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Assessing Parent Perceptions of Physical Activity in Families of Toddlers With Neurodevelopmental Disorders: The Parent Perceptions of Physical Activity Scale (PPPAS)

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***Purpose*:** The purpose of this study was to examine a new tool (PPPAS = Parent Perceptions of Physical Activity Scale-Preschool) developed to study parental perceptions of physical activity (PA) among parents of toddler and preschool age children. ***Method*:** 143 children (mean age 31.65 months; 75% male) and their parents were recruited from a neurodevelopmental clinic. Parents completed questionnaires, and both a psychologist and a physician evaluated the children. Eighty-three percent of the children received a diagnosis of Autism Spectrum Disorder; 20% of the children had a BMI > 85th percentile. Analyses were conducted to evaluate the reliability, concurrent validity, discriminant validity, and predictive validity of PPPAS scores. ***Results*:** Results supported a two-factor structure: Perceptions of the Benefits of PA and the Barriers to PA. The internal consistency of scores was good for both PPPAS subscales, derived from the two factors. Parent perceptions of barriers to PA were significantly correlated with delays in overall adaptive functioning, daily living skills, socialization, and motor skills. When a child's motor skills were delayed, parents were less likely to believe PA was beneficial and perceived more barriers to PA. Parent perceptions of barriers to PA predicted parent-reported weekly unstructured PA and ratings of how physically active their child was compared with other children. ***Conclusions*:** We present the PPPAS-Preschool for use in pediatric exercise research and discuss potential applications for the study of parent perceptions of PA in young children.

Keywords: autism spectrum, exercise

It is widely understood that physical activity (PA) is important for child development, yet levels of PA are insufficient for many groups of children (35), particularly children with disabilities who engage in less PA than their typically developing peers (26,27). This disparity has been documented across numerous groups of children with various disabilities. For example, there is evidence that children with Autism Spectrum Disorder (ASD) engage in less PA than their peers (19). Comparisons between children with and without ASD indicate that children with ASD spend more time engaged in sedentary behavior, which has been linked to greater use of screen time and BMI (20). Children with ASD also are less likely to engage in PA regularly, which has been linked to unhealthy weight (21), and demonstrate less physical fitness in the strength domain (22). Among children with ASD, older children engage in reduced PA compared with younger children (16), suggesting that the gap may widen as children grow older. Some results comparing PA in children with and without ASD have been mixed, depending on methodology, with findings of no differences in the amount of time engaged in moderate and vigorous activity as measured by accelerometry as well as findings of children with ASD engaged in less PA as compared with TD

children according to parental reports (2).

Individuals with ASD are not only at greater risk for unhealthy weight, but are so at an earlier age, with children ages two to five at increased risk of being overweight and obese (8). Although predictors of unhealthy weight among individuals with ASD may include multiple factors such as age, ethnicity, parental education levels, social-emotional well-being (8), investigations of patterns of PA may elucidate a potential mechanism to promote well-being in this high risk group.

Parent Beliefs and Children's PA

To address insufficient levels of PA among children with disabilities, it is important to understand the various factors impacting a child's PA. McLeroy, Bibeau, Steckler, & Glanz (17) developed a multidimensional socioecological model of factors that influence PA: intrapersonal, interpersonal, institutional, community, environmental, and public policy. For children with disabilities, challenges related to their disability are intrapersonal factors that will affect their PA. Interpersonal factors influencing PA include social influences, like peer groups or parental influence. Only recently have researchers studied the impact of parent perspectives on PA in children with disabilities (23). Obrusknikova & Miccinello (23) used an online survey and focus groups to identify parent perceptions of the advantages of PA, disadvantages of PA, barriers to PA, and facilitators of PA. Potential benefits of PA were not all widely endorsed by respondents, with only 57% of parents reporting perceived physical benefits, 44% identifying psychosocial benefits, and only 4% identifying cognitive benefits. Perceived disadvantages of PA were primarily psychosocial, with 67% of parents reporting perceived disadvantages in this domain, including teasing and bullying, decreased enjoyment, and decreased self-esteem. Thirty-three percent of respondents also perceived physical disadvantages, such as lack of success in performance of motor activities. Thus, it is clear that there is a need for PA programs that provide positive experiences for children with disabilities and provide parents with education regarding the many physical, social, and cognitive benefits of appropriate PA programs.

Parental beliefs and perceptions have an important role in developing positive health behaviors in children, and prior research has suggested that parental influence on children's PA may be of even greater importance among children with disabilities than among their typically developing (TD) peers (24). Seminal work investigating factors related to changing PA over time among typically developing children found strong links to support for PA from peers, teachers, and parents (22). Among children with special needs, parent and child PA patterns are strongly associated (36), and parental support predicts PA in children with disabilities (29). Recent research demonstrated that parental perceptions of the benefits of PA were associated with PA levels among children with developmental disabilities, with stronger beliefs in the benefits of PA predicting higher rates of children's PA (24). Similarly, a review noted that parents who believed strongly in the benefits of PA, modeled PA, and encouraged/supported PA had children with disability who were more active (30).

