The Effect of Music on Exercise Intensity among Children with Autism Spectrum Disorder: A Pilot Study

Ashley C. Woodman[1], Emily Breviglia[1], Yumiko Mori[2], Rebecca Golden[3], John Maina[2], & Hannah Wisniewski[1]

[1]University of Massachusetts Amherst, Amherst, MA, USA
[2]Boston Higashi School, Randolph, MA, USA
[3]Boston Children's Hospital, Boston, MA, USA

Background

- Children with ASD participate in less physical activity than their peers without ASD.
- Reduced participation in exercise may be due to the motor difficulties commonly observed in youth with ASD, but environmental factors are also likely to play a role.

Impact of Exercise on Well-Being

- Insufficient levels of exercise place children with ASD at risk for physical and mental health problems, including obesity, diabetes, hypertension, and depression.
- Lack of exercise may exacerbate existing sleep and behavioral issues in this population.

Exercise Intensity

- Vigorous-intensity exercise may be more beneficial than moderate-intensity exercise to children with ASD.
- Moderate-intensity exercise raises a child's heart rate to 90-120 beats per minute (BPM), whereas vigorous-intensity exercise may raise a child's heart rate to 130BPM or more.
- Vigorous-intensity exercise has been shown to reduced stereotypic, aggressive, and self-injurious behaviors as well as hyperactivity in children with ASD.

Music and Exercise

- Music may promote engagement, interactive communication and play in children with ASD.
- Music has been shown to motivate typically developing individuals to exercise more intensely, but little is known about the effect of music on exercise intensity among youth with ASD.

Research Questions

1) Do children with ASD jog more vigorously when no music, slow music, or fast music is playing?
2) Is the effect of music condition on exercise intensity moderated by child characteristics (age, gender, body mass index, adaptive behavior, maladaptive behavior, autism symptom severity)?

Participants

- 13 elementary school students between the ages of 5 and 13 years (*M* = 9.31, *SD* = 2.25) from a private school for students with ASD, the Boston Higashi School.
- An ASD diagnosis is required for admission to this school. Students in this school jog daily and are periodically exposed to music while jogging.
- Most participants (*N* = 11) were male.
- All participants had comorbid intellectual disability.

Procedures

- Consent forms were mailed to parents of all children in the elementary school division (*N* = 24). Students were shown a social story to obtain their assent.
- Teachers were consented and asked to complete questionnaires about participating students.
- Data were collected across six days during structured (e.g., verbal and physical prompts) and unstructured (e.g., minimal prompting) exercise periods.
- During these exercise periods, three music conditions were randomized: no music, slow music (60-80BPM), and fast music (144-160BPM).
- Students wore triaxial accelerometers on their waistbands throughout the morning.

Exercise Periods	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Structured (9:30-9:50) Unstructured (10:25-10:45)	Slow Music	Fast Music	No Music	Fast Music	No Music	Slow Music

Measures

- **Demographics:** Gender, age, and body mass index (BMI) were collected from the school's health office.
- **Maladaptive behaviors:** Scales of Independent Behavior-Revised (SIB-R; Bruininks et al., 1996).
- **Adaptive behavior:** Waisman Activities of Daily Living Scale (W-ADL; Maenner et al., 2013).
- **Autism symptom severity**: Autism Spectrum Quotient: Children's Version (AQ-Child; Auyeung et al., 2007).
- **Exercise intensity:** The Omron HJA-750C was placed on students' waistbands each morning of data collection. The accelerometer measures activity in Metabolic Equivalent of Tasks (METs) every 10 seconds. Two outcome variables were created based on data collected from the accelerometers:

a) Average METs during the exercise period

b) The percentage of 10 second intervals spent in vigorous activity (6+ METs)

Descriptive Statistics	M (SD)
Body mass index (BMI)	19.58 (5.84)
Adaptive behavior (W-ADL)	13.83 (5.63)
Maladaptive behavior (SIB-R)	119.08 (10.90)
Autism symptom severity (AQ)	86.62 (12.35)

