

**Title:** Parenting Stress in Caregiver-Mediated Interventions for Toddlers with Autism: An Application of Quantile Regression Mixed Models

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**Introduction:** Parents of children with Autism Spectrum Disorder (ASD) are known to experience levels of parenting stress significantly higher than those experienced by parents of typically developing children and by parents of children with other disabilities (Eisenhower et al., 2005; Hoffman et al., 2009; Schieve et al., 2007). In the context of parent-mediated interventions, self-reported parenting stress has been identified as a moderator to intervention efficacy (Osborne et al., 2008). Thus, in caregiver-mediated interventions, determining if particular sets of parents have differential stress responses to intervention may give insights into how to improve the implementation of these interventions.

This study proposes a novel linear quantile mixed model (LQMM) (Geraci & Bottai, 2007) to understand more clearly how particular intervention protocols may differentially affect parents with varying levels of parenting stress. LQMMs, which directly model discrete quantiles of the outcome variable, differ from commonly used longitudinal models like linear mixed effect (LME) models, which model the mean response. The premise of an LQMM is that factors may induce differential rates of change to distinct quantiles of the outcome variable; for instance, infants with low birthweight may be more adversely affected by parental smoking than average weight infants (Koenker & Bassett 1978; Geraci, 2014). Concerning parenting stress, an LQMM may illuminate the differential effect of treatment in parents with very low, low, middle, high, or very high levels of parenting stress.

**Method:** Participants in the original RCT were 86 toddlers with ASD and their primary caregiver (Kasari et al., 2015). The toddler-caregiver dyads were randomized to receive individualized caregiver coaching in a naturalistic developmental behavioral intervention (Joint Attention, Symbolic Play, Engagement, and Regulation- JASPER) or a parent psychoeducational intervention (PEI).

The Parenting Stress Index (PSI; Abidin, 1990) is a 120-item parent-report scale that measures the stress in the parent/child system. It contains two subdomains: the parent domain and the child domain. Higher scores indicate greater perceived levels of parenting stress. The PSI was administered at entry, exit, 3-month follow up, and 6-month follow up within this intervention research study.

Two separate LQMMs were constructed to predict parent domain scores and child domain scores. Each model contained the fixed effect of the treatment assignment (JASPER vs. PEI) and time (entry, exit, 3-month follow up, and 6-month follow up) along with an interaction of treatment by time. Additionally, random intercepts were incorporated to account for the within-subject variability across timepoints. Chronological age was also controlled for in each of the models due to evidence of significant differences between groups. Five specific quantiles ( $\tau$ ) of the outcome variables were investigated (0.1, 0.25, 0.5, 0.75, and 0.9). Operationally, we can think of these groups as very-low, low, average, high, and very high stress.

Statistical analysis was conducted in R (R Core Team, 2013) using the `lqmm` package (Geraci, 2014; Geraci & Bottai, 2014).

**Results:** There were no significant treatment effects observed within the child domain across any of the quantiles. However, within the parent domain model, significant treatment by time interactions occurred from entry to 3-month follow up in the very-low ( $\tau = 0.1$ ), low ( $\tau = 0.25$ ), middle ( $\tau = 0.5$ ), and high ( $\tau = 0.75$ ) stress groups. Meaning, among parents in these four stress quantiles, the change in parent-related stress scores from entry to the 3-month follow-up depended on treatment assignment. Parents in the JASPER group with very low, low, middle, and high stress entered the study with stress scores of 97.64, 114.62, 133.23, 136.66, respectively. At the 3-month follow-up, these stress scores had risen to 103.57 (+5.93), 118.40 (+3.78), 137.44 (+4.21), and 141.48 (+4.82). Conversely, parents in the PEI group within these same stress groups ( $\tau = 0.1$ ,  $\tau = 0.25$ ,  $\tau = 0.5$ ,  $\tau = 0.75$ ) entered the study with stress scores of 99.49, 118.35, 130.22, 137.08, respectively. The PEI groups' stress scores decreased at their 3-month follow-up to 94.12 (-5.37), 112.75 (-5.60), 124.84 (-5.38), and 131.52 (-5.56), respectively.

**Discussion:** In longitudinal intervention studies, we believe it is of substantive interest to model the complete conditional distribution of a dependent variable, not just the mean, to understand the full effects of the intervention more thoroughly. Overall, this study demonstrated that the use of LQMMs was appropriate to model growth curves to evaluate how parenting stress differentially impacts caregivers in an autism intervention study.

## References:

- Eisenhower, A. S., Baker, B. L., & Blacher, J. (2005). Preschool children with intellectual disability: Syndrome specificity, behaviour problems, and maternal well-being. *Journal of Intellectual Disability Research*, 49(9), 657–671. <https://doi.org/10.1111/j.1365-2788.2005.00699.x>
- Geraci, Marco. (2014). Linear Quantile Mixed Models: The **lqmm** Package for Laplace Quantile Regression. *Journal of Statistical Software*, 57(13). <https://doi.org/10.18637/jss.v057.i13>
- Geraci, M., & Bottai, M. (2007). Quantile regression for longitudinal data using the asymmetric Laplace distribution. *Biostatistics*, 8(1), 140–154. <https://doi.org/10.1093/biostatistics/kxj039>
- Geraci, Marco, & Bottai, M. (2014). Linear quantile mixed models. *Statistics and Computing*, 24(3), 461–479. <https://doi.org/10.1007/s11222-013-9381-9>
- Hoffman, C. D., Sweeney, D. P., Hodge, D., Lopez-Wagner, M. C., & Looney, L. (2009). Parenting Stress and Closeness: Mothers of Typically Developing Children and Mothers of Children With Autism. *Focus on Autism and Other Developmental Disabilities*, 24(3), 178–187. <https://doi.org/10.1177/1088357609338715>
- Kasari, C., Gulsrud, A., Paparella, T., Helleman, G., & Berry, K. (2015). Randomized comparative efficacy study of parent-mediated interventions for toddlers with autism. *Journal of Consulting and Clinical Psychology*, 83(3), 554–563. <https://doi.org/10.1037/a0039080>
- Koenker, R., & Bassett, G. (1978). Regression Quantiles. *Econometrica*, 46(1), 33–50. JSTOR. <https://doi.org/10.2307/1913643>
- Osborne, L. A., McHugh, L., Saunders, J., & Reed, P. (2008). Parenting Stress Reduces the Effectiveness of Early Teaching Interventions for Autistic Spectrum Disorders. *Journal of Autism and Developmental Disorders*, 38(6), 1092–1103. <https://doi.org/10.1007/s10803-007-0497-7>
- R Core Team (2019). *R: A Language and environment for statistical computing*. (Version 3.6) [Computer software]. Retrieved from <https://cran.r-project.org/>.
- Schieve, L. A., Blumberg, S. J., Rice, C., Visser, S. N., & Boyle, C. (2007). The Relationship Between Autism and Parenting Stress. *Pediatrics*, 119(Supplement 1), S114–S121. <https://doi.org/10.1542/peds.2006-2089Q>

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