



Autism Intervention Research  
Network on Physical Health

AIR-P Presents:

**Brain and Body in Motion: Understanding and supporting  
motor dysfunction in Autism**

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# Disclosures

- Funded by NIH
- Vice Chair, USTA Science Committee
- Neurology Node Director, AIR-P

# Outline

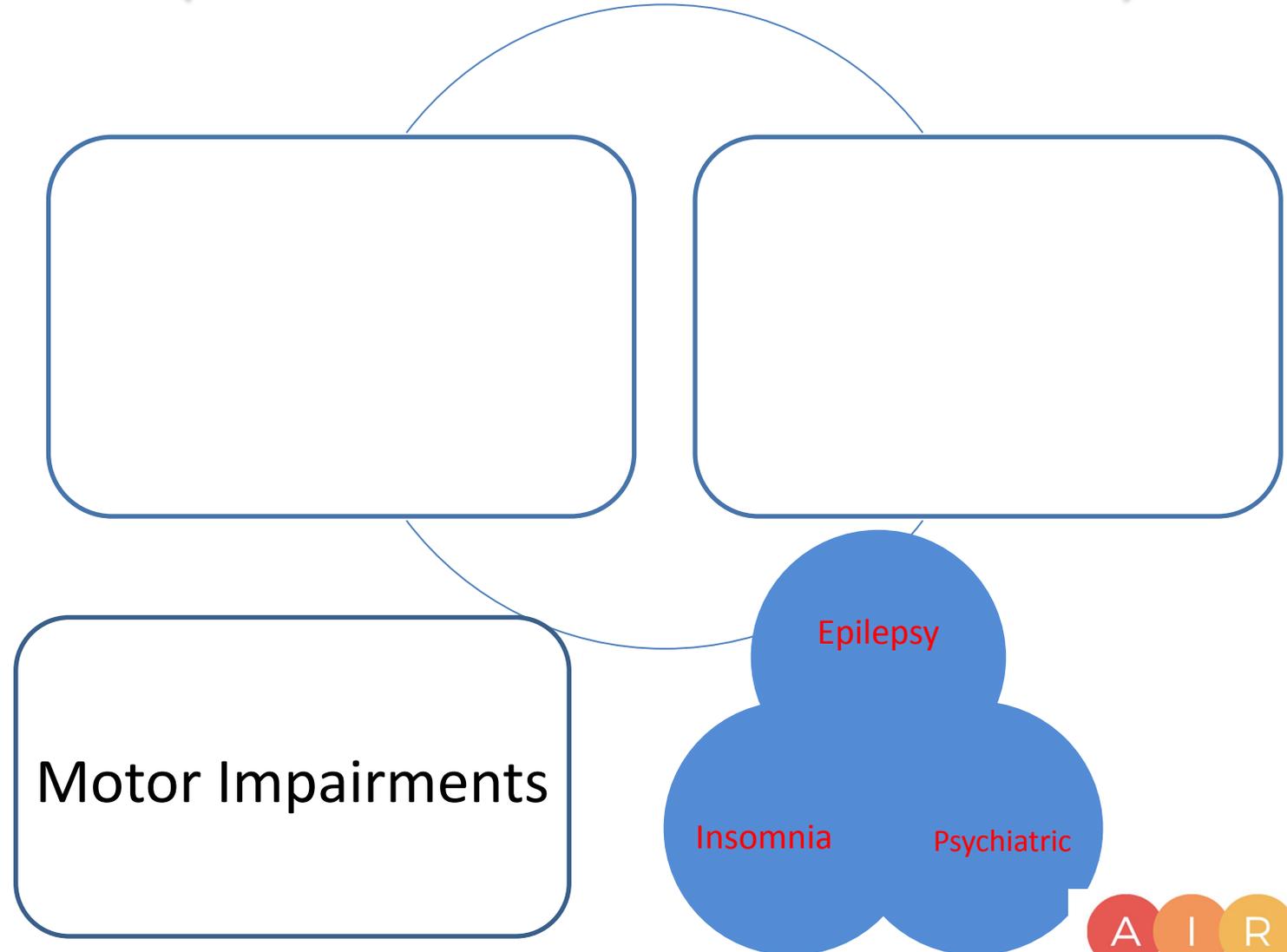
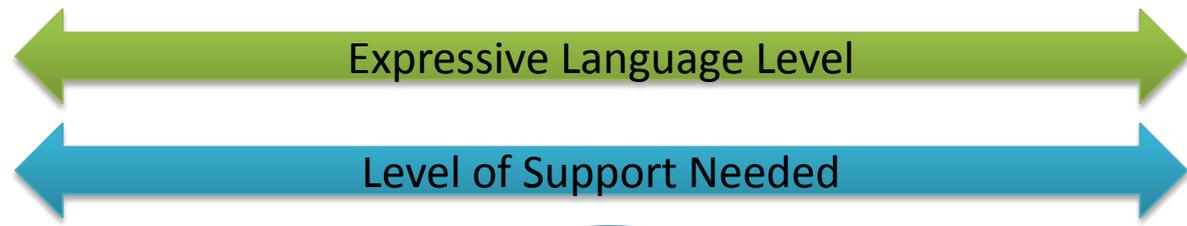
- Motor function/dysfunction in Autism
- Measuring motor function in Autism
- Why should autistic individuals participate in organized physical activity (OPA)?
- Benefits of organized physical activity (OPA)
- Outcomes of OPA for autistic individuals
- Clinical tips for referring autistic individuals to OPA