Results

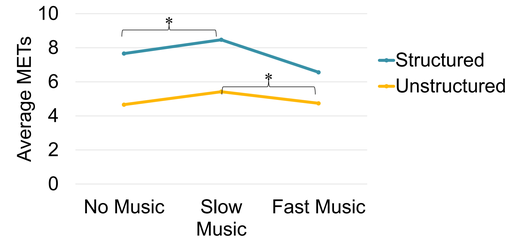
Preliminary Analyses

- Only two students (15%) at BMIs in the obese range.
- The number of minutes spent jogging ranged from 14.83-16.66 minutes (*M* = 15.71, *SD* = 0.70) during the structured exercise period and from 15.00 to 20.00 (*M* = 16.03, *SD* = 2.00) during the unstructured exercise period.
- The average time spent in vigorous-intensity exercise was 16 minutes per day. The number of minutes of jogging did not vary by music condition.

Effect of Music Condition on Exercise Intensity

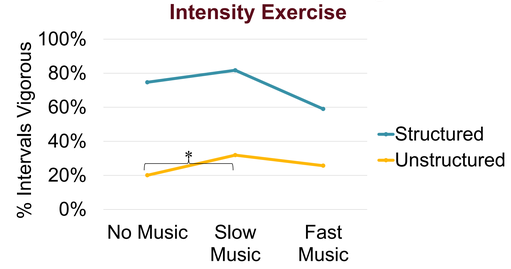
- Average METs were significantly higher in the structured exercise period across all music conditions.
- Levels of vigorous-intensity exercise were significantly higher in the structured exercise period across all music conditions.

Effect of Music Condition on Average METs



- During the **structured** exercise period, average METs was significantly higher in the slow music condition compared to the fast music condition. During the **unstructured** exercise period, average METs was significantly higher in the slow music condition compared to the no music condition.

Effect of Music Condition on Vigorous-Intensity Exercise



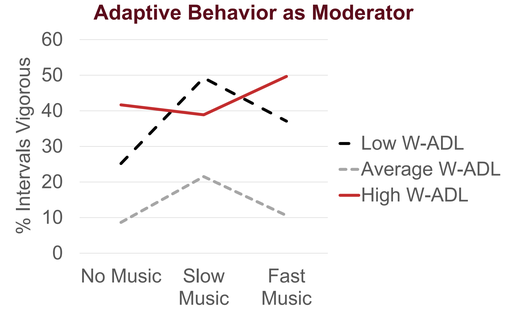
- During the **structured** exercise period, the effect of music condition on vigorous-intensity exercise was approaching significant. During the **unstructured** exercise period, music condition had a main effect on vigorous-intensity exercise.

Results

Child Characteristics

- Child age, gender, BMI, autism symptom severity, maladaptive behavior and adaptive behavior were examined as main effects and potential moderators of the impact of music condition on exercise intensity.
- The effect of music condition on average METs differed by levels of **maladaptive behavior** during the structured and unstructured exercise periods.
- The effect of music condition on vigorous-intensity exercise differed by levels of **adaptive behavior** during the unstructured exercise period.

Adaptive Behavior as Moderator



Discussion

Limitations

- The sample is small and lacks racial/ethnic and gender diversity.
- Fewer obese children in this sample (15%) than would be expected of children with ASD more generally (30%).
- This group of children is accustomed to jogging, so the impact of music on jogging in other populations is unknown.
- Teachers were not blind to the music condition, therefore they may have unintentionally influenced the pace of the students' jogging.

Conclusions

- Music, particularly slow music, may motivate young students with ASD to engage in the levels of vigorous exercise recommended to avoid obesity and other health problems.
- Compared to other interventions for people with ASD, jogging is a low-cost intervention that can be easily implemented in an educational setting.
- Music should be incorporated in physical education programs for youth with ASD, like their typically developing peers.

This study has been published: Woodman, A. C., Breviglia, E., Mori, Y., Golden, R., Maina, J., & Wisniewski, H. (2018). The effect of music on exercise intensity among children with autism spectrum disorder. *Journal of Clinical Medicine,* 7(3), 38.