

Deviant driving measures and variability in Parkinson's disease patients and healthy controls in simulated driving

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BACKGROUND & AIMS

Within-person variability in cognitive measures and reaction time is predictive of functional decline and cognitive impairment, both at baseline and longitudinally (e.g., Thaler et al., 2015). Variability is higher in older drivers in simulated driving (Bunce et al., 2012). Despite its potential importance, it has been investigated to a very limited extent.

Drivers with Parkinson's disease (PD) fail on-road testing more frequently than healthy controls and make more driving errors (Classen et al., 2014), but little is known about their performance in experimental conditions, frequency of deviant scores and variability of performance.

The study examines the proportion of healthy controls and PD patients with driving measures deviating from the mean in simulated driving.

METHODS

Participants

- 43 healthy controls over 38 years of age (age of youngest patient)
 - 15 PD patients
- All participants were regular drivers

Driving simulator experiment

- Data from **Distract** and **DriverBrain** research projects
- All participants underwent a neurological, neuropsychological and ophthalmological assessment
- **Driving simulator assessment:** all drivers drove a quarter-cab FOERST driving simulator (3 LCD wide screens 42", full HD: 1920x1080pixels - total field of view 170 degrees, validated against a real world environment) in **4 rural conditions**, counterbalanced across participants:



moderate traffic
with & without distraction



high traffic
with & without distraction



Distraction condition:
conversation with passenger

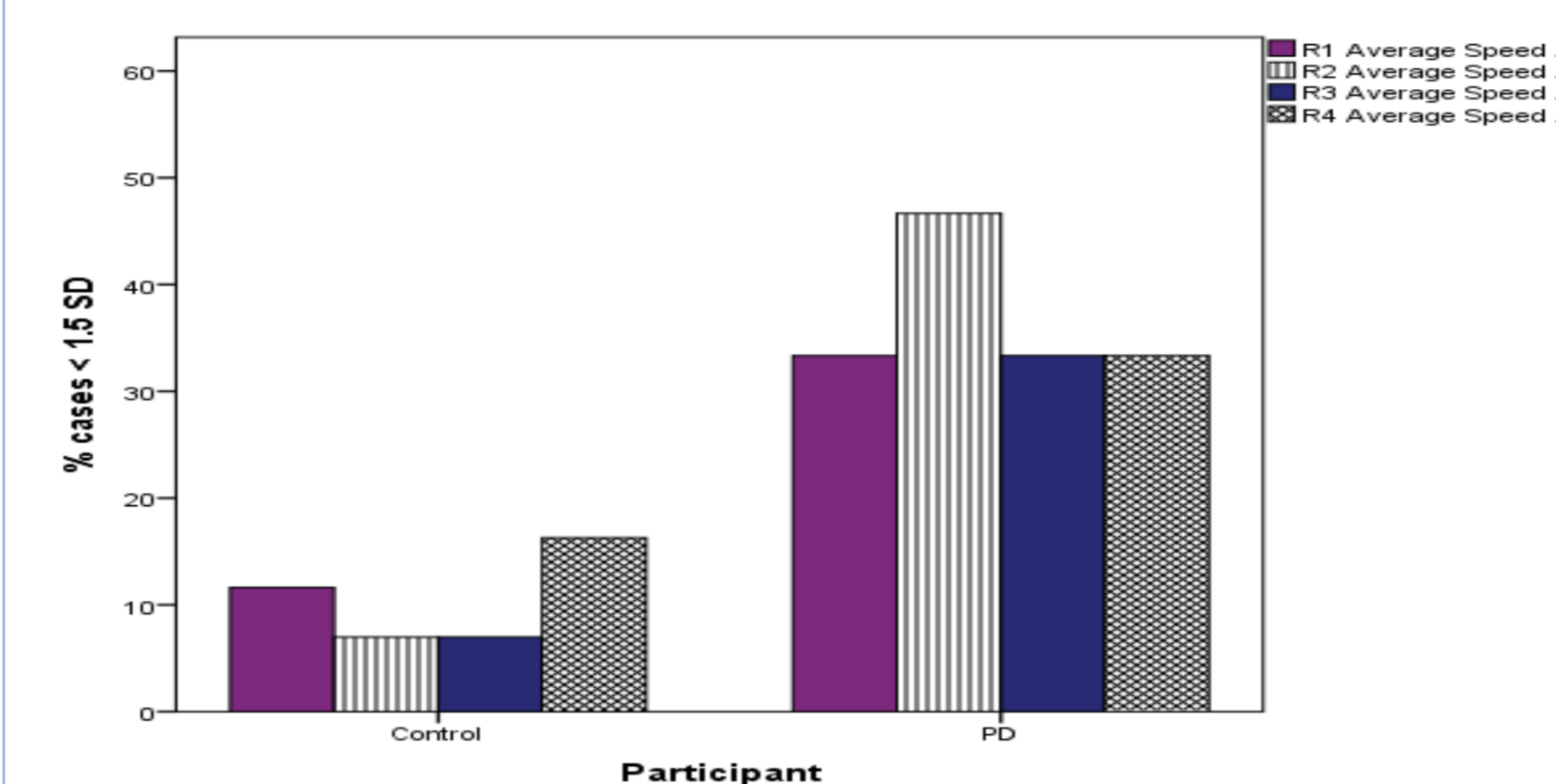
- A practice drive (10-15 minutes) preceded the driving assessment
- The rural drive took place in a single carriageway route, zero gradient, with mild horizontal curves