# DSM-5 Diagnostic Criteria for ASD

1. Deficits in social-emotional reciprocity
  2. Deficits in nonverbal communicative behaviors used for social interaction
  3. Deficits in developing, maintaining and understanding relationships
- Need symptoms in all 3 subdomains

1. Stereotyped or repetitive motor movements, use of objects or speech
  2. Insistence on sameness, inflexible adherence to routines
  3. Highly restricted, fixated interests that are abnormal in intensity or focus
  4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment
- Need symptoms in 2 of 4 subdomains

1. Odd Gait
2. Clumsiness
3. Other abnormal motor signs



# Importance of motor function in ASD

Motor development is the earliest benchmark of developmental progress and is crucial in driving multiple cognitive processes

Motor impairments are prevalent and one of the first signs of atypical development in autism

Motor development can be observed and measured over time

Motor function can serve as a target for intervention

# Prevalence of Motor Difficulties in Autism Spectrum Disorder: Analysis of a Population-Based Cohort

Melissa K. Licari , Gail A. Alvares , Kandice Varcin , Kiah L. Evans, Dominique Cleary, Siobhan L. Reid, Emma J. Glasson, Keely Bebbington, Jess E. Reynolds, John Wray, and Andrew J. O. Whitehouse

- 2,084 individuals with ASD
- **35.4%** met criteria for motor difficulties (intellectual disability-37%)
- Prevalence of motor difficulties increased with age
- Diagnosing clinicians reported motor difficulties in only **1.34%** of cases

## Motor Functioning in People With Autism Spectrum Disorders

**Table 1.**

Motor Impairments in Children and Adults With Autism and Motor Delays in Infants and Toddlers at Risk for Autism Spectrum Disorders (ASDs)

Motor Impairments or Delays	Impairments in School-Aged Children and Adults With ASDs	Delays in Infants at Risk for ASD and in Toddlers and Preschoolers With ASDs
Gross motor coordination	Poor upper-limb and lower-limb coordination, including bilateral coordination and visuomotor coordination	Gross motor delays in supine, prone, sitting skills are present in the first year of life. Delayed onset of walking may be present in the second year of life. Gross motor delays are also present in preschoolers recently diagnosed with ASDs.
Fine motor coordination	Poor fine motor coordination such as in performance on manual dexterity tasks (eg, Purdue Pegboard Test)	Reaching and grasping appear to be delayed in infants at risk for ASDs. Fine motor delays persist in the second and third years of life.
Motor stereotypies	Motor stereotypies are common in older children and adults with ASDs.	Motor stereotypies such as repetitive banging of objects or unusual sensory exploration may appear in the first year of life, but most often emerge in the second year of life.
Postural	Feedforward and feedback control of posture are affected in children and adults with ASDs. Overall, deficient postural control persists in adults with ASDs.	Delays are evident in postures such as rolling and sitting. There are suggestions of unusual postures held for brief to long periods in infants who later developed ASDs.
Imitation and praxis	Imitation impairments are present during postural, gestural, and oral imitation. Performance of complex movement sequences is poor during imitation, on verbal command, and during tool use, suggesting generalized dyspraxia not specific to imitation.	

(Bhat et al, 2011; Fournier et al, 2010 )

# Motor impairments impact overall development

**Motor impairments can have a cascading impact on language, cognition, social communication, and physical activity**

The interrelationships between motor, cognitive, and language development in children with and without intellectual and developmental disabilities

(Houwen et al., Res in Dev Disabil, 2016)

(Piven, 2018; Iverson et al, 2019; Ozonoff et al, 2011)

# Gaps in the field

Motor assessments that can be utilized in individuals with a range of cognitive and behavioral abilities

Sensitive and specific measures that can yield objective results regarding the nature of these motor impairments and their relationship to neurodevelopmental outcomes



**Identify the neural mechanisms underlying motor dysfunction in NDDs**

# How do we measure motor function?

- Caregiver Questionnaires
- Vineland Adaptive Behavior Scales
  
- Motor Measures
- Neurological Examination
- Standardized developmental assessments
- Standardized motor assessments





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# What's missing in autism spectrum disorder motor assessments?

