Academic Profile of Children with 22q11.2 Deletion Syndrome: Delineating Specific Mathematics and Reading Disabilities

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Conflicts of Interest

- The investigators have no conflicts of interest to disclose.

Introduction

- Intellectual functioning in children with 22q11DS varies from the low average to mild intellectual disability range.
  - 45% qualify for an Intellectual Disability.
- Additional deficits have been documented in:
  - Sustained attention
  - Visual-spatial abilities, with some reported similarities to nonverbal learning disability
  - Executive functions
- Psychiatric disorders have been noted in up to 60% of children with 22q11DS
  - Attention-Deficit/Hyperactivity Disorder (ADHD)
  - Anxiety disorders
  - Approximately 25% develop major psychiatric illnesses (e.g., schizophrenia, bipolar illness, major depression) in late adolescence/early adulthood

Introduction

- The focus of much of the research with 22q11DS has been on neurocognitive and psychiatric functioning, particularly in light of the fact that this population is at higher risk for severe psychiatric disorders.
- Less focus has been placed on academic functioning of these children which, perhaps predictably, is also an area of difficulty for many.
- The available research has shown specific deficits in mathematics, with relatively better reading and spelling abilities.

Introduction

- Deficits in math in children with 22q11DS have been shown to be related more to procedural difficulties than fact retrieval.
  - Retrieving basic arithmetic facts tends to be faster than when borrowing and carrying numbers is required to complete a calculation
- They also have been shown to experience greater difficulty solving word problems, and comparing the magnitude of numbers.

Introduction

- Studies investigating reading are sparse.
- Available findings are somewhat mixed with respect to specific reading skills:
  - Overall average pre-reading abilities with relatively lower phonological awareness.
  - Significantly better developed word reading skills compared to reading comprehension.
  - Reading comprehension level is equivalent to word reading level.

Study Objectives

- To investigate the prevalence of learning problems in children with 22q11DS.
- To investigate the overall academic performance of children with 22q11DS compared to controls.
- To provide an in-depth analyses of specific academic skill areas within mathematics and reading in children with 22q11DS.
  - Such a description would provide targeted information that would be helpful in devising academic interventions for children with 22q11DS.

Sample Description

- Sample Size (22q11DS = 85; Controls = 76)
- Preliminary data analyses revealed no group differences on:
  - Chronological age, $t(161) = -1.55$, $p = .124$
    - 22q11DS = 13.57±3.1 years
    - Control = 13.46±2.7 years
  - Socioeconomic status, $t(148) = -0.31$, $p = .75$
    - 22q11DS = 29.17±14.3
    - Control = 33.5±17.8
  - Gender, $\chi^2(2) = .223$, $p = .895$
    - 22q11DS= 52.9% male
    - Controls = 53.8% male
  - Ethnicity, $\chi^2(8) = 15.4$, $p = .052$
    - 22q11.2DS = 82.4% Caucasian
    - Controls = 70.5% Caucasian

Measures

- Intelligence
  - Wechsler Intelligence Scale for Children-III/IV
- Achievement
  - Wechsler Individual Achievement Test-II/III
    - The WIAT-III, allows for in-depth skills analyses on several subtests that provide a more specific look at academic strengths and weaknesses.

Data Analyses

- Learning problems were defined via a low achievement model.
  - Bottom quartile compared to their peers in achievement
  - IQ broadly within the average range (≥ 80)
- Group comparisons employed MANCOVA.
  - Group differences on the Spelling subtest used ANCOVA.
- Percent correct variable was calculated for each skill area.
  - The percent correct was based on the number of items correct in the specific skill area divided by the total number of items administered.

Prevalence of Learning Problems

- Borderline to low average academic functioning across all tasks.
- Overall Reading ($M = 83.53 \pm 15.43$) and spelling ($M = 84.34 \pm 16.23$) scores were higher than overall Math ($M = 73.6 \pm 17.68$).
- No significant discrepancies between subtests within an academic domain.