Moreover, parental concerns about safety and their child's competence may become barriers to PA (29). Among children with disabilities, prior research (14) has indicated parents may perceive emotional and behavioral dysfunction as a greater barrier to PA than physical or structural difficulties. Must et al. (19) found that parents of children with ASD reported more barriers to PA than parents of TD children, particularly barriers related to their children's need for more supervision and trained care providers and social issues including exclusion by other children. In addition, they found that barriers to PA were related to parent-reported levels of a child's PA and increased screen time in children with ASD.

Fully understanding the various factors that impact a child's engagement in PA is an important step toward developing strategies to increase PA in children with disabilities (30). Researchers have noted that efforts should be made to understand parents' beliefs about the benefits of PA (21) and to study the impact of education on parents' beliefs, and thereby, children's PA (24,29). To accomplish this, a robust measure of parents' perceptions is needed. Prior research studies in this area have used qualitative methods (e.g., focus groups) and author-

developed surveys. However, there is a need for a validated measure that could be easily used across studies. To address this need, we developed pilot items for a parent questionnaire. The Parent Perceptions of Physical Activity Scale (PPPAS-Preschool) was based on 40 pilot items (see Appendix) developed by researchers at the UC Irvine Pediatric Exercise and Genomics Research Center (PERC: www.perc.uci.edu), which were adapted from an unpublished infant version of the questionnaire. These items were generated to measure parent perceptions of the benefits of PA, barriers to PA, and their ability to influence PA in their children. We administered the questionnaire in a sample of parents of children with neurodevelopmental disabilities for several reasons. First, as prior research has clearly indicated that children with ASD and other disabilities are less likely to participate in the recommended levels of PA, we developed the questionnaire particularly for research with children who may be less likely to participate in PA due to developmental challenges or disability. We did not restrict the sample to children only with an ASD diagnosis because prior research has shown that restricted variance in a sample will reduce reliability coefficients, and, therefore, psychometric studies benefit from some heterogeneity in samples (12). Thus, the current study was designed to address the following research questions and hypotheses in a sample of parents who had toddlers/preschoolers with neurodevelopmental disorders, including but not limited to ASD:

1. Will the pilot items load on the predicted subscales? We predicted that the items would load on the predicted subscales and also expected that we could reduce the number of items to create a scale of manageable length.
2. Do the PPPAS-Preschool scales produce scores with sufficient internal consistency? We predicted that the scales would demonstrate at least good internal consistency, as evidenced by an alpha of > .80. A matrix for estimating adequacy of internal consistency coefficients provided by Ponterotto & Ruckdeschel (25) indicated that an alpha of > .80 for a scale with 7–11 items and a sample size of 100–300 would be considered "good."
3. Is there evidence of concurrent validity? In prior research (23), parents of children with ASD have indicated that barriers to PA included a child's motor, social, and communication difficulties. Thus, we predicted that greater parent reports of barriers to PA would be significantly correlated with parent reports of overall child adaptive functioning, specifically in the domains of communication, daily living skills, socialization, and motor skills. We predicted that greater parent perceptions of the benefits of PA would be significantly correlated with greater child motor skills.
4. Is there evidence of divergent validity? We predicted that parent perceptions of their influence on PA and the benefits of PA would not be significantly correlated with domains of child communication, daily living skills, and socialization.
5. Is there evidence of predictive validity? We predicted that parents who report fewer barriers to PA would also report higher levels of PA in their children and would view their children as similarly active when compared with other children their age.

Methods

Participants and Procedures

This study was approved by a University Institutional Review Board. Parents of 143 children on a waiting list for a diagnostic evaluation at a university neurodevelopmental clinic provided written informed consent for participation in the study. Families attended three visits; two visits involved data collection via parental questionnaires and semistructured child assessments conducted by a developmental or licensed psychologist. At the third visit, participants had a clinical evaluation at the university specialty clinic; clinical evaluations were conducted by either a board-certified developmental behavioral pediatrician or a board-certified pediatric neurologist.

Measures

Demographic Questionnaire. Parents completed a demographic questionnaire with items inquiring about child age, ethnicity, race, relationship to child, household income, and parent education.

Parent Perceptions of Physical Activity Scale— Preschool Version (PPPAS). The 40 pilot items (see appendix) required approximately 15 min to complete. The items were developed to assess parent perceptions of their influence on their child's PA (6 items), as well as perceived benefits of (19 items) and barriers to (15 items) PA, using a 4-point Likert scale with responses ranging from Strongly Disagree to Strongly Agree.