Rujuta B. Wilson<sup>1\*</sup>, James T. McCracken<sup>1</sup>, Nicole J. Rinehart<sup>2</sup> and Shafali S. Jeste<sup>1</sup>

- Motor assessments that can be used to assess individuals with varying cognitive and behavioral function
- Move beyond capturing only motor milestones and skill acquisition
- Objectively quantify qualitative differences in motor function



MENTAL HEALTH

# Autism in Motion: Could Motor Problems Trigger Social Ones?

Kids battling physical awkwardness may miss crucial opportunities to learn about interaction

By Nicholette Zeliadt, Spectrum on June 5, 2017



# Quantitative tests of motor skills could improve autism care

BY RUJUTA BHATT WILSON / 2 APRIL 2019

## RESEARCH ARTICLE

# Quantitative Gait Analysis in Duplication 15q Syndrome and Nonsyndromic ASD

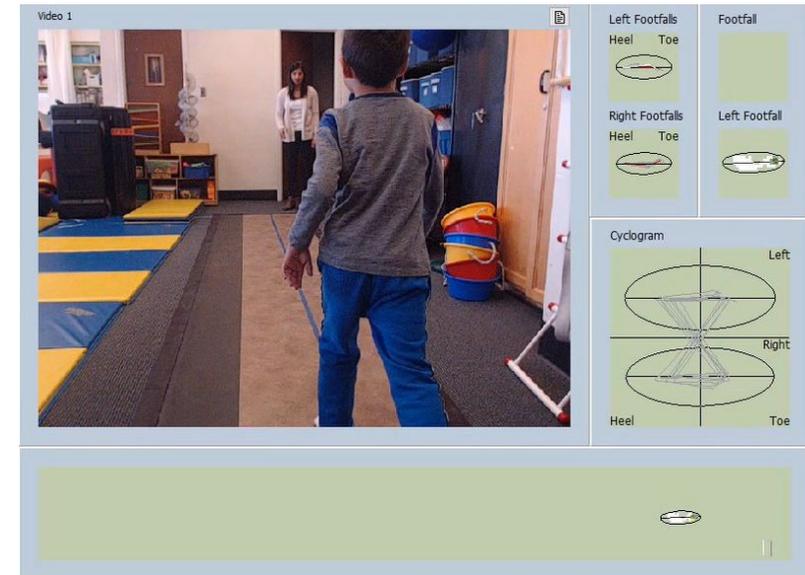
Rujuta B. Wilson , David Elashoff, Arnaud Gouelle , Beth A. Smith, Andrew M. Wilson , Abigail Dickinson , Tabitha Safari, Carly Hyde, and Shafali S. Jeste

**Three groups:** Dup15q (n = 39), NsASD (n = 21), and TD (n = 131)

**Three domains of gait:** 1. Pace: 2. Postural control 3. Variability

Successful evaluation of individuals with ASD and a wide range of behavioral and intellectual abilities

Features of poor postural control and variability in gait could indicate a common deficit in cerebellar function in Dup15q syndrome and nsASD (shown in preclinical and clinical imaging studies)





Emma Burdekin,  
DGSOM MS3

## The Neurodevelopmental and Motor Phenotype of SCA21 (ATX-TMEM240)

Emma Burdekin, BA, Julian Martinez, MD, Jessica E. Rexach, MD, PhD, Brent L. Fogel, MD, PhD, Shafali S. Jeste, MD, Charlotte DiStefano, PhD, Carly Hyde, BS, Tabitha Safari, BS, **Rujuta B. Wilson, MD**

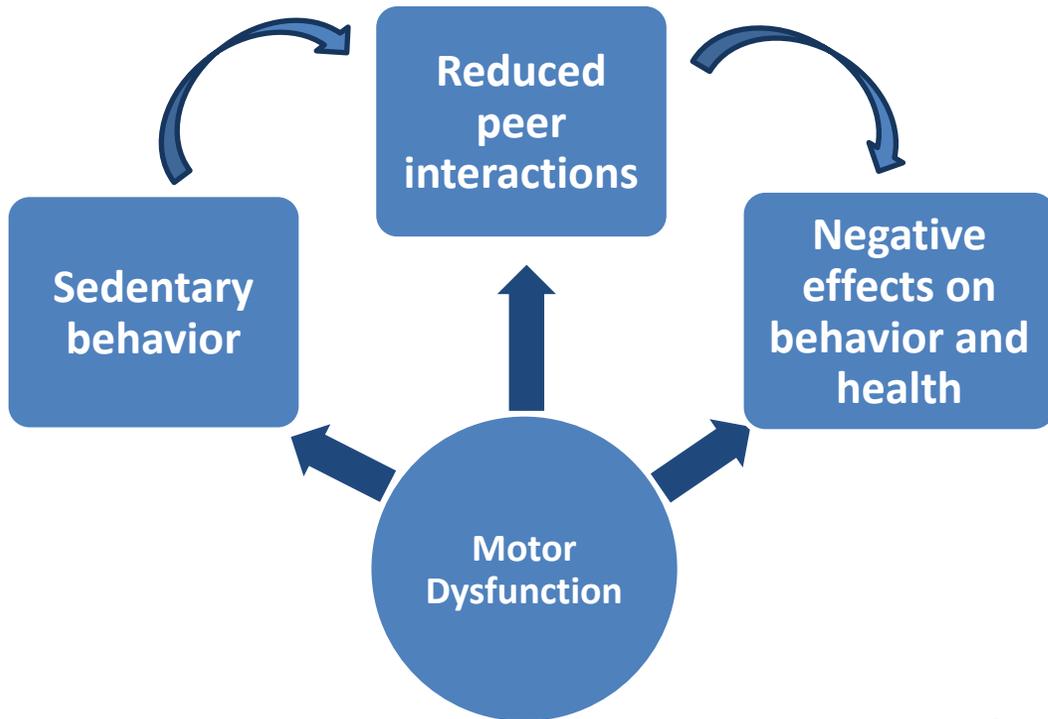
- Coexistence of ataxia, motor impairments, and neurodevelopmental disorders suggest a common role for affected spinocerebellar pathways
- Greater ataxia correlated with greater severity of neurodevelopmental diagnoses

