Driving risks of novice drivers with symptoms of attention deficit hyperactivity disorder (ADHD)

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Introduction

- Young novice drivers belong to one of the highest traffic injury risk group.
- Risky behaviour, including risky traffic behaviour, is associated with high impulsivity.
- Impulsivity related behaviours are associated with biological differences, including dopaminergic functioning in the brain.
- Attention deficit hyperactivity disorder (ADHD) is related to impulsivity, aggression and dopaminergic functioning in the brain.
- Allelic variations in dopamine transporter gene (*DAT1* VNTR) mediate dopaminergic functioning in the brain [1].

The aim

- Investigate how symptoms of attention deficit hyperactivity disorder (ADHD) are related to risk-taking in traffic, impulsivity, and *DAT1* VNTR in novice drivers;
- Find out whether the positive effect of a brief psychological impulsivity-focussed intervention for novice drivers is affected by symptoms of ADHD.

Methods

This intervention study in driving schools started in 2014 and follow-up period was 3 years [2]. The study is part of the Estonian Psychobiological Study of Traffic Behaviour.
Subjects filled in:

- **Adult ADHD Self-Report Scale (ASRS; n=995)** [3] with two subscales: Inattention (9 items), Hyperactivity/Impulsivity (9 items); There is also **the ADHD Screening score**, which is calculated by adding up the results of 6 of the most predictive questions: **Low ADHD score (n=305)**, 0 – 7 points – six ADHD symptoms were „not at all" or „rarely"; **Medium ADHD score (n=596)**, 8 – 14 points – up to three symptoms occured „frequently"; **High ADHD score (n=94)**, 15 – 24 points – at least four symptoms occured "frequently", which may refer on them having ADHD.

- **Adaptive and Maladaptive Impulsivity Scale (AMIS; n = 987)** was used to measure different facets of impulsivity (fast decision-making, thoughtlessness, disinhibition and excitement seeking).

- **Driving Behaviour Questionnaire (DBQ; n=588)** [4] is used to assess the subjective risks of drivers. The questionnaire is made up of 28 statements, which measure the frequency of different risky behaviours of drivers on a scale of 0 (never) to 5 (almost always). DBQ violations scale low and high scorers were separated on the base of median value.

Data from Estonian Traffic Insurance Fund and Estonian Police and Border Guard Board databases -> General traffic risk (high - occurrence of either recorded traffic offence or a collision)

***DAT1* VNTR were genotyped**
- 9-repeat carriers (9R/9R and 9R/10R; n=356; 38.8%)
- 10-repeat homozygotes (10R/10R; n=561; 61.2%)

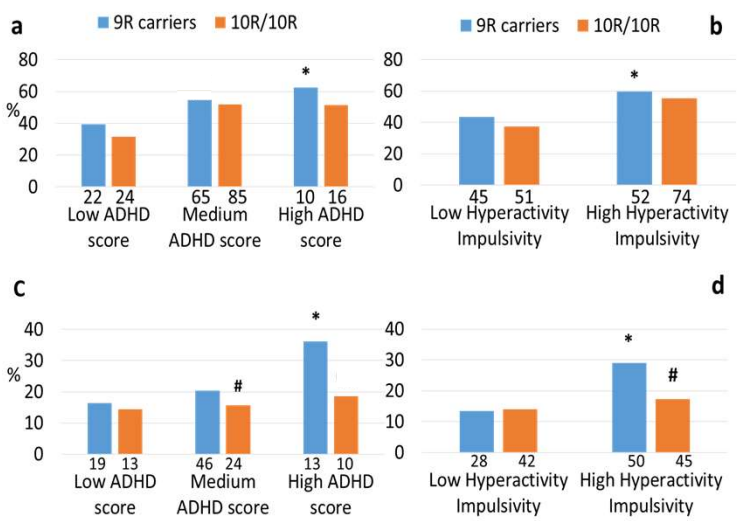
Results

Table 1. Comparison of different variables between ADHD screening score groups.

Independent variable	Low ADHD score	Medium ADHD score	High ADHD score
Age, mean (SD)	25.0 (9.3)	22.3 (7.7)**	19.5 (3.7)**#
sex, male, n (%)	126 (41.3)	211 (35.4)	41 (43.6)
DAT1 9R allele carriers, n (%)	113 (40.4)	209 (38.1)	34 (38.6)
Fast decision making, mean (SD)	18.4 (4.4)	17.5 (4.1)*	17.3 (5.3)*
Excitement seeking, mean (SD)	17.2 (15.3)	19.3 (4.8)**	21.2 (5.2)**#
Thoughtlessness, mean (SD)	12.9 (4.3)	16.1 (4.5)**	19.1 (5.0)**##
Disinhibition, mean (SD)	14.9 (4.3)	18.2 (3.9)**	20.6 (4.1)**##
DBQ violations, mean (SD)	4.4 (4.7)	5.8 (5.5)*	6.6 (5.9)*
Traffic violations, n (%)	24 (7.9)	60 (10.1)	17 (18.1)*
High general traffic risk, n (%)	46 (15.1)	102 (17.1)	24 (25.5)

*p<0.05 statistically significant difference from low scorers; ** p < 0.001 statistically significant difference from low scorers; # p < 0.05 statistically significant difference from medium scorers; ## p < 0.001 statistically significant difference from medium scorers.

Figure 1. High scorers in self reported DBQ violations (%, panel a, b) and high general traffic risk (%, panel c, d) by ADHD measures and *DAT1* VNTR



a – High scorers in DBQ violations by ADHD Screening score and *DAT1* VNTR;
b – High scorers in DBQ violations by ADHD Hyperactivity/Impulsivity and *DAT1* VNTR;
c – High general traffic risk by ADHD Screening score and *DAT1* VNTR;
d – High general traffic risk by ADHD Hyperactivity/Impulsivity and *DAT1* VNTR);
*p<0.05, significant difference compared to respective low scorers of ADHD measure; # p<0.05 significant difference compared to *DAT1* VNTR 9R carriers in respective group of ADHD measure; n, the number below columns refers to subjects with high score in DBQ violations or high general traffic risk respectively in each subgroup.

Table 3. Logistic regression models predicting high general traffic risk

Independent variable	OR (95% CI)	Adjusted OR (95% CI) [1]
1) Age	0.99 (0.97-1.0)	0.99 (0.96 - 1.00)
2) Sex, male vs female	**3.70 (2.80 – 4.90)**	**3.72 (2.63 – 5.25)**
3) Intervention vs controls	**0.67 (0.52 – 0.88)**	**0.67 (0.48 – 0.93)**
4) DAT1, 9R-allele carriers vs 10R/10R homozygotes	1.32 (1.00 – 1.74)	**1.42 (1.00 – 2.00)**
5) Fast decision making score	**1.08 (1.04 – 1.12)**	**1.08 (1.04 – 1.13)**
6) Excitement seeking score	**1.08 (1.04 – 1.11)**	**1.08 (1.04 – 1.11)**
7) DBQ violations	**2.24 (1.42 – 3.53)**	**2.08 (1.28 – 3.38)**
8) ADHD Screening groups, high vs low	**1.33 (1.01 – 1.75)**	
9) ADHD Hyperactivity/Impulsivity	**1.80 (1.29 – 2.51)**	
10) ADHD Inattention	1.01 (0.72 – 1.40)	

[1] adjusted by ADHD Screening score; Bold - significant predictor; Odds ratio (OR) with 95 percent confidence intervals (CI).

Conclusions

- There might be up to 10% of novice drivers who have ADHD.
- Subjects with high ADHD scores 1) are significantly younger, 2) are more impulsive (besides fast decision making subscale), 3) have more self reported violations by DBQ, 4) have more actual traffic violations by police database.
- *DAT1* 9R-allele carriers with high ADHD scores (especially subjects with high Hyperactivity/Impulsivity) take more risks in traffic compared to 10R/10R homozygotes.
- The effect of the brief intervention „Reducing Impulsive Action in Traffic" to high general traffic risk remained significant, even after adjusting the model with ADHD screening scores.

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