Measures

- **Average speed** (in km)
- **Headway average** (distance from the vehicle ahead in m)
- **Average speed variability** (SD of average speed)
- **Headway average variability** (SD of headway average)
- **Lateral position variability** (SD of the distance of the vehicle from the right road border in m)
- The measures were z-transformed based on the performance of all 86 control participants in each of the driving conditions (mean age 46±16.04) and the number of participants deviating by > 1.5 SD from the mean were computed.

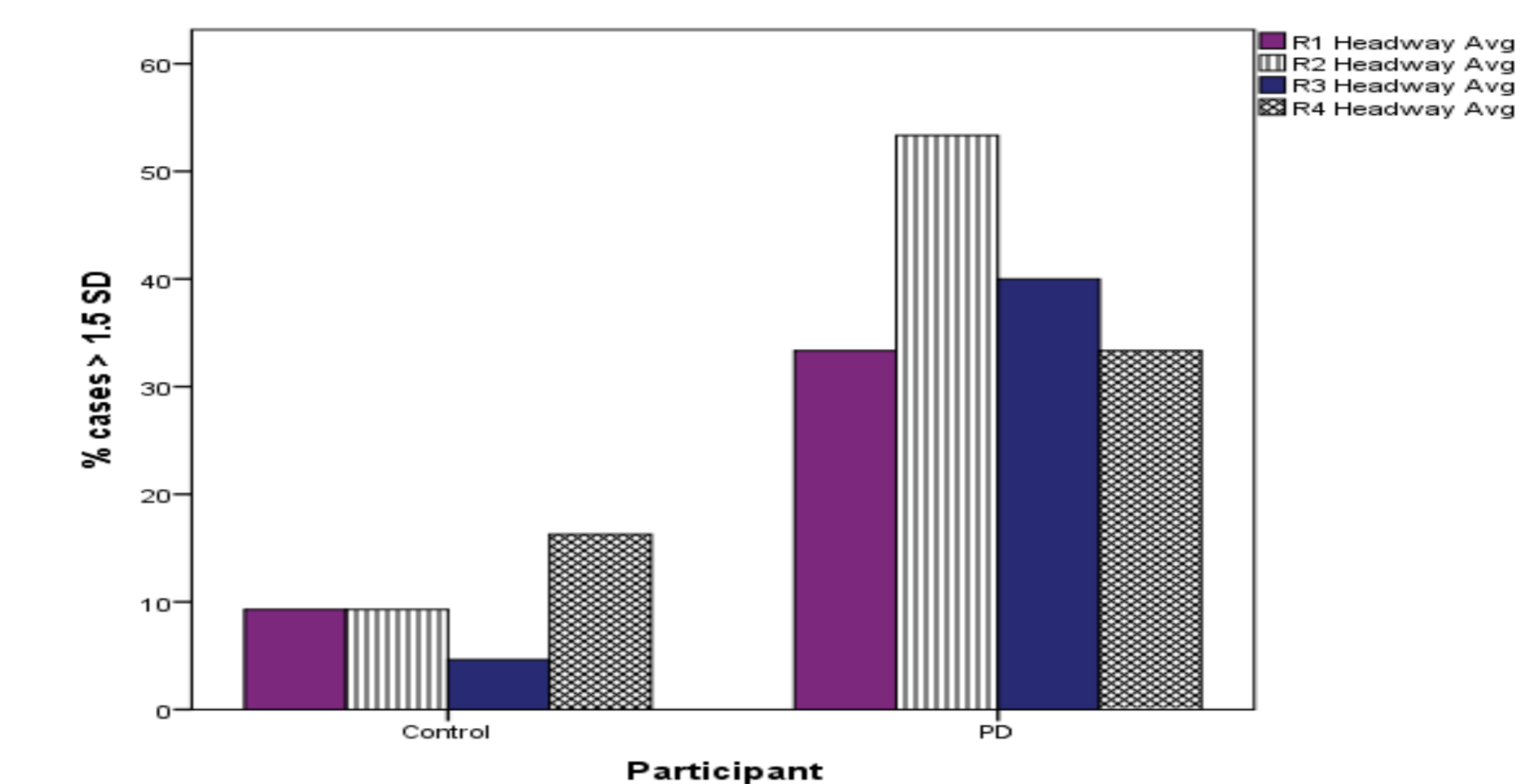
RESULTS

Figure 1. Average speed by participant by condition



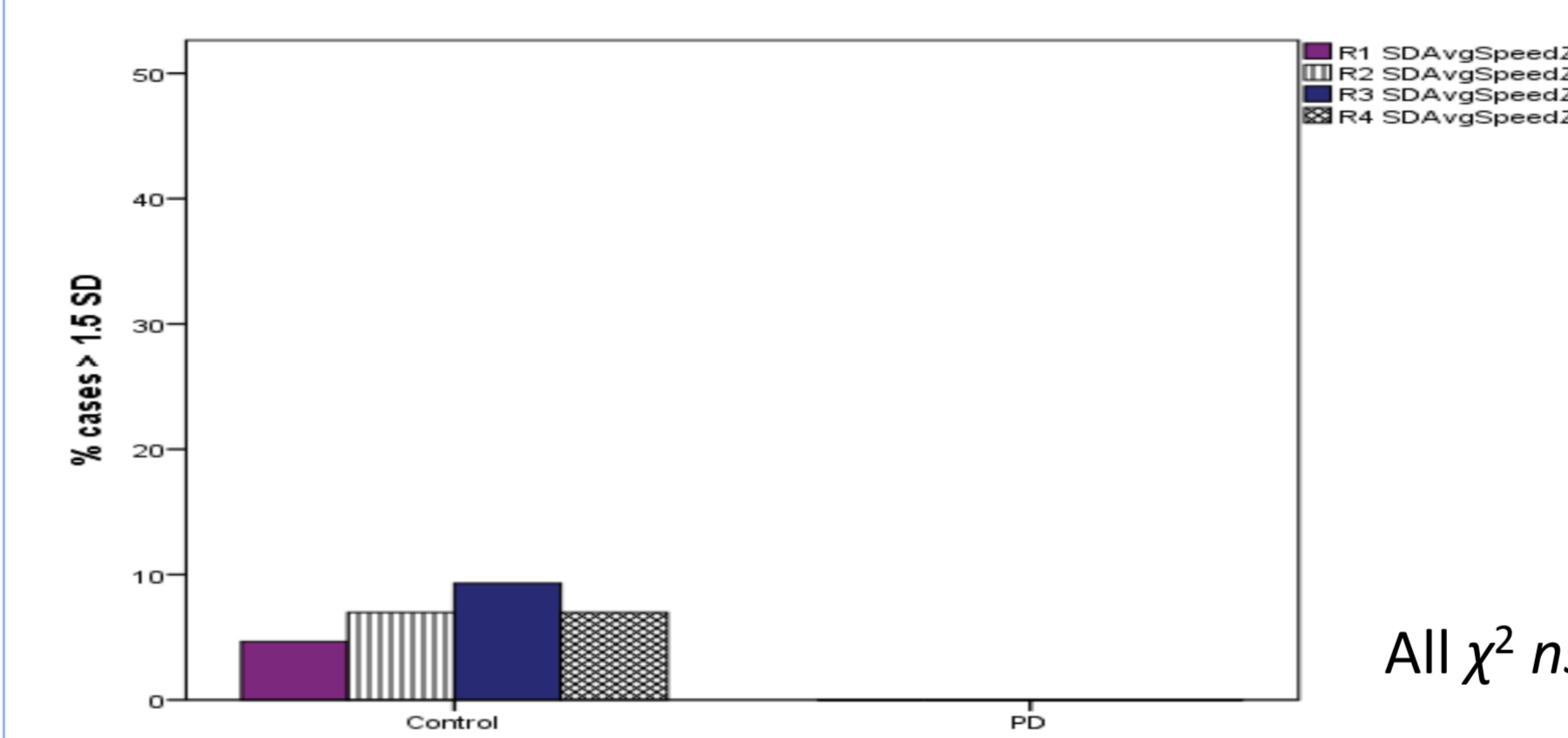
R1: $\chi^2(1, N=58) = 3.67, p = .055$ R2: $\chi^2(1, N=58) = 12.28, p < .001$
 R3: $\chi^2(1, N=58) = 6.50, p = .011$ R4: $\chi^2(1, N=58) = 1.97, p > .05$

