amphetamine use							
To stay awake	–	–	100.0	100.0;100.0	–	–	
TACOM performance							0.010[d]
Very poor	100.0	0.0;100.0	50.0	15.4;84.7	81.8	65.7;97.9	
Low Average	0.0	0.0;0.0	37.5	4.0;71.0	13.6	0.0;28.0	
High Average	0.0	0.0;0.0	12.5	0.0;35.4	4.5	0.0;13.3	
Numerical variable	Mean	95%CI	Mean	95%CI	Mean	95%CI	p[c]
Age	40.9	39.0;42.7	37.7	34.0;41.4	40.4	38.8;42.0	0.520
Trajectory (in km)	638.5	437.7;839.2	1,156.7	649.8;1,663.5	698.4	515.3;881.5	0.010[d]
Travel time (in hours)	11.2	10.4;12.1	14.9	10.9;19.0	11.7	10.8;12.6	0.970
Time in profession (in years)	15.9	3.9;17.9	15.7	12.1;19.4	15.8	14.0;17.5	0.760
Stroop-time A (in seconds)	21.1	17.5;24.8	15.7	13.3;18.0	19.5	16.0;23.0	0.084
Stroop-time B (in seconds)	21.7	19.0;24.5	19.3	18.7;20.0	21.0	18.7;23.3	0.327
Stroop-time C (in seconds)	33.6	28.8;38.4	31.0	24.2;37.8	32.6	28.3;37.0	0.635
COWAT_F (number of words generated)	7.3	4.6;10.0	9.0	6.5;11.5	7.9	5.7;10.1	0.343
COWAT_A (number of words generated)	8.6	5.8;11.3	7.8	5.7;9.8	8.3	6.2;10.4	0.848
COWAT_S (number of words generated)	8.9	7.7;10.0	7.5	4.2;10.9	8.4	6.8;9.9	0.562
DSST (number of hits)	23.3	18.7;27.9	23.4	17.1;29.6	23.3	19.5;27.1	0.811
PSQI	5.3	2.6;8.0	5.5	2.5;8.6	5.4	3.2;7.6	0.849
Most recent-amphetamine use (in days)	–	–	33.60	0.0;76.9	–	–	–

AU: amphetamine users; COWAT: Controlled Oral Word Association Test (letters F, A and S); DSST: Digit Symbol Substitution Test; NAU: non-amphetamine users; Stroop: Stroop Color Word Test; TACOM: Sustained Attention Test; PSQI: Pittsburgh Sleep Quality Index

[a] Numerical variables are expressed as means (95%CI), and categorical variables are expressed as % (95%CI).

[b] Fisher's Exact Test (two-tailed test).

[c] Mann-Whitney Test (two-tailed test).

[d] The null hypothesis was rejected at a significance level of $p < 0.05$.

the Mann-Whitney test for numerical variables and Fisher's Exact Test for categorical variables using the R library survey software. The null hypothesis was rejected at a significance level of $p < 0.05$.

The drivers were invited to participate voluntarily; they were not financially compensated for their participation. The drivers were requested to read and sign, if in accordance with, a written informed consent form (TCLE). The study protocol followed the Declaration of Helsinki set of principles and was approved by the Research Ethics Committee of the Faculty of Medicine of the *Universidade de São Paulo* (Protocol No. 377/11).

RESULTS

All participants were young men with low levels of schooling (81.8% reported to have between eight and 11 years of formal education). They had an average of 15.8 years in the profession, had traveled an average of 698.4 km and had driven an average of 11.7 hours without rest before reaching the data collection location. Most of them (68.2%) were married or living with a partner, 70% self-reported as white or Caucasians and all of them were hired by a transportation company.

About 50.0% of the interviewees reported they had tried amphetamines in their lifetime, 36.7% had used amphetamines in the previous 12 months and 22.7% had used amphetamines in the 30 days previous to the interview. Among those who reported using amphetamines in the previous 12 months, the last time of use was 33.6 days before the interview on average; 71.4% of them declared using amphetamines at least once a week. All of them reported continuing such use to stay awake for a longer period to carry out their occupational activities. There were no intergroup (AU x NAU) differences regarding alcohol, tobacco, marijuana and cocaine use in the last 12 months. None of the tested samples were positive for amphetamines, nor for other drugs in the drug urine screening, indicating that the interviewed truck drivers were not under the acute effects of any screened drug.

There were no intergroup differences (AU x NAU) according to performance in the selective attention tests (COWAT, Stroop and DSST) nor with regards quality of sleep (PSQI).

The drivers who reported not having used amphetamines (NAU) presented the worst performance ($p < 0.01$) on the sustained attention test (TACOM) and 95.4% of the participants performed below the average level in TACOM, irrespective of amphetamine use, indicating the truck drivers' difficulty maintaining their attention focused for prolonged periods.

Long-haul truck drivers seemed to be more prone to reporting AU ($p < 0.01$), i.e., while NAU drivers reported traveling an average of 638.5 km, those who were AU had travelled an average of 1,156.7 km.

DISCUSSION

The interviewed truck drivers may be suffering from sustained attention deficits, i.e., inadequacy in the ability to maintain selective attention for a prolonged period, an outcome that seemed to be less frequent among amphetamine users.