Vineland Adaptive Behavior Scales, Second Edition (Vineland-II). The Vineland-II (31) was used to evaluate children's adaptive skills including communication, daily living skills, socialization, and motor skills. Standard scores are provided for each subscale and the overall scale.

Parent-Reported PA. On an unpublished study questionnaire designed to capture data on current physical activity and sports participation, we asked parents two questions related to the current study. First, parents were asked, "Over the past 3 months, about how much time has your child spent participating in unstructured physical activity (e.g., riding trikes or bikes, playground activity) per week?" Parents had four response options: less than 1 hr, 2–4 hr, 5–7 hr, or more than 7 hr. We also asked parents, "Compared to other children of the same age, how physically active is your child in his/her current free time outside of organized (scheduled) sports?" Parents selected one of four responses: "a lot less active," "slightly less active," "slightly more active," or "a lot more active."

BMI. Children's body mass index (BMI) was obtained using the recorded height and weight data from their study physician evaluation. BMI percentile and weight status category were calculated using the Centers for Disease Control and Prevention's (CDC) BMI-for-age growth charts (4).

Analyses

SPSS 23 was used to conduct all analyses. During informed consent, parents were told that they could skip any study procedure or item if they chose to do so. Therefore, some data were missing at random due to nonresponse (i.e., a parent chose to skip a question). Missing data were not replaced. Thus, we analyzed complete data only, and *n*'s for some analyses varied (ranging from 118 to 143, or 83–100% of the sample) and are reported in table notes.

We conducted principal components analysis (PCA), which has been shown to be robust in research with assessment instruments used to gather Likert scale data and is recommended when data reduction is a goal (6). Cronbach's alpha was used to evaluate the internal consistency of each of the PPPAS subscales. The Shapiro-Wilk test of normality was used to evaluate scale distributions. Spearman's Rho correlations were computed to address the concurrent and discriminant validity hypotheses. Regression analyses were conducted to examine the predictive validity of parent perceptions of barriers to PA. For correlations and regressions, the significance value selected was $p < .05$.

Results

Demographic Characteristics

Table 1 presents participant characteristics (N = 143; 75% male). Eighty-three percent of the children received a physician diagnosis of ASD, with the remaining children receiving a variety of neurodevelopmental diagnoses (e.g., global developmental delay, disruptive behavior disorder). Twenty percent of participants were overweight or obese (BMI percentile > 85%).

Principal Components Analysis

We ran a principal components analysis (PCA) on the 40 items generated for the PPPAS-Preschool. Before analysis, we assessed the suitability of PCA for our data. An inspection of the correlation matrix revealed that all variables had at least one correlation coefficient greater than 0.3. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.87. Bartlett's test of sphericity was significant ($p < .001$), indicating that the data were likely factorizable. The first PCA revealed eight components that had eigenvalues greater than 1, which explained 37.39%, 9.30%, 5.66%, 5.11%, 4.69%, 3.41%, 2.79%, and 2.69% of the variance, respectively. These values suggested two primary components. In addition, visual inspection of the scree plot supported retention of two components plotted before the inflection point. A two-component solution met the criterion for interpretability. Four items had weak loadings (less than .40) and were removed (see Table 2 note). Subsequently, PCA was rerun without the four items (i.e., with 36 total items), yielding similar results that also supported retention of two components. [Seven components with eigenvalues > 1 explained 39.25%, 10.40%, 5.86%, 5.10%, 4.46%, 3.43%, and 2.84% of the variance, respectively. The scree plot and interpretability criterion suggested retention of the first two components.]

Table 1 Participant and Respondent Characteristics

Characteristics	Mean (Standard Deviation)
Child's age in months	31.65 (4.39)
Child's BMI percentile	54.9 (30.83)
	Percentage
Female	25%
Male	75%
Hispanic	35%
Race	
White	45%
Black	1%
Asian	23%
Samoan/Pacific Islander	2%
Other/decline to state	4%
Respondent relationship to child	
Biological mother	81%
Adoptive or foster mother	4%
Biological father	14%
Other	1%
Annual household income ($)	
<30,000	23%
30,000–50,000	9%
50,000–75,000	19%
75,000–99,999	18%
>100,000	22%
Respondent education level	
less than a bachelor's degree	47%
bachelor's degree or greater	53%

Therefore, PCA was rerun on the 36 items with fixed factors set to two. This two-component solution explained 49.66% of the total variance (the two components explained 39.25% and 10.40% of the variance, respectively). A Varimax orthogonal rotation was used to help with interpretability. The rotated solution exhibited a "simple structure" (34). Interpretation of the data were consistent with the categories the questionnaire was designed to measure, with strong loadings of opinions regarding the benefit of PA on Component 1 and beliefs related to perceived barriers to PA on Component 2. However, perceptions of parental influence on child's PA loaded on Component 1 (see Table 2), rather than remaining an independent factor. Thus, these two components were used to create two PPPAS subscales: Beliefs in the Benefits of PA and Perceptions of Barriers to PA. In prior experience with the PPPAS, parental influence was identified as a third component; however, in this study, items addressing one's ability to influence PA and beliefs in the value of PA loaded on a single factor. Therefore, we used the two components to develop two, rather than three, subscales for the PPPAS-Preschool.

