



Introduction

- The prevalence of psychiatric and behavioural disorders, including **attention deficit hyperactivity disorder (ADHD)**, has increased during past decades, especially in younger age-groups.
- Majority of traffic accidents are associated with risky driving behaviour, which is especially common among young novice drivers.
- 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.
- ADHD is related to impulsivity and dopaminergic functioning in the brain.
- Allelic variations in dopamine transporter gene (*DAT1* VNTR) mediate dopaminergic functioning in the brain [1].

The aim

- To investigate how symptoms of attention deficit hyperactivity disorder (ADHD) are related to risk-taking in traffic, impulsivity and *DAT1* VNTR in novice drivers;
- To investigate how symptoms of attention deficit hyperactivity disorder (ADHD) are related with the effect of a brief psychological impulsivity-focused intervention in novice drivers.

Methods

The intervention study in driving schools started in 2014 and follow-up period was 3 years. From 1441 subjects (mean age 22.5 (SD=7.9) years) were collected 1341 saliva samples. The study is part of the Estonian Psychobiological Study of Traffic Behaviour. Subjects filled in:

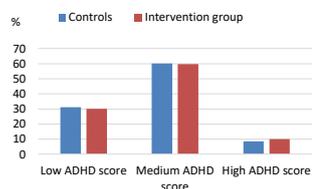
- Adult ADHD Self-Report Scale (ASRS; n=995) [2]**
Scales: Screen, Inattention, Hyperactivity Impulsivity
Groups were formed according to ADHD Screen score:
Low ADHD score, 0 – 7 points – ADHD symptoms were „not at all“ or „rarely“
Medium ADHD score, 8 – 14 points – up to three symptoms occurred „frequently“
High ADHD score, 15 – 24 points – at least four of the six symptoms occurred „frequently“, which may refer on them having ADHD
- DAT1* VNTR were genotyped**
 - 9-repeat carriers (9R/9R and 9R/10R; n=502; 38.9%)
 - 10-repeat (10R/10R) homozygotes (n=810; 60.4%)
- Traffic insurance and police databases -> General traffic risk** (high - occurrence of either recorded traffic offence or a collision)
- Driving school teachers were specially trained (2 ECTS) to carry out short intervention „Reducing Impulsive Action in Traffic“ (1.5 hours) [3, 4]

Table 1. Main ideas and aims of the intervention

Impulsivity awareness	To help students to spot and acknowledge impulsive tendencies both in themselves and in others.
Self-monitoring	To guide students to monitor personal risk proneness and notice situations that are dangerous specifically to them because of their personal features.
Self-regulation	To teach students the general cognitive-behavioral idea that behavior can be changed because we can choose what we think.

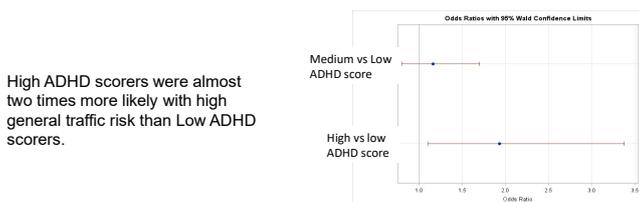
Results

Figure 1. Proportions of ADHD groups by control and intervention groups



High ADHD screening score (15-24 points) was in 9.8% of 995 subjects. There were no significant differences in proportions of ADHD groups between control and intervention groups.

Figure 2. ADHD Screen score groups in association with general traffic risk



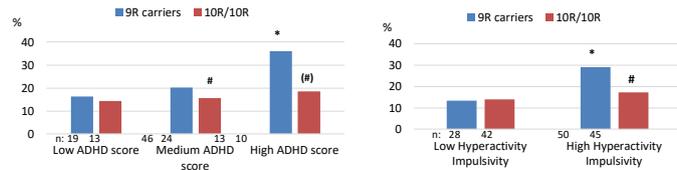
High ADHD scorers were almost two times more likely with high general traffic risk than Low ADHD scorers.

Table 2. ADHD Screen score groups in association with impulsivity and Mild Social Deviance

	Medium vs Low ADHD score OR (95% CI)	High vs Low ADHD score OR (95% CI)
Fast Decision Making	0.7 (0.5-0.9)	0.6 (0.4-0.9)
Excitement seeking	2.1 (1.7-2.7)	4.5 (3.0-6.8)
Thoughtlessness	3.4 (2.6-4.4)	11.2 (7.3-17.2)
Disinhibition	4.0 (3.1-5.2)	11.3 (7.4-17.3)
Barratt Impulsivity	5.2 (4.0-6.8)	31.4 (20.1-49.3)
Mild Social Deviance	2.3 (1.8-3.0)	6.5 (4.3-9.9)

Medium and High ADHD scorers were more likely with higher impulsivity (but with impulsivity measure Fast Decision Making on the opposite direction) and were socially more deviant than Low ADHD scorers.

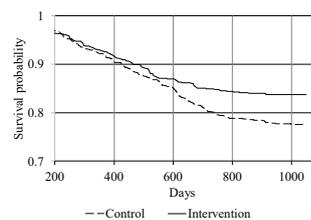
Figure 3. High general traffic risk in subgroups by ADHD measures and *DAT1* VNTR



*p<0.05, significant difference compared to respective low scorers of ADHD measure; #p<0.05, (#)p=0.06, (significant) difference compared to *DAT1* VNTR 9R carriers in respective group of ADHD measure; n, the number of subjects with high general traffic risk in each subgroup .

There were statistically significant differences in proportions of general traffic risk in subgroups by *DAT1* VNTR and ADHD measures (ADHD screening score - $\chi^2 = (5)11.9$; p=0.04, ADHD Hyperactivity Impulsivity score (low vs high by median split) - $\chi^2 = (3)20.8$; p=0.0001).

Figure 4. High general traffic risk



The intervention reduced general traffic risk during three-year study period (p=0.004)

Table 3. Univariate Cox regression models predicting high general traffic risk

	HR (95% CI)
Excitement Seeking	1.07 (1.04-1.10)
Fast Decision Making	1.07 (1.04-1.11)
BIS Motor Impulsiveness	1.07 (1.03-1.11)
ADHD Hyperactivity Impulsivity	1.03 (1.01-1.06)
Mild Social Deviance	1.08 (1.03-1.14)
<i>DAT1</i> VNTR, 9R carriers vs. 10R/10R	1.28 (1.01-1.64)

The effect of intervention on high general traffic risk remained significant when ADHD related measures (Hyperactivity Impulsivity and *DAT1* VNTR) were taken into account.

Conclusions

- There might be up to 10% of novice drivers who have ADHD and they have higher impulsivity and are socially more deviant than other novice drivers.
- Novice drivers with high ADHD screening scores, high Hyperactivity Impulsivity and risky traffic behaviour were with elevated dopaminergic functioning in the brain.
- The intervention „Reducing Impulsive Action in Traffic“ appeared as a promising prevention strategy, even for subjects with high ADHD screening scores.

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