Figure 2. Headway average by participant by condition



R1: $\chi^2(1, N=58) = 4.90, p = .027$ R2: $\chi^2(1, N=58) = 13.14, p < .001$
 R3: $\chi^2(1, N=58) = 11.96, p = .001$ R4: $\chi^2(1, N=58) = 1.97, p > .05$

Figure 3. Average speed variability by participant by condition



All χ^2 ns

Figure 4. Headway avg variability by participant by condition

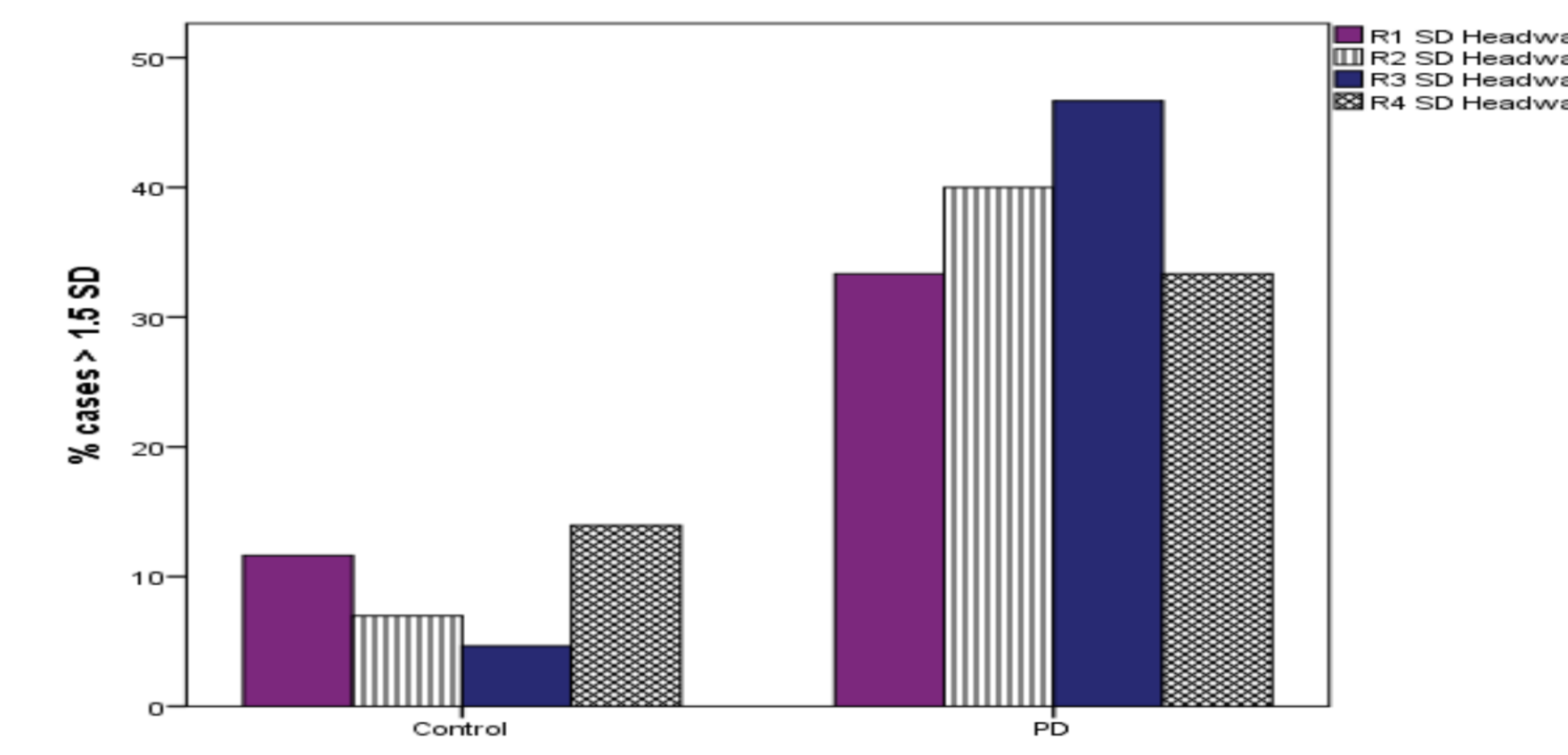
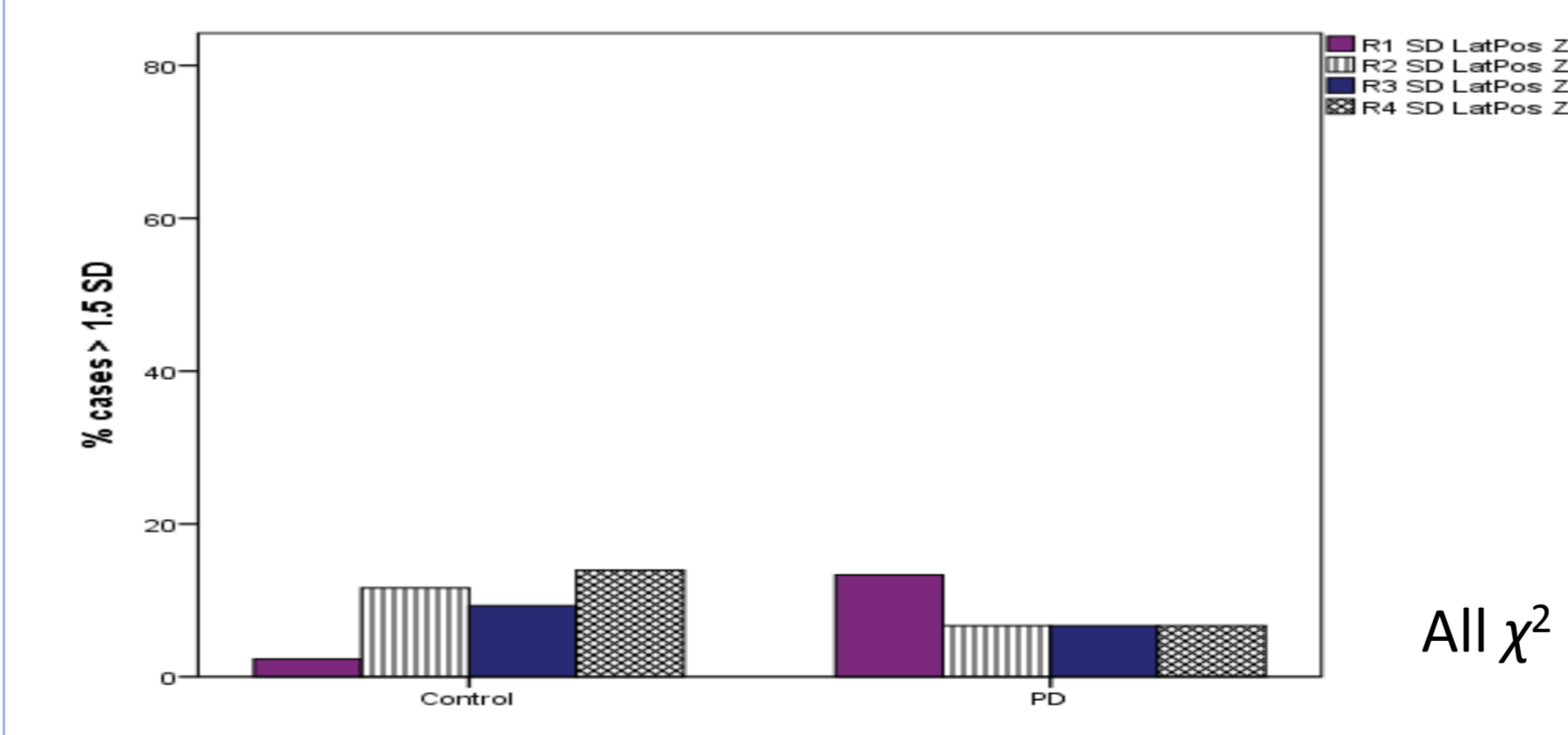


Figure 5. Lateral position variability by participant by condition



All χ^2 ns

R1: moderate speed;
 R2: high speed;
 R3: moderate with distraction;
 R4: high speed with distraction

CONCLUSION

- PD patients deviated more frequently from the mean in speed and headway average and were more variable in headway distance.
- Patient characteristics linked with deviant scores are being explored in further analyses.
- The clinical significance of deviant scores is being explored in their association with braking during unexpected incidents.