*"I'm a medical genetics fellow in NC, and I was writing because I read your 2020 paper, "The Neurodevelopmental and Motor Phenotype of SCA21 (ATX-TMEM240)" with interest as a I recently saw a child with diagnosis of autism and odd movements...we later chose to pursue testing and she has a mutation in TMEM...."*

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# Why should autistic individuals participate in OPA



- Higher rates of sedentary behaviors
  - Not meeting recommended 60 minutes of physical activity a day for children
  - Reduced bone mineral density leading to higher rates of fractures
- Increased rates of obesity
  - Leading to greater risk of other medical co-morbidities such as high blood sugar and high cholesterol

Physical activity rates in children and adolescents with autism spectrum disorder compared to the general population

# Benefits of organized physical activity (OPA)

- Good for the Brain
- Long term health benefits
- Mental Health Benefits
- Cognitive benefits
- Building social relationships

nature reviews neuroscience

Be smart, exercise your heart:  
exercise effects on brain and  
cognition

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*Charles H. Hillman, Kirk I. Erickson and Arthur F. Kramer*

**“As fitness has also been related to the frontoparietal network, it would follow that children might derive benefits in school performance from increased participation in physical activity”.**

# Why don't we refer autistic individuals to OPA?

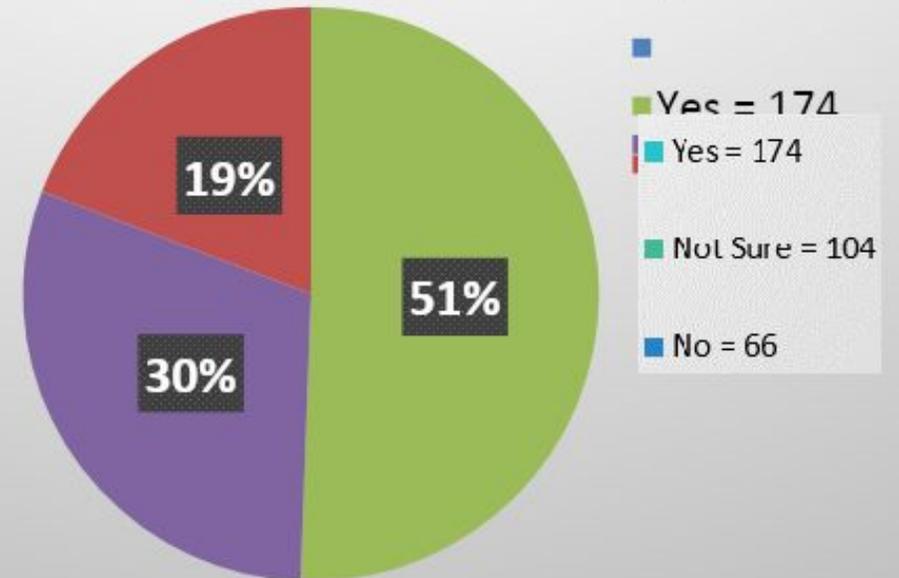
- Long term motor dysfunction under diagnosed
- Unsure about the benefits for individuals with autism
- Focused on other therapies (speech, behavioral)
- Unsure about child's ability
- Programs are not available
- Parental concerns