Abbreviated Scale

In measurement development, practicality of assessment is an important consideration. Researchers often prefer shorter scales, when a fewer number of items can achieve the same results in terms of the reliability and validity of scores. Thus, we reviewed PCA and reliability results to remove items when doing so would not reduce reliability below the desired threshold (> .80). This process yielded a 27-item scale (see Figure 1), with two subscales: Barriers to PA (9 items) and Benefits of PA (18 items). After removing items, reliability coefficients were reduced from .96 (24 items) to .95 (18 items) for the Benefits scale and from .84 (12 items) to .81 (9 items) for the Barriers scale.

We conducted PCA for the revised 27-item scale. PCA revealed five components that had eigenvalues greater than 1, which explained 41.13%, 12.09%, 7.93%, 5.75%, and 5.03% of the variance, respectively. Visual inspection of the scree plot supported retention of two components; a two-component solution met the criterion for interpretability. However, two items with sufficient loadings in prior analyses failed to meet the cutoff (.40) in this analysis (items #32 and #29 with loadings of .385 and .383, respectively). The two-component solution for the 27-item scale explained 53.22% of the total variance (the two components explained 39.25% and 10.40% of the variance, respectively).

Subsequently, we conducted PCA for a revised 25-item scale that eliminated the two items with low loadings in the prior analysis. The two-component solution for the 25-item scale explained 55.30% of the total variance (the two components explained 42.76% and 12.55% of the variance, respectively). A Varimax orthogonal rotation was used to help with interpretability. The rotated solution exhibited a "simple structure" (21). Interpretation of the data were consistent with the categories the questionnaire was designed to measure, with strong loadings of opinions regarding the benefit of PA on Component 1 and beliefs related to perceived barriers to PA on Component 2. Results for this final PCA are presented in Table 3.

Descriptive Statistics and Internal Consistency Coefficients

All subsequent analyses were conducted using the abbreviated scale, with 25 total items (18 for the Benefits scale, and 7 for the Barriers scale; see Figure 1). The internal consistency coefficients were good or excellent (25,28) for the subscales of the final 25-item PPPAS (see Table 4). As noted previously, a matrix for estimating adequacy of internal consistency coefficients provided by Ponterotto & Ruckdeschel (25) indicated that an alpha of > .80 for a scale with 7–11 items and a sample size of 100–300 would be considered "good."

Concurrent and Discriminant Validity of Scores

Consistent with our predictions, parent perceptions of barriers to PA were significantly correlated with parent reports of impairments in overall adaptive functioning and specifically in the domains of daily living skills, socialization, and motor skills (see Table 4). Thus, parents perceived fewer barriers to PA when their children were rated as having higher functioning in these areas. Moreover, as we hypothesized, a child's motor functioning was significantly correlated with parent perceptions of the benefits of PA, and perceptions of barriers to PA. Parents were more likely to believe PA was beneficial (i.e., had a higher Benefits score) and perceived fewer barriers to PA (i.e., had a lower Barriers score) when their child's motor skills were rated as better developed. Our discriminant validity hypotheses were also supported. Parent perceptions of their ability to influence their child's level of PA and their perceptions of the benefits of PA were not significantly correlated with parent reports of child communication, daily living skills, socialization, and overall adaptive functioning.

Predictive Validity

Regression analyses were conducted to examine the predictive validity of parent perceptions of barriers to PA. Durbin-Watson statistics (2.185 and 2.431 for the first and second regressions, respectively) indicated that there was independence of residuals. No outliers were observed. A visual inspection of the plot of standardized residuals versus standardized predicted values indicated that there was homoscedasticity. Residuals were also normally distributed for both analyses, per a visual inspection of the normal probability plots. Parent perceptions of barriers to PA significantly predicted parent-reported weekly unstructured PA, $R^2 = .05$, F (1, 100) = 5.313, $p < .05$. When parents perceived fewer barriers to PA, they reported a greater number of hours per week of PA. Parent perceptions of barriers to PA also significantly predicted parent reports of how physically active their child was compared with other children, $R^2 = .04$, F (1, 118) = 5.033, $p < .05$.

