

Cross-sectional Comparison on Stress Physiology Between Adolescents on the Autism Spectrum and Typically Developing Peers

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Background

Lower cardiac vagal modulation has been found in individuals on the autism spectrum as compared to control groups [1]. These lower levels have been associated with higher levels of autism-specific symptoms as well as more internalizing symptoms [2-4]. However, methodological shortcomings in previous research prohibit the formulation of firm conclusions [5-7]. Therefore, further research has been recommended.

Objectives

Research about this topic in adolescents on the autism spectrum is scarce. Therefore, the presented cross-sectional data comparisons provide more insight into differences in autonomic functioning between adolescents on the autism spectrum and their typically developing peers. To overcome some of the methodological shortcomings of prior research, a standardized stress-provoking protocol is used.

Methods

An age and gender matched group of adolescents on the autism spectrum and typically developing peers is included in this cross-sectional study [8]. A standardized stress-provoking protocol is used which contains a baseline measurement and the ‘Stroop Word-Color Interference task’ and the ‘Social Stress Recall Task’ as stress-provoking tasks. Physiological data is continuously gathered using the NeXus-10 MKII biofeedback device and Biotrace+ Software. Saliva samples are collected to determine the level of cortisol at three time points during the assessment, reflecting the cortisol level at baseline and after both stress-provoking tasks. The root mean square of successive differences (RMSSD) as a measure of cardiac vagal modulation is used as the primary outcome measure to test the hypothesized aberrant levels of cardiac vagal modulation in adolescents on the autism spectrum. A detailed description of the used software and statistical analyses can be found in Thoen et al. [8].

Preliminary Results

Preliminary results of 43 adolescents on the autism spectrum (18 male, 15.68 ± 1.74 years) and 47 typically developing peers (22 male, 15.90 ± 1.80 years) were presented. A repeated measures ANOVA on log-transformed RMSSD data revealed statistically significant differences between tasks [$F(2.515, 221.356) = 16.712$, $p < 0.001$, Partial eta squared = 0.16] and lower cardiac vagal modulation for adolescents on the autism spectrum [$F(1, 88) = 4.119$, $p = 0.045$, Partial eta squared = 0.045]. However, no significant time x group interaction effect could be found. The repeated measures ANOVA on log-



transformed cortisol data revealed differences between tasks [$F(1.268,106.508) = 13,658, p < 0.001$, Partial eta squared = 0.14] where cortisol levels during the Social Stress Recall Task were significantly lower in comparison to the other two cortisol measurements. No statistically significant group-differences were revealed.

Preliminary Conclusions

Adolescents on the autism spectrum presented lower cardiac vagal modulation during the entire stress-provoking protocol. The level of cortisol was comparable for both adolescent groups and was lower during the Social Stress Recall Task, which may reflect the inability of this task to induce stress in these age groups. However, caution must be taken with the interpretation of preliminary results.

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Ethics Approval

This study was approved by the Ethics Committee UPC KU Leuven (ref. EC2020-541) and the Ethics Committee Research UZ/KU Leuven (ref: S64219).

Informed Consent

All parents and participants gave their informed consent and assent.

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Competing Interests

None.

References

- [1] Y-C., Cheng, Y-C., Huang, W-L., Huang. "Heart rate variability in individuals with autism spectrum disorders: A meta-analysis" *Neurosci Biobehav Rev.* 118, 463-71, 2020. <https://doi.org/10.1016/j.neubiorev.2020.08.007>
- [2] T.W., Benevides, S.J., Lane. "A review of cardiac autonomic measures: considerations for examination of physiological response in children with autism spectrum disorder" *J Autism Dev Disord.* 45, 2, 560-75, 2015. <https://doi.org/10.1007/s10803-013-1971-z>
- [3] E.E., Condy, A., Scarpa, B.H., Friedman. "Restricted repetitive behaviors in autism spectrum disorder: A systematic review from the neurovisceral integration perspective" *Biol Psychol.* 148, 107739, 2019. <https://doi.org/10.1016/j.biopsycho.2019.107739>
- [4] M.A., Patriquin, E.M., Hartwig, B.H., Friedman, S.W., Porges, A., Scarpa. "Autonomic response in autism spectrum disorder: Relationship to social and cognitive functioning" *Biol Psychol.* 145, 185-97, 2019. <https://doi.org/10.1016/j.biopsycho.2019.05.004>
- [5] B.A., Corbett, R.A., Muscatello, C., Baldinger. "Comparing stress and arousal systems in response to different social contexts in children with ASD" *Biol Psychol.* 140, 119-30, 2019. <https://doi.org/10.1016/j.biopsycho.2018.12.010>
- [6] S., Lydon, O., Healy, P., Reed, T., Mulhern, B.M., Hughes, M.S., Goodwin. "A systematic review of physiological reactivity to stimuli in autism". *Dev neurorehabil.* 19, 6, 335-55, 2016. <https://doi.org/10.3109/17518423.2014.971975>
- [7] R.A., Muscatello, S.N., Vandekar, B.A., Corbett. "Evidence for decreased parasympathetic response to a novel peer interaction in older children with autism spectrum disorder: a case-control study". *J Neurodev Disord.* 13, 1, 6, 2021. <https://doi.org/10.1186/s11689-020-09354-x>
- [8] A., Thoen, J., Steyaert, K., Alaerts, T., Van Damme. "Evaluating the potential of respiratory-sinus-arrhythmia biofeedback for reducing physiological stress in adolescents with autism: study protocol for a randomized controlled trial" *Trials*, 22, 1, 730, 2021. <https://doi.org/10.1186/s13063-021-05709-4>