Prevalence of Learning Problems

- Prevalence of learning problems (Standard Score $\leq$ 90) was high:
  - 87% (74/85) for a math problem
  - 67% (57/85) for a reading problem
  - 36% (31/85) for a spelling problem
- When the requirement of an average IQ was applied (IQ ≥ 80):
  - 16.5% for a math problem
  - 3.5% for a reading problem
  - 2.4% for a spelling problem

Group Differences on WIAT-II/III Subtests

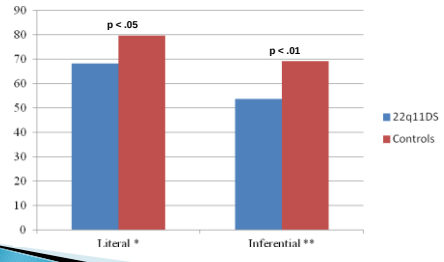
Measure	22q11DS (n=85)	Controls (n=76)	*F* value	Partial eta-squared
WIAT Reading Scores MANCOVA F (3, 149) = 7.04, p < .001				
Word Reading	86.19 (14.08)	94.18 (14.17)	18.77***	.111
Reading Comprehension	82.78 (19.08)	97.88 (15.83)	7.12**	.045
Pseudoword Coding	89.69 (14.46)	95.07 (15.53)	17.70***	.105
WIAT Mathematics Scores MANCOVA F (2, 158) = .522, p = .594 MANOVA F (2, 160) = 41.61, p < .001				
Numerical Operations	78.4 (17.29)	99.09 (14.46)	66.76***	**.293**
Math Problem Solving	74.29 (16.85)	99.53 (21.39)	70.89***	**.306**
WIAT Spelling Scores (ANCOVA)				
Spelling	84.34 (16.23)	93.08 (13.51)	14.69***	.085

Note. Standard scores have a mean = 100, SD = 15.
**p < .01; ***p < .001

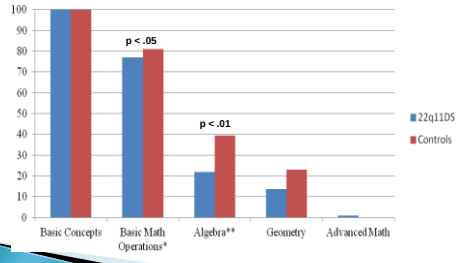
Specific Academic Skills

- Several critical academic skills were examined using the WIAT-III specific skills analysis.
  - Reading Comprehension (literal and inferential comprehension)
  - Numerical Operations (basic concepts, basic math, algebra, geometry)
    - Multiplication (1-, 2-, 3-digit multiplication)
  - Math Reasoning (basic concepts, everyday applications, algebra, geometry)

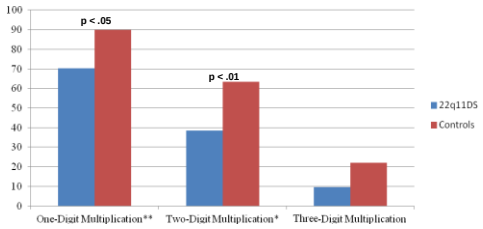
Skills Analysis for Reading Comprehension



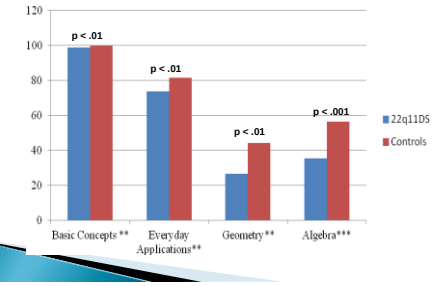
Skills Analysis for Numerical Operations



Skills Analysis for Multiplication Problems



Skills Analysis for Math Reasoning



Conclusions

- Results indicated an overall profile of better reading and spelling than math abilities.
  - These findings replicated earlier studies.
- Despite the majority of children with 22q11DS performing in the lowest quartile when compared to their peers, very few met criteria for the low achievement definition of a learning disability in the U.S.
  - It is unclear how they might respond to a Response-to-Intervention-based approach (RTI).
- There were many significant differences on the supplemental scores of the WIAT-III, with the exception of very basic skills that would be learned at a young age, and advanced skills in which neither group was proficient.

Conclusions

- From an assessment perspective, academic skills need to be assessed on a regular basis, in detail, and progress monitoring implemented.
- From an intervention perspective:
  - Early intervention for both reading and math skills is necessary
  - Higher-order comprehension skills may require ongoing scaffolding and treatment
  - Higher-order math skills will require ongoing assistance that likely will go beyond typical instruction and tutoring.
- Increased examination of neurological underpinnings for associated learning problems.

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Questions?

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