Table 2 Principal Components Analysis

Item	Component 1	Component 2	Communalities
My child's physical endurance is improved by encouraging him/her to be active (27).	.881	-.147	.799
Physical activity in childhood will make my child healthier (36).	.850	-.135	.741
Increasing activity increases my child's level of physical fitness (20).	.829	-.107	.698
Activity improves functioning of my child's cardiovascular system (21).	.789	-.112	.636
My child will live longer if I encourage him/her to be an active child (26).	.788	-.163	.647
Physical activity increases my child's mental alertness (30).	.781	-.189	.645
My exercise habits will strongly impact the exercise habits that my child will develop over the course of his/her life (1). [b]	.776	-.167	.630
Physical activity improves my child's flexibility (24).	.764	-.214	.630
Physical activity increases my child's muscle strength (16).	.759	-.176	.606
My child has improved feelings of well being from physical activity (22).	.758	-.172	.604
I will improve future health by encouraging physical activity in my child (5).	.733	-.143	.558
My attitudes about exercise will strongly impact my child's attitude toward exercise over the course of his/her life (2). [b]	.721	-.065	.524
Physical activity is good entertainment for my child (33).	.720	-.152	.542
Physical activity gives my child a sense of personal accomplishment (17).	.708	-.211	.547
Physical activity improves overall body functioning for my child (35).	.699	-.099	.499
How much I value exercise will impact how active my child is (3). [b]	.695	-.034	.484
Exercising helps my child sleep better at night (25).	.693	-.109	.492
My child feels proud when doing physical activity (28). [a]	.688	-.244	.533
Encouraging my child to be active will let me have contact with my child (18). [a]	.687	.043	.474
My child will learn exercise habits through watching my example (4). [b]	.685	-.089	.477
Physical activity allows my child to carry out normal activities without becoming tired (31). [a]	.679	-.102	.471
Physical activity improves my child's mental health (14). [a]	.609	-.149	.393
Physical activity now will keep my child from having weight problems in the future (19). [a]	.608	-.081	.376
I plan to encourage physical activity when my child is in elementary school (6). [a]	.462	-.093	.222
I worry that my child will not be accepted by others if s/he participates in a group sport or activity program. (39)	-.039	.724	.525
I worry that participating in physical activities or sports will be a bad experience for my child. (40)	-.039	.692	.480
I am worried about my child's ability to participate in sports or physical activities (12).	.112	.683	.480
My child is not able to participate in group physical activity or sports programs. (38)	.045	.653	.429
Physical activity will make my child frustrated (9).	-.241	.651	.481
I am scared that physical activity will lead to disappointment for my child (11).	-.264	.622	.457
I am scared that physical activity will be harmful for my child (10).	-.261	.535	.354
My family members do not encourage me to do physical activity with my child (29).	-.121	.532	.298

(continued)

Table 2 *(continued)*

Item	Component 1	Component 2	Communalities
Encouraging my child to be active will take too much time from my family responsibilities (32).	-.189	.527	.314
My child is not strong enough for physical activity. (37)[a]	-.295	.498	.335
Physical activity is hard work for my child (34). [a]	-.009	.493	.243
Encouraging children to do physical activity takes too much time (15). [a]	-.162	.476	.253

Note. Four items from the piloted list (see Appendix items numbered 7, 8, 13, and 23) are not included in the table as they had factor loadings of less than .40 in initial PCA. [a] Item was eliminated from final scale to further reduce the length of the scale. [b] In this study, the item loaded on one of two components, but these items have formed a third component/subscale in prior research with parents of infants (Parental Influence on PA).

Table 3a PCA for 25-Item PPPAS-Preschool

Rotated Component Matrixa	Component 1	Component 2	Communalities
My child's physical endurance is improved by encouraging him/her to be active (27).	.891	-.087	.802
Physical activity in childhood will make my child healthier (36).	.869	-.080	.761
Increasing activity increases my child's level of physical fitness (20).	.839	-.082	.711
My child will live longer if I encourage him/her to be an active child (26).	.805	-.092	.657
Activity improves functioning of my child's cardiovascular system (21).	.799	-.090	.647
Physical activity increases my child's mental alertness (30).	.784	-.132	.632
Physical activity improves my child's flexibility (24).	.755	-.220	.619
My child has improved feelings of well-being from physical activity (22).	.747	-.189	.593
Physical activity is good entertainment for my child (33).	.741	-.071	.554
Physical activity improves overall body functioning for my child (35).	.708	-.080	.508
Physical activity gives my child a sense of personal accomplishment (17).	.706	-.184	.532
Exercising helps my child sleep better at night (25).	.703	-.099	.503
My exercise habits will strongly impact the exercise habits that my child will develop over the course of his/her life (1).	.691	-.164	.505
I will improve future health by encouraging physical activity in my child (5).	.666	-.133	.462
Physical activity increases my child's muscle strength (16).	.663	-.071	.445
My child will learn exercise habits through watching my example (4).	.612	-.081	.381
How much I value exercise will impact how active my child is (3).	.611	-.047	.375
My attitudes about exercise will strongly impact my child's attitude toward exercise over the course of his/her life (2).	.609	-.098	.380
I worry that my child will not be accepted by others if s/he participates in a group sport or activity program. (39)	-.067	.824	.684
I am worried about my child's ability to participate in sports or physical activities (12).	.074	.811	.664
I worry that participating in physical activities or sports will be a bad experience for my child. (40)	-.046	.789	.624
My child is not able to participate in group physical activity or sports programs. (38)	.034	.719	.518
Physical activity will make my child frustrated (9).	-.306	.624	.483
I am scared that physical activity will lead to disappointment for my child (11).	-.323	.606	.472
I am scared that physical activity will be harmful for my child (10).	-.307	.468	.313

