**Title**: Differences in literacy skill development for children with Down syndrome and Down syndrome-ASD/ADHD dual diagnoses

**Authors**: Jennifer Harris1, MSE; Rebecca Bernstein1, BA; Kristine Wolter-Warmerdam1, PhD ABD, MA; Allison Meyer1,2 , PhD

**Introduction**: Individuals with Down syndrome (DS) are known to have different literacy development schedules compared to their neurotypical peers (Harris et al, 2024). Children with DS also have a higher incidence of co-occurring conditions and secondary medical complications compared to the typically developing population, including autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) (Santoro et al., 2020; Baumer & O’Neil, 2022). While children with ASD and ADHD have been identified as having different learning patterns for literacy skills, little is known when combined with a diagnosis of DS (Cook & Rowladn, 2021; Hilvert & Sterling, 2019; Naess et al., 2021). The aim of our study was to preliminarily identify literacy skill patterns for children with a DS-ASD or DS-ADHD dual diagnosis compared to their peers with DS only.

**Method**: This is a retrospective, cohort review of children with DS receiving care at the Sie Center for Down syndrome at Children’s Hospital Colorado. Literacy Development Parent Questionnaire (LDPQ) responses were collected from caregivers of 415 unique children with DS between 3-18 years of age that were seen by an education specialist, which include children with DS only (n=359; mean age=9.0 years ± 4.0), children with DS-ASD (n=44; mean age=9.0 ± 3.6) and children with DS-ADHD (n=12; mean age=11.0 ± 4.0). The literacy skills focused on alphabetic principle, phonological awareness, and phonics. For each skill, an answer of “Yes”=2 points, “Sometimes”=1 point, and “No”=0 points. If a child achieved 70% or more of the total possible score, they were identified as within the literacy level. One hundred literacy skills were organized into seven literacy stages: Foundational Reader (achieve level=17-24 points), Early Emergent Reader (25-36 points), Emergent Reader (24-34 points), Developing Reader (21-30 points), Early Fluent Reader (11-16 points), Emergent Fluent Reader (24-34 points), and Fluent Reader (18-26) (Appendix). One-way ANOVAs and t-tests were conducted to determine if literacy scores were different for the DS-only, and DS-ASD, DS-ADHD groups by age.

**Results**: Age at each emerging literacy reader level was identified for children with DS (Foundational Reader=3 years of age; Early Emergent Reader=5 years; Emergent Reader=7 years; Developing Reader=8 years; Early Fluent Reader= 8 years; Emergent Fluent Reader=11-12 years; Fluent Reader=11-12 years). Group differences were found across ages with children with DS-only and DS-ADHD achieving higher literacy scores compared to children with DS-ASD (Table 1).

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| Table 1. Total LDPQ scores in children with Down syndrome (DS) by DS-only, DS-ASD, and DS-ADHD group |
|  | TOTAL | DS-Only |  | DS-ASD |  | DS-ADHD |  |
|  | n | n | mean ± SD |  | n | mean ± SD |  | n | mean ± SD | Results |
| 3-4 years | 56 | 50 | 44.1 ± 24.0 |  | 6 | 29.0 ± 8.8 |  | - | - | t(54)=-1.52, p=.13 |
| 5 years | 62 | 53 | 58.9 ± 35.5 |  | 7 | 25.9 ± 18.8 |  | 2 | 30.0 ± 2.8 | F(2,59)=3.48, p=.04 |
| 6 years | 47 | 43 | 75.5 ± 32.7 |  | 3 | 27.0 ± 11.5 |  | - | - | t(44)=-2.53, p=.02 |
| 7 years | 54 | 47 | 77.0 ± 41.6 |  | 6 | 74.3 ± 43.7 |  | - | - | t(51)=-.15, p=.89 |
| 8 years | 54 | 45 | 89.2 ± 48.3 |  | 8 | 52.9 ± 41.4 |  | - | - | t(51)=-1.99, p=.05 |
| 9-10 years | 75 | 67 | 85.9 ± 46.3 |  | 5 | 41.4 ± 47.0 |  | 3 | 132.3 ± 42.2 | F(2,72)=3.81, p=.03 |
| 11-12 years | 38 | 30 | 111.5 ± 50.6 |  | 5 | 55.2 ± 38.9 |  | 3 | 110.7 ± 73.4 | F(2,35)=2.64, p=.09 |
| 13-14 years | 59 | 46 | 107.2 ± 52.2 |  | 10 | 61.4 ± 32.0 |  | 3 | 99.0 ± 16.0 | F(2,56)=3.65, p=.03 |
| 15-16 years | 30 | 27 | 94.6 ± 53.2 |  | 2 | 50.0 ± 28.3 |  | - | - | t(27)=-1.16, p=.26 |
| 17-18 years | 20 | 18 | 110.2 ± 51.0 |  | - | - |  | - | - |  |
| Literacy Development Parent Questionnaire (LDPQ)**;** Autism spectrum disorder (ASD); Attention-deficit/hyperactivity disorder (ADHD) |

**Discussion:** Our study shows promise in determining the differences in literacy development among those with DS-ASD and DS-ADHD and is consistent with previous research suggesting differences in literacy for those with ASD or ADHD without DS. There are notable differences in literacy development with particular shifts around 8 years of age. Further investigation is needed to better understand specific skills and developmental trajectories among those with dual diagnoses in order to support their literacy growth and provide tailored teaching supports. While the sample size for both DS-ASD and DS-ADHD are small, our initial analysis indicates further need to understand the differences in literacy development of those with DS-ADHD and DS-ASD.

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1Sie Center for Down Syndrome, Children’s Hospital Colorado

2University of Colorado School of Medicine, Department of Pediatrics