## The Importance of Motor Function and Physical Activity in Autism Spectrum Disorder

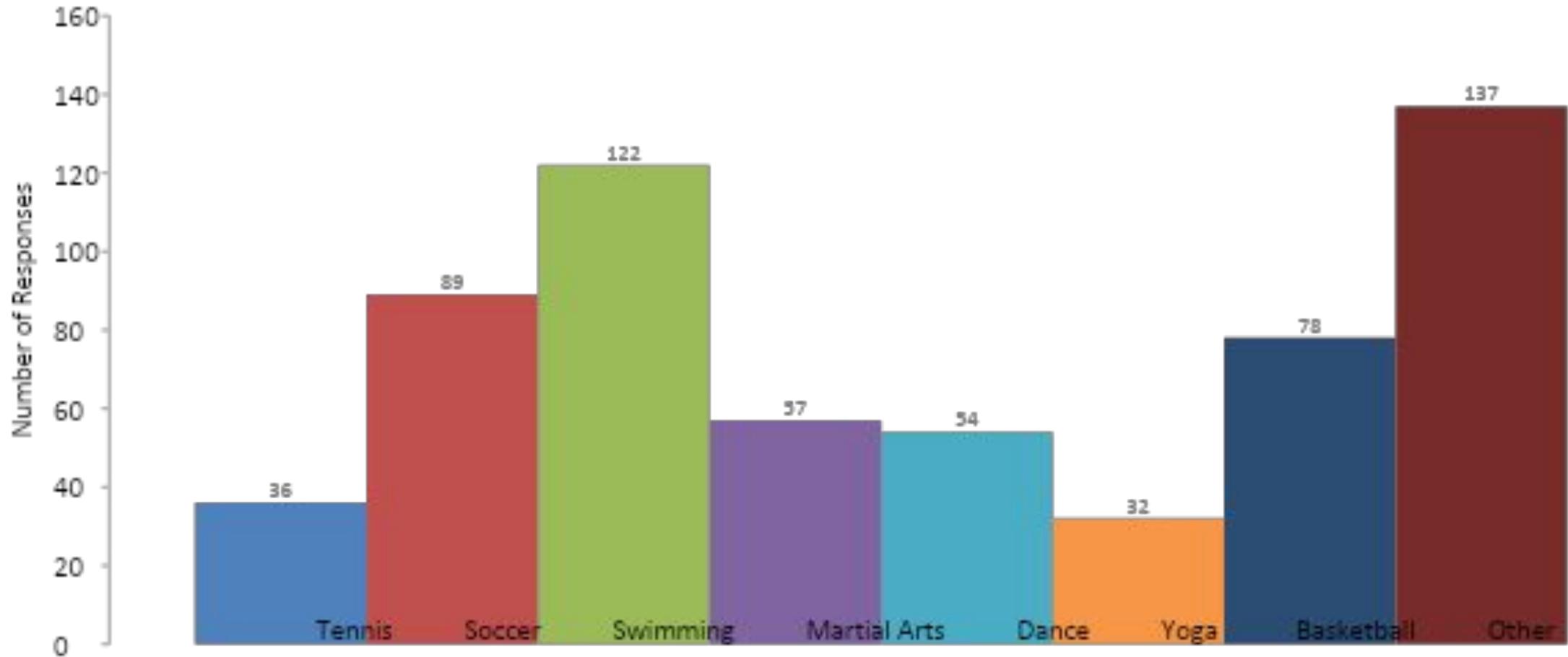
Rujuta Bhatt Wilson, M.D. and Shafali Spurling Jeste, M.D.



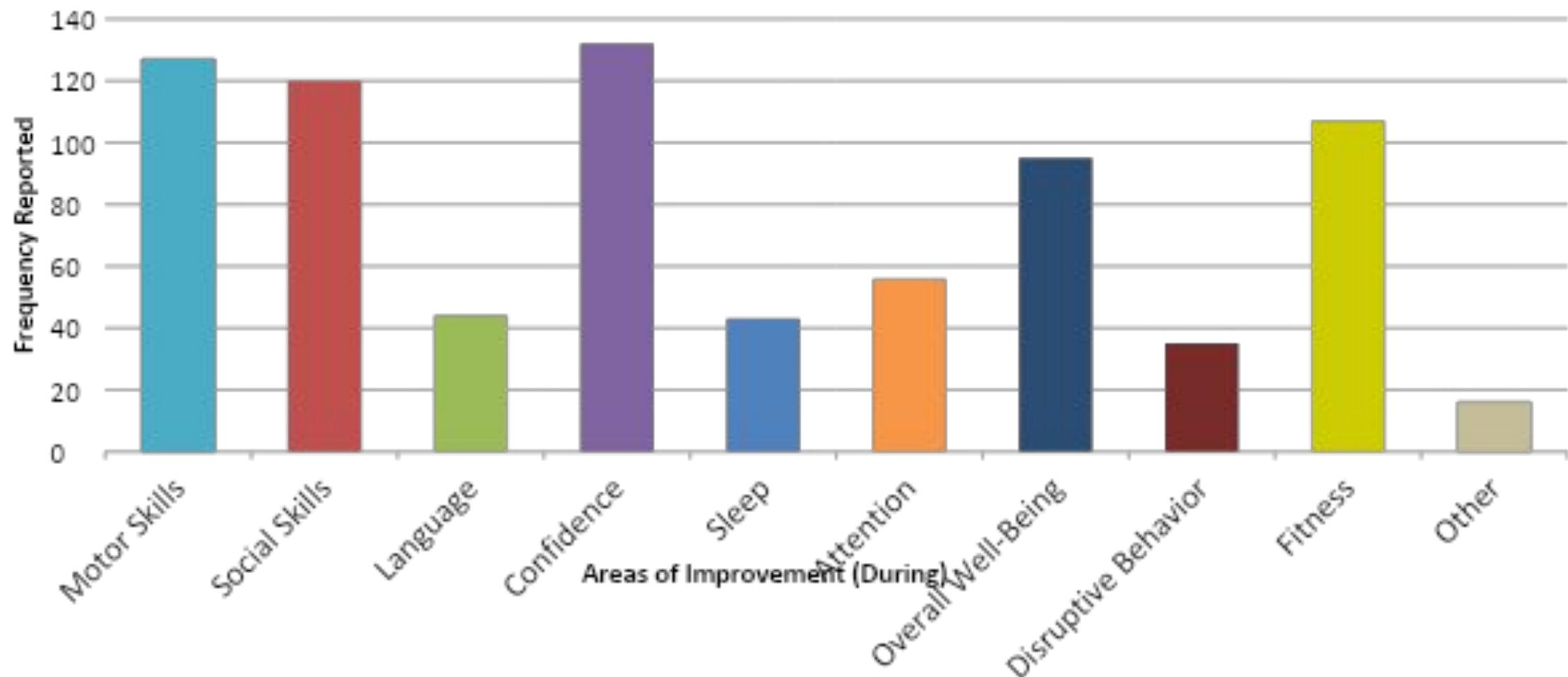
Are there physical activity or sports programs adapted for individuals with NDDs available in your community?