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Table 3b Descriptive Statistics and Internal Consistency Coefficients for 25-item PPPAS

Subscale	Cronbach's alpha	Median	Mean (SD)	Skewness (SE)	Kurtosis (SE)	W	*p*
Barriers to PA (7 items)	.83	1.71	1.73 (0.55)	0.35 (0.21)	-0.55 (0.42)	.94	.00
Benefits of PA (18 items)	.95	3.69	3.56 (0.42)	-0.42 (0.22)	-1.44 (0.44)	.85	.00

Note. N's range from 118 to 130 due to missing data.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My exercise habits will strongly impact the exercise habits that my child will develop over the course of his/her life.				
2. I am scared that physical activity will be harmful for my child.				
3. My child will learn exercise habits through watching my example.				
4. I worry that participating in physical activities or sports will be a bad experience for my child.				
5. Activity improves functioning of my child's cardiovascular system.				
6. I am worried about my child's ability to participate in sports or physical activities.				
7. Physical activity increases my child's mental alertness.				
8. Increasing activity increases my child's level of physical fitness.				
9. Physical activity will make my child frustrated.				
10. Physical activity increases my child's muscle strength.				
11. Exercising helps my child sleep better at night.				
12. My child's physical endurance is improved by encouraging him/her to be active.				
13. Physical activity improves my child's flexibility.				
14. My attitudes about exercise will strongly impact my child's attitude towards exercise over the course of his/her life.				
15. My child is not able to participate in group physical activity or sports programs.				
16. I am scared that physical activity will lead to disappointment for my child.				
17. My child has improved feelings of well-being from physical activity.				
18. Physical activity gives my child a sense of personal accomplishment.				
19. I will improve future health by encouraging physical activity in my child.				
20. Physical activity in childhood will make my child healthier.				
21. My child will live longer if I encourage him/her to be an active child.				
22. Physical activity is good entertainment for my child.				
23. How much I value exercise will impact how active my child is.				
24. Physical activity improves overall body functioning for my child.				
25. I worry that my child will not be accepted by others if he/she participates in a group sport or activity program.				

Figure 1 — The PPPAS-Preschool. Note: Average items 1, 3, 5, 7, 8, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24 for the Benefits subscale; and items 2, 4, 6, 9, 16, 15, 25 for the Barriers subscale.

Table 3b Descriptive Statistics and Internal Consistency Coefficients for 25-item PPPAS

Subscale	Cronbach's alpha	Median	Mean (SD)	Skewness (SE)	Kurtosis (SE)	W	*p*
Barriers to PA (7 items)	.83	1.71	1.73 (0.55)	0.35 (0.21)	-0.55 (0.42)	.94	.00
Benefits of PA (18 items)	.95	3.69	3.56 (0.42)	-0.42 (0.22)	-1.44 (0.44)	.85	.00

Note. N's range from 118 to 130 due to missing data.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My exercise habits will strongly impact the exercise habits that my child will develop over the course of his/her life.				
2. I am scared that physical activity will be harmful for my child.				
3. My child will learn exercise habits through watching my example.				
4. I worry that participating in physical activities or sports will be a bad experience for my child.				
5. Activity improves functioning of my child's cardiovascular system.				
6. I am worried about my child's ability to participate in sports or physical activities.				
7. Physical activity increases my child's mental alertness.				
8. Increasing activity increases my child's level of physical fitness.				
9. Physical activity will make my child frustrated.				
10. Physical activity increases my child's muscle strength.				
11. Exercising helps my child sleep better at night.				
12. My child's physical endurance is improved by encouraging him/her to be active.				
13. Physical activity improves my child's flexibility.				
14. My attitudes about exercise will strongly impact my child's attitude towards exercise over the course of his/her life.				
15. My child is not able to participate in group physical activity or sports programs.				
16. I am scared that physical activity will lead to disappointment for my child.				
17. My child has improved feelings of well-being from physical activity.				
18. Physical activity gives my child a sense of personal accomplishment.				
19. I will improve future health by encouraging physical activity in my child.				
20. Physical activity in childhood will make my child healthier.				
21. My child will live longer if I encourage him/her to be an active child.				
22. Physical activity is good entertainment for my child.				
23. How much I value exercise will impact how active my child is.				
24. Physical activity improves overall body functioning for my child.				
25. I worry that my child will not be accepted by others if he/she participates in a group sport or activity program.				