The ability to selectively detect stimuli is a mechanism that the brain uses to manage the massive influx of sensory information into the cortex and to reduce distractions from irrelevant inputs.[3] A deficit in truck drivers' ability to maintain their selective attention for a prolonged period (sustained attention) may raise safety and legal issues, since truck drivers often spend several hours at the steering wheel, as mentioned above. Driver distraction is predictive of driving lapses, errors and violations,[9] which may culminate in negative outcomes such as traffic accidents.

This sustained attention deficit was less frequent among amphetamine users, suggesting that amphetamines may attenuate or mask it, a finding that is consistent with the reason most commonly reported by truck drivers for their use of amphetamines, i.e., to stay awake longer during their occupational activities, as presented here and elsewhere.[1] This effect of amphetamines on attention seemed to be independent of their acute effects on the central nervous system (CNS), since none of the urine samples was positively screened for amphetamines. The observed outcomes may occur due to a chronic use of amphetamines, since most of the interviewed truck drivers reported consuming amphetamines at least once a week.

There seems to be a positive relationship between blood amphetamine concentrations and driving impairment.[4] Amphetamine use may appear to be an advantage for truck drivers. However, when the amphetamine stimulant effect ends, the user is subject to fatigue, depression and sleepiness, increasing the risk of accidents and other negative outcomes in traffic. Nascimento et al[5] found an association between amphetamines use by truck drivers and traffic accidents in Brazil. Those drivers are likely to develop drug abuse and dependence, and to suffer intercurrences.[a] Hence, the onus of amphetamine use is much bigger than the apparent advantage of increased attention for a longer period and it should therefore be avoided by truck drivers and policed by competent authorities.

Considering that road traffic accidents are a predictable and preventable cause of deaths and injuries,[10] the outcomes of this study should help public authorities to enforce Laws that regulate the work schedule of truck

drivers, as well as the use of amphetamines in Brazil. The enforcement of the Brazilian Law 12,619, popularly known as *Lei do Motorista*,[d] may positively impact on the daily distance that drivers travel, their feelings of tiredness, their attention functioning and finally on their use of amphetamines. Although the data were collected before the implementation of Resolution 52/2011 by the Brazilian Agency of Health Surveillance (ANVISA), which banned the manufacture, importation, exportation, handling, prescribing and dispensing of drugs or drug formulations containing the substances amfepramone, fenproporex and mazindol, their salts, isomers and intermediates,[d] such law should also be enforced.

The effects reported here seemed to be independent of quality of sleep, since there was no difference between groups regarding performance in the PSQI.

Some limitations must be addressed: The cross-sectional design limited our ability to assess a causal relationship between amphetamine use and attention performance. Also, this is a pilot study, and, therefore, the sample size is small. The researchers are working to expand the sample so that future research may be able to evaluate the effects of drug use on attention functioning while controlling for confounding factors. A follow-up is required.

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REFERENCES

1. Knauth DR, Pilecco FB, Leal AF, Seffner F, Teixeira AM. Manter-se acordado: a vulnerabilidade dos caminhoneiros no Rio Grande do Sul. *Rev Saude Publica*. 2012;46(5):886-93. DOI:10.1590/S0034-89102012000500016
2. Miotto EC. Avaliação neuropsicológica e funções cognitivas. In: Miotto EC, Lucia MCS, Scaff M. Neuropsicologia Clínica. São Paulo: Rocca; 2012. p. 31-32.
3. Murray JD, Ardid S. What Can Tracking Fluctuations in Dozens of Sensory Neurons Tell about Selective Attention? *Front Syst Neurosci.* 2011;5:35. DOI:10.3389/fnsys.2011.00035
4. Musshoff F, Madea B. Driving under the influence of amphetamine-like drugs. *J Forensic Sci.* 2012;57(2):413-9. DOI:10.1111/j.1556-4029.2012.02055.x
5. Nascimento EC, Silva JP. Uso de álcool e anfetaminas entre caminhoneiros de estrada. *Rev Saude Publica*. 2007;41(2):290-3. DOI:10.1590/S0034-89102007000200017
6. Souza JC, Paiva T, Reimao R. Sleep habits, sleepiness and accidents among truck drivers. *Arq Neuro-Psiquiatr.* 2005;63(4):925-30. DOI:10.1590/S0004-282X2005000600004
7. Strauss E, Sherman SEM, Spreen O. A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary. New York: Oxford University Press; 2006.
8. Tonglet EM. Bateria de funções mentais para motoristas - BFM-1: Testes de Atenção. São Paulo: Vetor; 2007.
9. Wickens CM, Toplak ME, Wiesenthal DL. Cognitive failures as predictors of driving errors, lapses, and violations. *Accid Anal Prev.* 2008;40(3):1223-33. DOI:10.1016/j.aap.2008.01.006
10. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva; 2009.
11. World Health Organization. Global status report on road safety 2013: supporting a decade of action. Geneva; 2013.

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The authors declare that there are no conflict of interests.

[d] Brasil. Lei nº 12.619, de 30 de abril de 2012. Dispõe sobre o exercício da profissão de motorista; altera a Consolidação das Leis do Trabalho – CLT, aprovada pelo Decreto-Lei no 5.452, de 1o de maio de 1943, e as Leis nos 9.503, de 23 de setembro de 1997, 10.233, de 5 de junho de 2001, 11.079, de 30 de dezembro de 2004, e 12.023, de 27 de agosto de 2009, para regular e disciplinar a jornada de trabalho e o tempo de direção do motorista profissional; e dá outras providências. *Diario Oficial Uniao*. 2 maio 2012:5.