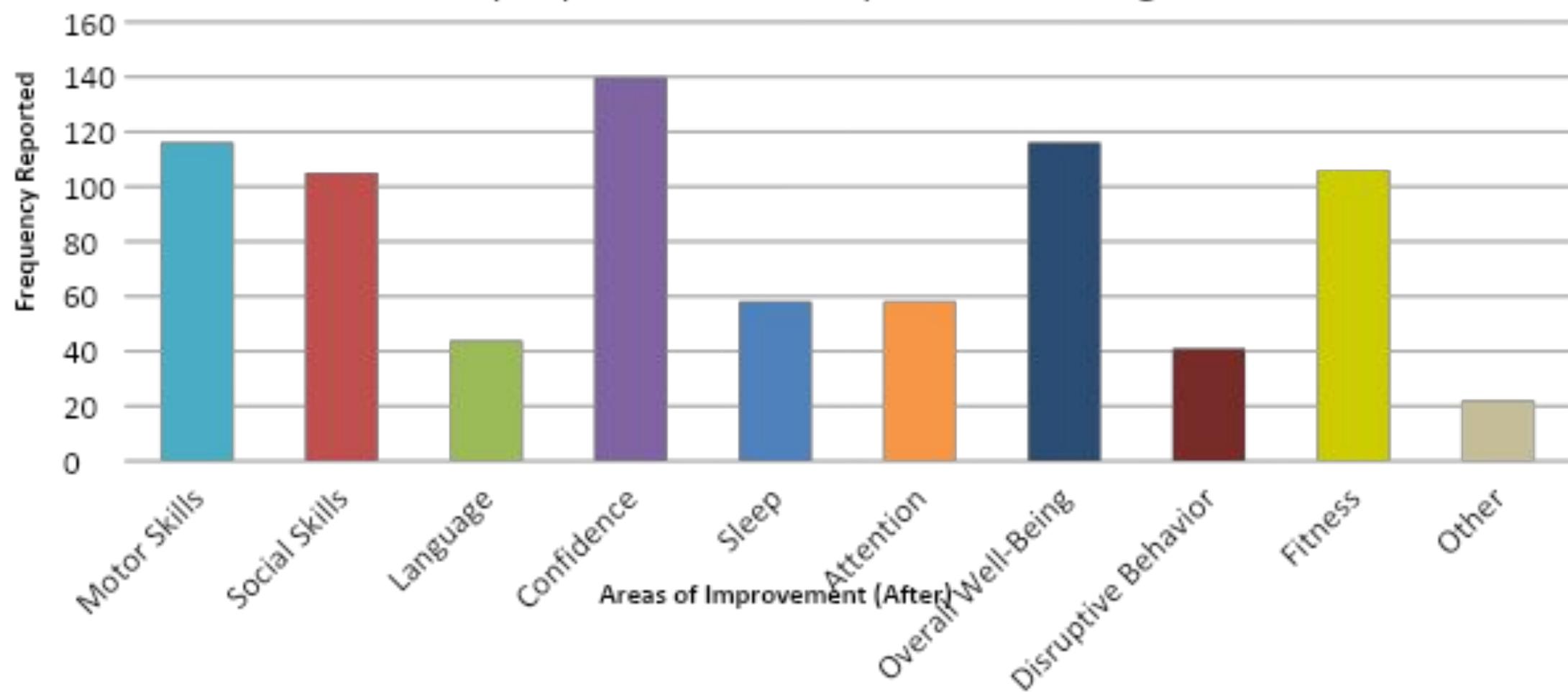
## Types of Adapted physical activity Programs available



During participation in the physical activity or sports programs, did you observe improvements in any of the following areas?



After participation in the physical activity or sports programs, did you observe any improvements in any of the following areas?



# Gaps and Needs in Programs

- How Can the Programs Improve?

- Greater availability and accessibility
- More informed coaches and instructors
- Programs focused on specific needs
- More programs for “higher functioning” children
- More programs for children with “greater needs”

- Why some do not participate?

- No programs available
- Unsure of how their child will do
- Unaware that a program exists
- Program does not meet specific needs
- Has not been recommended

# Benefits of OPA for children with Autism

## Organized physical activity programs: improving motor and non-motor symptoms in neurodevelopmental disorders

*Nicole J. Rinehart, Shafali Jeste, Rujuta B. Wilson  
Dev Med Child Neurol 2018*

**A Meta-Analytic Review of the Efficacy of Physical Exercise Interventions on Cognition in Individuals with Autism Spectrum Disorder and ADHD**

*(Tan et al., J Autism and Dev Disord, 2016)*

# Outcomes of OPA for individuals with Autism

48-week program focused on basic coordination and strength exercises vs control  
Children with ASD (6-12 y/o)



Improved lipid profile, perceived quality of life, and repetitive and stereotyped behaviors

(Toscano et al., Percept Mot Skills, 2018)

12-week remote exercise intervention  
1 vs 2 x per week  
Adults with Down Syndrome (18-35 y/o)



2 x per week led to significant improvement in memory and nonsignificant in attention and reaction time

(Ptomey et al., Disabil Health J, 2018)

10-week swimming intervention vs control  
Children with ASD (6-9 y/o)



Improved social competence  
Reduced irritability

(Pan CY, Autism, 2010)

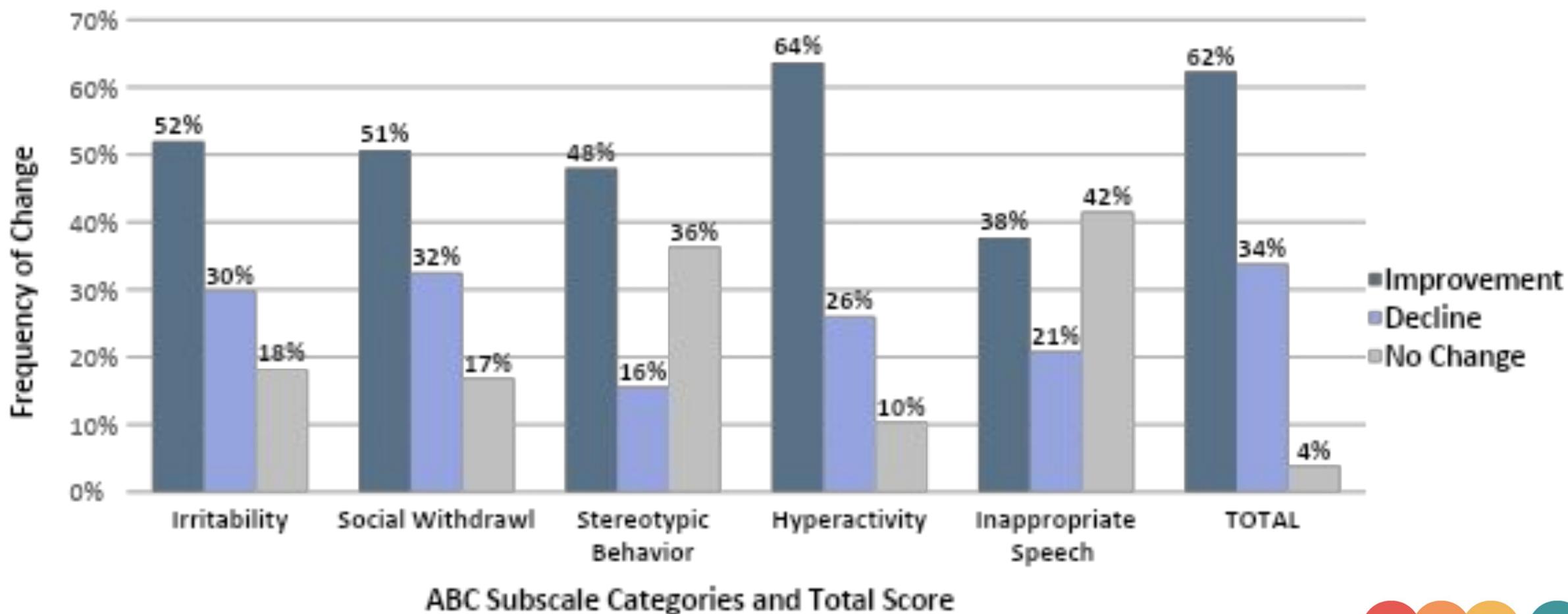
# Benefits of OPA for children with NDDs

**ACEing Autism:** Tennis program adapted for kids with Autism Spectrum Disorder Programs are 6-12 weeks in duration and there are 80 program sites across the US

Standardized Caregiver Questionnaires and Surveys to evaluate program outcomes

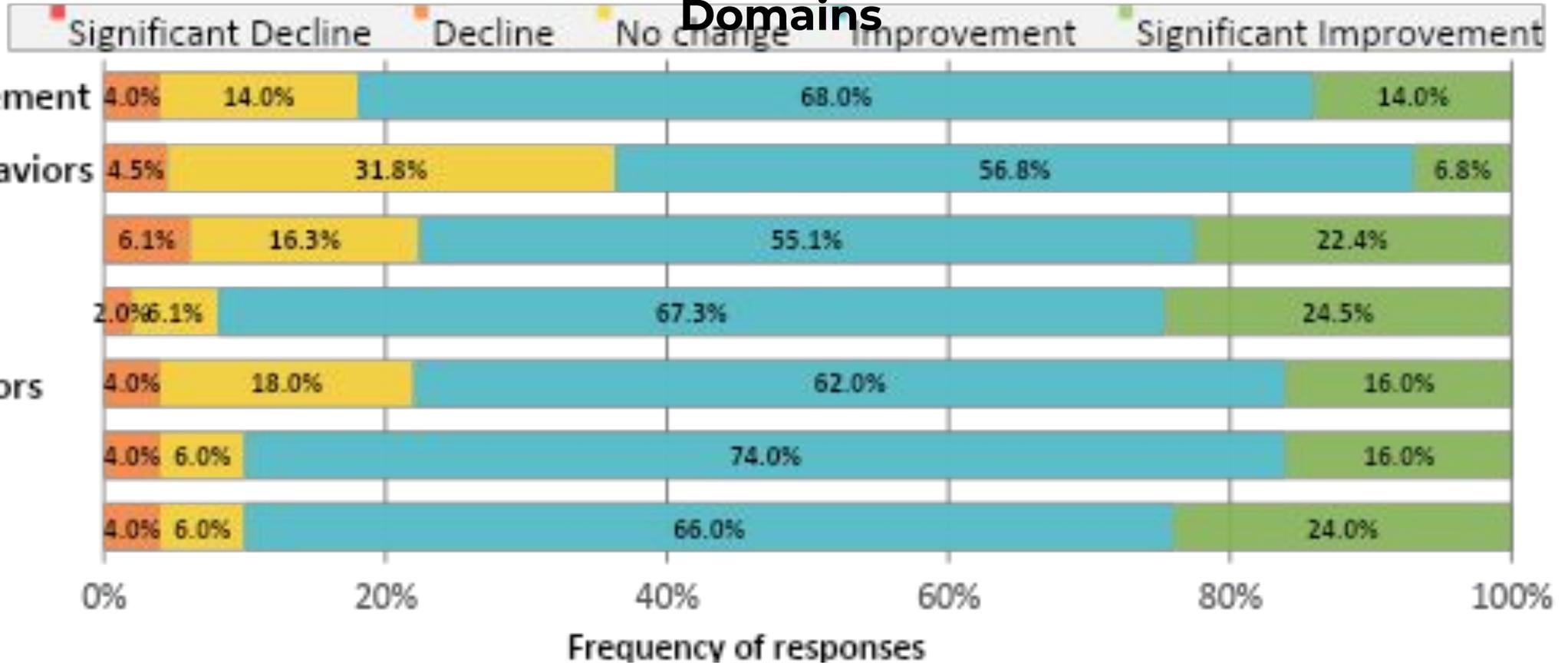


# Aberrant Behavior Checklist (ABC) Results



# Program Survey Represents 60 Sites Across The United States

## Assessment of Change in Developmental Domains



(Wilson, RB, *Pediatrics*, under review)





Emily Coker, DGSOM MS4



## Mission

**Provide an expressive outlet for children with disabilities**

**Foster mentorship and a sense of community among students and volunteers**

**Eliminate the stigma and reduce the challenges associated with disability on the  
UCLA campus and beyond**

## Dance club seeks to provide inclusive, accessible space for kids with disabilities



- Founded at UCLA in 2019
- UCLA Student Run Organization-50 volunteers
- Training in NDDs, disparities in care, benefits of OPA, adapting movement skills
- Served over 150 children in person and over 60 children virtually (nationally)



<https://www.emiucla.org/>



Autism Intervention Research  
Network on Physical Health

<https://airpnetwork.ucla.edu/>

### Study Design: waitlist control

- Active Group: 18, Control Group: 16

### Participants

- 4-17 years of age with a developmental disabilities

### Program

- 1-hour virtual dance classes, 1X/week for 10 weeks

### Measures

- Physical activity engagement and motivation
- Motor skills
- Adaptive skills
- Social communication/Repetitive Behaviors
- Quality of life
- Parental stress



# Clinical Tips and Referral to OPA

- Routine screening for motor impairments in individuals with NDDs
  - Developmental history, DCDQ, MABC checklist
- Referral to programs adapted for children with NDDs, and potentially specific to certain NDDs
- Recommend activities for families that reduce sedentary behaviors
- Help the family create a medical profile for the child (e.g., information on seizures, behavioral difficulties, language level)

## Resources for adapted programs and indoor activity

emiucla.org

Aceingautism.org

<https://teamprimetime.org/>

<https://www.specialolympics.org/school-of-strength>

<https://www.specialolympics.org/our-work/covid19>

# Summary

- Motor dysfunction are a prevalent and pervasive co-occurring condition
- Quantitative + Qualitative tools can improve identification of motor dysfunction in autism
- Routine screening of motor dysfunction is important for overall care
- Motor dysfunction can impact health and physical activity
- Organized physical activity (OPA) can have both motor and non-motor benefits for individuals with ASD
- Routine recommendations of these programs should be considered

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HRSA AIR-P





Autism Intervention Research  
Network on Physical Health

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**[Feedback Survey](#)**



**Thank you for attending!**  
**A link to view the recording will be emailed to all registrants.**

**We hope to see you next month!**

**Tuesday, June 15, 2021**

**4:00 p.m. - 5:00 p.m. ET**

**Zoom webinar**

**Register:**



**AIR-P Presents – Lifestyle Interventions: Moving from the Clinic to the Community**

**By Drs. Candace Gragnani and Priyanka Fernandes**

This webinar will introduce the audience to how Lifestyle and Preventive Medicine approaches health and well-being in the clinical setting. It will walk the audience through the vision of translating the work from a clinical setting to a community-based intervention.