Figure 1 — The PPPAS-Preschool. Note: Average items 1, 3, 5, 7, 8, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24 for the Benefits subscale; and items 2, 4, 6, 9, 16, 15, 25 for the Barriers subscale.

Discussion

Our research resulted in a 25-item parent questionnaire (PPPAS-Preschool) that generated two subscales: parent perceptions of the Benefits of PA and Barriers to PA. Although in prior work with infants the scale also produced a third subscale, Parent Influence on PA, in the current study these items loaded strongly on the Benefits of PA scale, suggesting that at least among parents in this sample, parent endorsement of beliefs in their ability to influence PA were strongly correlated with their beliefs in the benefits of PA. Results from this study indicate that scores produced by the PPPAS-Preschool in a sample of toddlers with neurodevelopmental disorders had good internal consistency as well as sufficient concurrent, discriminant, and predictive validity.

Table 4 Validity Analyses: Spearman's Rho Correlation Coefficients

Subscale	Correlation Coefficients					
	1	2	3	4	5	6
1. Benefits of PA (PPPAS)						
2. Barriers to PA (PPPAS)	-.34**					
3. Communication (V)	.00	-.21*				
4. Daily Living Skills (V)	.08	-.35**	.61**			
5. Socialization (V)	.11	-.39**	.66**	.72**		
6. Motor Skills (V)	.20*	-.32**	.31**	.52**	.50**	
7. Adaptive Behavior (V)	.10	-.40**	.78**	.84**	.89**	.71**

Note. PPPAS = the Parent Perceptions of Physical Activity Scale. V = the Vineland.

N = 143; some correlations had slightly smaller n's (the range in n's was 119–143) due to missing data (items on a scale without responses). *p<.05.

**p<.01

Parent Perceptions of Benefits of PA

Awareness of the many benefits of PA is growing, and research in this area has begun to address benefits for children with specific disabilities. In addition to physical benefits, benefits of PA among children with ASD include a reduction in maladaptive behaviors and promotion of positive behaviors (13). Benefits of PA for children with ASD also have been reported in behavioral and cognitive domains. PA has been linked to reduction in maladaptive behaviors such as stereotypy, aggression, and elopement (13) and improvements in attention (e.g., on-task behavior), academic responding, and inhibitory and memory functions (13,33). Thus, there are many benefits to increasing PA in children with ASD. There will likely continue to be a growing need for PA intervention programs for children with ASD and other neurodevelopmental disorders.

Parent Perceptions of Barriers to PA

Our findings were consistent with prior research in which parents of children with neurodevelopmental disorders like ASD reported significantly greater barriers to PA for their children compared with parents of TD children (20). Parental perceived barriers to PA among children with neurodevelopmental disorders include personal barriers (e.g., children's lack of knowledge and skills, children's preferences for activities), social barriers (e.g., parental concerns or behaviors such as about safety, or time, or financial constraints), environmental barriers (e.g., suboptimal facilities, lack of transportation), or policy barriers (e.g., lack of appropriate programs, staff capacity) (30). Specifically, among children with ASD, parental perceived barriers are similar and include concerns regarding adults lacking skills for appropriate inclusion of their children and peer relations (e.g., children having few friends and social exclusion) (20). In our study, parents perceived more barriers to PA when their children had lower scores in the domains

of daily living skills, socialization, motor functioning, and adaptive behavior.

Limitations

This study's sample was comprised of primarily young children with ASD, and if using the PPPAS with other populations (such as typically developing toddlers and preschoolers) the factor structure, reliability, and validity should be further investigated as recommended by the Standards for Educational and Psychological Testing (1). Moreover, there was likely a recall bias among parents when reporting PA that could have affected measurement in this study. Further examination of multimethod approaches that compare the PPPAS-Preschool results to objective data gathered from actigraphs or accelerometers may help to elucidate similarities and differences across methodologies. Another limitation of the current study was related to missing data, as some parents did not respond to all items on a questionnaire, reducing the *n* for certain analyses. However, missing data were minimal, and each analysis included at least 83% or more of the full sample.

Potential Applications

A majority of parents of children with ASD (74%) seek complementary and alternative (CAM) medicine treatment approaches primarily due to concerns with safety and side effects of prescribed medications (7). In a recent review of CAM, Lofthouse, Hendren, Hurt, Arnold, &

Butter (15) concluded that PA met the criteria of being sensible, cheap, safe, and easy and promoted it as "acceptable" for children with ASD. The American College of Sports Medicine (ACSM) Position Stand (5) highlights the evidence supporting the link between PA and both cognition and academic achievement. Although the ACSM does not have a specific PA guidelines for children with ASD, Srinivasan, Pescatello, & Bhat (32) recommend exercise programs combining components of aerobic (e.g., walking/running, swimming), resistance (e.g., jumping, climbing), flexibility and neuromuscular training (e.g., stretching, therapeutic horseback riding, yoga) toward enhancing fitness and body composition. Thus, the development and study of PA intervention programs for children with ASD is an important research priority.

Early PA intervention efforts for children with ASD and other disabilities may be supported by the use of the PPPAS-Preschool; for example, parental perceptions of barriers to PA for their children may be systematically examined and used to inform nonpharmacological treatment planning that includes PA. Identification of parent-perceived barriers to PA would help program developers identify concerns that could be addressed through the program, such as programmatic modifications to increase accessibility for children and education for parents regarding the benefits of PA for their child's health and development. The PPPAS-Preschool could also be used in research to study changes in parent perceptions following intervention or parent education and could be used to design PA protocols that address accessibility for children with neurodevelopmental disorders. Future research should examine its utility as both an outcome measure and as a predictor of parent behavior.

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Appendix. PPPAS—Toddler/Preschooler Version: Pilot Items and Hypothesized Subscales

1. My exercise habits will strongly impact the exercise habits that my child will develop over the course of his/her life. (Influence)
2. My attitudes about exercise will strongly impact my child's attitude toward exercise over the course of his/her life. (Influence)
3. How much I value exercise will impact how active my child is. (Influence)
4. My child will learn exercise habits through watching my example. (Influence)
5. I will improve future health by encouraging physical activity in my child. (Influence)
6. I plan to encourage physical activity when my child is in elementary school. (Influence)
7. I should try to decrease physical activity in my child. (Barriers)
8. It is dangerous for my child to be physically active. (Barriers)
9. Physical activity will make my child frustrated. (Barriers)
10. I am scared that physical activity will be harmful for my child. (Barriers)
11. I am scared that physical activity will lead to disappointment for my child. (Barriers)
12. I am worried about my child's ability to participate in sports or physical activities. (Barriers)
13. My child enjoys physical activity. (Benefits)
14. Physical activity improves my child's mental health. (Benefits)
15. Encouraging children to do physical activity takes too much time. (Barriers)
16. Physical activity increases my child's muscle strength. (Benefits)
17. Physical activity gives my child a sense of personal accomplishment. (Benefits)
18. Encouraging my child to be active will let me have contact with my child. (Benefits)
19. Physical activity now will keep my child from having weight problems in the future. (Benefits)
20. Increasing activity increases my child's level of physical fitness. (Benefits)
21. Activity improves functioning of my child's cardiovascular system. (Benefits)
22. My child has improved feelings of well-being from physical activity. (Benefits)
23. My spouse (or significant other) does not encourage physical activity. (Barriers)
24. Physical activity improves my child's flexibility. (Benefits)
25. Exercising helps my child sleep better at night. (Benefits)
26. My child will live longer if I encourage him/her to be an active child. (Benefits)
27. My child's physical endurance is improved by encouraging him/her to be active. (Benefits)
28. My child feels proud when doing physical activity. (Benefits)
29. My family members do not encourage me to do physical activity with my child. (Barriers)
30. Physical activity increases my child's mental alertness. (Benefits)
31. Physical activity allows my child to carry out normal activities without becoming tired. (Benefits)
32. Encouraging my child to be active will take too much time from my family responsibilities. (Barriers)
33. Physical activity is good entertainment for my child. (Benefits)
34. Physical activity is hard work for my child. (Barriers)
35. Physical activity improves overall body functioning for my child. (Benefits)
36. Physical activity in childhood will make my child healthier. (Benefits)
37. My child is not strong enough for physical activity. (Barriers)
38. My child is not able to participate in group physical activity or sports programs. (Barriers)

39. I worry that my child will not be accepted by others if he/she participates in a group sport or activity program. (Barriers)
40. I worry that participating in physical activities or sports will be a bad experience for my child. (Barriers)

Note. The three hypothesized subscales were: Impact of Parental Influence, Benefits of Physical Activity, Barriers to Physical Activity. For each item, parents were asked to rate their agreement using a Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree).