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Ability of Ages and Stages Questionaire 3rd Edition to Identify Children in Need of Comprehensive Motor Evaluation

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ABILITY OF AGES AND STAGES QUESTIONNAIRE 3RD EDITION TO

IDENTIFY CHILDREN IN NEED OF COMPREHENSIVE

MOTOR EVALUATION

By

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A doctoral project submitted in partial fulfillment

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THE GRADUATE COLLEGE

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Courtney Michele Carmichael, Elizabeth Ann Willison, and Qing Zhang

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ABSTRACT

PURPOSE: The Ages and Stages Questionnaire Third Edition (ASQ-3) is a widely used screening tool designed to identify children who need comprehensive developmental assessment. Its accuracy for identifying children in need of additional motor assessment has not been determined. The purposes of this study were to establish concurrent validity between ASQ-3 gross motor (GM) and fine motor (FM) scores and their corresponding Peabody Developmental Motor Scales Second Edition (PDMS-2) quotients, and to examine the diagnostic accuracy of the ASQ-3 using the PDMS-2 as a gold standard reference test.

MATERIALS/METHODS: This was a secondary analysis of a previous study in which both ASQ-3 and PDMS-2 data were collected, and ASQ-3 data were not analyzed. The sample included 27 children aged 18 to 59 months (mean=41.52 months) with and without known disabilities. The Pearson Correlation Coefficient was used to examine relationships between ASQ-3 GM and FM scores and their corresponding PDMS-2 motor quotients. Diagnostic accuracy was calculated for the ASQ-3 GM and FM scores compared to the PDMS-2 gross motor quotient (GMQ) and fine motor quotient (FMQ). Contingency tables (2x2) were used to calculate sensitivity (SN), specificity (SP), positive and negative predictive values (PPV/NPV), and positive and negative likelihood ratios (PLR/NLR). All values were calculated using one and two standard deviations (1SD/2SD) below the norm as a construct for delay, as eligibility requirements vary across states.

RESULTS: There were no significant correlations between ASQ-3 scores and PDMS-2 scores. The ASQ-3 was found to have high SP in identifying children who need further

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motor testing (SP for GM = 0.91; SP for FM = 0.96). ASQ-3 also showed low sensitivity (SN=0) for identifying children in need of further testing for gross and fine motor delay. Predictive values for GM were as follows: PPV at 1 and 2SD = 0, NPV at 1SD = 0.84, NPV at 2SD = 0.92. Predictive values for 1 and 2SD FM were as follows: PPV = 0.5 and NPV = 0.96. Likelihood ratios for GM were as follows: at 1SD PLR = 0, NLR = 1.10; at 2SD PLR = 0, NLR = 1.09. Likelihood ratios for FM were as follows: at 1SD and 2SD PLR = 12.5, NLR = 0.52.

CONCLUSION: The ASQ-3 performed best for correctly identifying children in need of further assessment of fine motor skills, since children who scored below the ASQ-3 FM cutoff also scored below norms on the PDMS-2 FMQ. The ASQ-3 demonstrated limited accuracy for identifying children in need of further assessment of gross motor skills, since children who scored below the ASQ-3 GM cutoff scored at or above the mean on the PDMS-2 GMQ. Study limitations included a small and homogenous population with low prevalence of motor delay. Clinicians should carefully consider the purpose of conducting screening and importance of correctly allocating limited resources in deciding whether or not to use the ASQ-3 as a means of identifying children in need of comprehensive motor assessment.

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INTRODUCTION AND PURPOSE

Early and accurate detection of children who have or are at significant risk for developmental delay is of critical importance to the success of early intervention. The American Academy of Pediatrics (AAP) recommends that all children be screened for developmental delay and receive follow-up comprehensive examination when appropriate.[1] The AAP has made this recommendation so children with delays are appropriately identified and enrolled in habilitation services, thus improving developmental outcomes.[2] Early intervention that targets developmental concerns with sound, evidence-based treatments can promote the development of neural connections that are dependent upon the child's successful experience of target skills.[3] When practitioners either fail to screen or screen incorrectly, interventional resources may be misdirected and opportunities may be lost to provide services during maximal periods of developmental plasticity. When these errors are multiplied over many children, the cost to society may be very high.

In the United States, more than 400,000 children are at risk of developing an early motor delay each year.[4] A motor delay or dysfunction can be defined as delayed or disordered gross or fine motor skills that could be attributed to a neurologic or orthopedic impairment.[5,6] One of the reasons motor delay is especially problematic is that the presence of motor delay can have profound impact on other developing systems when a child's ability to explore the environment is impacted.[7]

Examining achievement of motor and cognitive milestones is key to identifying and addressing developmental delays in pediatric populations.[8] Surveillance and screening tools are two primary methods used to identify children who may need further

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diagnostic evaluation in motor or other areas of development. Developmental surveillance is a process that pediatricians, in addition to other health and development professionals, utilize in order to follow a child's motor development. However, using only surveillance is less likely to identify children with delays as compared to using a standardized screening tool.[9,10] Screening tools use a standard approach that aim to identify a child's developmental areas that differ from the age-appropriate norm. The comparison allows the screen to help determine if the child is likely to have a delay and need further testing.[10] The American Academy of Pediatrics (AAP) recommends both the use of surveillance and standardized screening tools for all children to identify developmental delays or disabilities.[1]

The importance of early detection of delay by use of screening tools is reinforced by requirements of the Individuals with Disabilities Education Improvement Act enacted as a revision of the Individuals with Disabilities Education Act in 2004.[11] This law requires states to establish procedures to identify and evaluate all children to ensure they receive the free and appropriate public education to which they are entitled. However, implementation of this law has been problematic for states struggling to prioritize precious resources earmarked for Early Intervention services. For example, states experiencing difficulties providing adequate services to identified children may be less than eager to qualify additional children. A consortium of states known as the National Academy for State Health Policy presently have identified five instruments as being on their "short list" of recommended developmental screening tools for young children.[12] These tools are: Ages and Stages Questionnaire (ASQ), Ages and Stages Questionnaire – Social Emotional (ASQ-SE), Parents' Evaluation of Developmental Status (PEDS and

PEDS-Online), PEDS: Developmental Milestones (PEDS:DM), and the Pediatric Symptom Checklist.[13–15]

One of the most widely used screening tools is the ASQ, specifically the most current edition (ASQ-3). This screen has been translated for use around the world. The ASQ-3 is popular due to its accessibility and cost-effectiveness when compared to the cost of a physician's office visit. The ASQ has been recommended for use as a parent-based instrument to screen for general developmental delay.[16] According to the publisher, the ASQ-3 has a specificity of 85 percent and a sensitivity of 86 percent for identifying children in need of further motor assessment compared to the Batelle Developmental Inventory (BDI). The BDI is a standardized assessment with a strong inter-rater reliability of r=0.94.[17] The ASQ-3 manual discusses the process used to obtain this information, however it is unclear if the reported reliability is for all domains, motor domains, or language and cognition. Additionally, outside of the publisher's report, there is minimal research on the diagnostic accuracy of the ASQ-3.[17] Therefore, a disparity is seen in the research for the reliability of using the ASQ-3, specifically in the domain of motor development.

The Peabody Developmental Motor Scales, Second Edition (PDMS-2) is the gold standard test used to assess children who require additional examination for potential developmental delay or disability. The PDMS-2 demonstrated good test-retest reliability over a one-week period in which the three composite scores (gross motor quotient [GMQ], fine motor quotient [FMQ] and total motor quotient [TMQ]) and had an intra-class correlation coefficient between 0.88 and 1.00.[18,19] The PDMS-2 is used by pediatric

occupational and physical therapists as a comprehensive tool for examining fine and gross motor skill development.

Thus, the overall purpose of this study was to evaluate the ability of the ASQ-3 to correctly identify young children in need of more comprehensive motor assessment when compared to the PDMS-2 as the gold standard. To achieve this purpose, two approaches were performed: 1) to establish concurrent validity between the motor scales of the ASQ-3 and PDMS-2 by examining the relationships among ASQ-3 fine and gross motor scores with their corresponding fine and gross motor quotients on the PDMS-2, and 2) examining the diagnostic accuracy of the ASQ-3 using the PDMS-2 as a gold standard test for comparison.

METHODS

Design

This cross-sectional study used de-identified, existing data that have not been previously investigated. The ASQ-3 data were collected as part of a study whose purpose was to determine whether there was a difference in the PDMS-2 total, gross, and fine motor quotient scores when the test was administered in natural versus isolated, quiet environments.[18,19] The ASQ-3 information was collected at that time to allow families to communicate with the investigators about whether or not they had any concerns about their child's motor development. This secondary analysis was approved by the necessary Institutional Review Board[i] and the review committee of the Early Childhood Education Center (ECEC) from which most of the subjects were recruited.

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[i]Institutional Review Board protocol number: 0903-3067

Children with and without disabilities (n=34) were recruited for the parent study

from the ECEC and the nearby community. Center enrollees also included children of

faculty, staff and students (up to 50% of Center enrollees) and children from the

community (remaining 50%). Children in the sample included 22 males and 12 females

and ranged in age from 19 months to 59 months, with a mean age of 41.52 months.

Parents were asked if their child had any known medical, health, or developmental issues.

Answers reported included asthma, ventricular/atrial septal repair, hyperactivity, autism,

abdominal hernia, hypochondroplasia, umbilical hernia, and potty issues. Two parents

identified children as having a medical, health, or developmental issue without further

detail. Of the children receiving health or developmental services, only two parents

identified the services, one being physical therapy and the other being speech therapy.

Additional details of sample demographics may be found in Table 1. << Insert Table 1

here>>

Instrumentation

The screening tool being evaluated in this study was the ASQ-3. The ASQ-3 is a

parent-report questionnaire frequently utilized to screen children for gross and fine motor

delays. The ASQ-3 uses a series of 21 age-specific questionnaires to screen children from

one to 66 months of age.[17] The ASQ-3 has been shown to have a sensitivity of 85.9% for

children ages 27 to 36 months, 82.5% sensitivity for 42 to 60 month olds, and an overall

sensitivity of 86% for identifying children in need of further evaluation for

developmental delay or disability.[17] Specificity of the ASQ-3 was reported as 85.7% for

27 to 36 month olds and 92.1% for 42 to 60 month olds and an overall specificity of 85% for detecting children for additional comprehensive motor testing.[17]

The Peabody Developmental Motor Scales, 2nd edition (PDMS-2) served as our gold standard of gross and fine motor skill assessment in children from birth to five years of age. The PDMS-2 is divided into gross and fine motor subscales. The gross motor portion consists of four subtests: reflexes, stationary, locomotion. The fine motor portion consists of object manipulation, grasping, and visual-motor integration, which measure the child's capacity to perform motor skills outside of a functional context. The PDMS-2 is widely used in clinics, schools, and research due to its established reliability and validity.[18] The PDMS-2 has demonstrated good test-retest reliability over a period of one week.[20] In the parent study from which the PDMS-2 data were derived for this secondary analysis, the inter-rater reliability intra-class correlation coefficients (ICC) among the four examiners was ≥ 0.988 with a 95% confidence interval.[18,19]

The PDMS-2 was used to evaluate the ability of the ASQ-3 to identify children who require further motor skills assessment. Both one and two standard deviations below the mean were used as criteria for categorizing children as having true motor delay due to variance in state eligibility requirements and procedures used in published reports using the PDMS-2 as the gold standard diagnostic test. [21]

Procedures

Prior to completing questionnaires, all parents gave permission for their children to participate in both studies. Child assent for participation on the PDMS-2 was assumed when children cooperated with testers during test administration.

Cross-sectional study designs allow investigators to create a snapshot of a child's development across measures administered at a single point in time. In the parent study, the PDMS-2 was administered to each child twice; once in a quiet, isolated environment and once in a natural classroom or playground environment. The scores from the first administration date were utilized for the present study, regardless of the environmental condition under which the test was administered, as that was closest to the time the parent completed the ASQ-3 questionnaire. The ASQ-3 guidelines for distributing the correct questionnaire according to each child's age were followed. Corrected age was used to assign age-appropriate questionnaires for children who were born prematurely and who were less than 2 years of age at the time they participated.

Data Analysis Plan

Descriptive statistics were used to characterize demographic and other information about the characteristics of the children including their parents' general perception of their development. Relationships between ASQ-3 and PDMS-2 scores were tested using Pearson's Correlation Coefficient. Sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios were calculated using contingency tables to determine diagnostic accuracy of the ASQ-3 for identifying children in need of comprehensive evaluation of motor skills as judged by their scores on the PDMS-2. In the PDMS-2, the gross motor quotient (GMQ) and the fine motor quotient (FMQ) were utilized as the respective gold standard for motor skills testing. For each of the statistical analyses where appropriate, confidence intervals of 95% and an alpha level of 0.05 were reported. Although 34 children were enrolled in the parent study, only 27 of them completed the ASQ-3 (See Figure 1). All statistical analyses were

completed using SPSS Version 21 software (SPSS IBM. New York, U.S.A.).[22] The seven

children with missing ASQ-3 scores were excluded from the remaining analyses.

<<Insert Figure 1 here>>

<center>RESULTS</center>

Descriptive statistics for ASQ-3 and PDMS-2 scores were calculated using SPSS

as described (See Tables 2 and 3). Of the children whose families completed the ASQ-3

(n=27), the gross motor (ASQ-3 GM) scores ranged from 20/60 to 60/60 (mean =

53.89/60 ±10.22). Two children scored below the established cutoff score for their age-

specific questionnaire and sixteen children received the highest possible score of 60/60

on the ASQ-3 GM. On the ASQ-3 fine motor (ASQ-3 FM) scale, the scores ranged from

15/60 to 60/60 (mean = 44.81± 14.84). Two children scored below the established cutoff

scores and five children received 60/60 on the ASQ-3 FM. Scores on the PDMS-2 GMQ

ranged from 61 to 115 (mean = 91.59 ± 13.54). <<Insert Tables 2 and 3 here>> The

distribution of scores according to developmental domain (ASQ-3 FM scores by PDMS-2

FMQ and ASQ-3 GM scores by PDMS-2 GMQ) is pictured in a scatterplot in Figure 2.

<<Insert Figure 2 here>>

Pearson Correlation Coefficient testing revealed no significant relationships

between ASQ-3 scores and PDMS-2 scores (See Table 4). The correlation coefficient

between ASQ-3 GM and PDMS-2 GMQ was 0.322 (p = 0.102). The correlation

coefficient between ASQ-3 FM and PDMS-2 FMQ was 0.296 (p = 0.134). <<Insert

Table 4 here>>

<center>8</center>

Tables 5 through 7 display results of the 2x2 contingency tables and describe how values related to diagnostic accuracy were calculated with 95% confidence intervals. Calculations used both one and two standard deviations below the mean as criteria due to variability between states in eligibility requirements for services in children with developmental delay.[21] The first comparison (See Table 5) establishes values using one standard deviation below the norm on the PDMS-2 GMQ as the gold standard for a positive therapy diagnosis of motor delay when compared to the ASQ-3 GM as a screening tool. For this comparison, ASQ-3 GM demonstrated sensitivity = 0, specificity = 0.91, positive predictive value (PPV) = 0, negative predictive value (NPV) = 0.84, positive likelihood ratio (PLR) = 0, and negative likelihood ratio (NLR) = 1.10. The second comparison (See Table 6) establishes values using two standard deviations below the norm on the PDMS-2 GMQ as the gold standard when compared to the ASQ-3 GM as a screening tool. For this comparison, ASQ-3 GM demonstrated sensitivity = 0, specificity = 0.92, PPV = 0, NPV = 0.92, PLR = 0, and NLR = 1.09. The third comparison (See Table 7) established values using either one or two standard deviation below the norm on the PDMS-2 FMQ as the gold standard when compared to the ASQ-3 FM as a screening tool. This table combines the values since they did not change with the difference in standard deviations. For this comparison, ASQ-3 FM demonstrated sensitivity = 0.50, specificity = 0.96, PPV = 0.5, NPV = 0.96, PLR = 12.5, and NLR = 0.52. <<Insert Tables 5-7 here>>

DISCUSSION

This study aimed to evaluate the ability of the ASQ-3 to correctly identify young children in need of more comprehensive motor assessment when compared to the PDMS-

2. To achieve this purpose, the relationships between the ASQ-3 gross and fine motor components with their corresponding gross and fine motor quotient on the PDMS-2 were examined. In addition, the diagnostic accuracy of the ASQ-3 compared to the PDMS-2 in a population of 27 male and female children was assessed. The results indicated that the ASQ-3 scores did not correlate with PDMS-2 scores in this population. The current research also demonstrated that the ASQ-3 was a screening tool with high specificity and low sensitivity in identifying children with motor delay. Additionally, the current research demonstrated high positive likelihood ratios for fine motor but not gross motor, in addition to low negative likelihood ratios.

The demographics displayed the sample population consisted primarily of males of white ethnicity without a known disability or developmental delay. Furthermore, only a small number of children fell below the cutoff in gross and fine motor according to the gold standard test, the PDMS-2, revealing that only a small portion of the sample actually had a developmental delay. Even though the sample population was representative of the community, its homogeneity may have limited the results.

Additionally, the small sample size is a limiting factor of this study. Numbers severely decreased when the parents of 7 of 34 participants did not complete and return the ASQ-3 questionnaire. This inaction rendered them ineligible for this secondary analysis. The high percentage of incompletion seen in our study is consistent with the literature. Meade et al[23] recognized that decreased completion rate is a limitation of the Ages and Stages Questionnaire Second Edition (ASQ-2), the relevance of which carries over to the third edition, which was utilized in this study.

Prior to performing psychometrics on the dataset, correlations were calculated with the assumption that if the screen was a good representation of the gold standard, strong correlations would be present. However, associations between the corresponding ASQ-3 and PDMS-2 subsections were not statistically significant. It was hypothesized that these correlations were limited by the strong ceiling effect of the ASQ-3 since a large fraction of the subjects had the highest possible score. It is possible that the correlations would be stronger if the sample size was larger and contained a great representation of other points along the distribution. It is also possible that the correlations would be stronger if the sample population was more diverse.

Sensitivity is the true positive rate of the test, or in this case, the ability to identify delay when the child actually has a developmental delay or disability. For both gross and fine motor components, sensitivity is much lower than the accepted rate of 70 to 80 percent. Therefore, an examiner would not be able to confidently rule out a developmental delay if a child obtains a positive test on the ASQ-3 GM or ASQ-3 FM. This study's low sensitivity findings are not consistent with the previously published 85 percent sensitivity of the test.[17] The disparity is likely secondary to the small sample size and the homogenous sample population consisting primarily of typically-developing children.

Specificity is the true negative rate of the test, or the ability to obtain a negative when the child does not actually have a developmental delay or disability. Specificity is very strong for both gross and fine motor components of the ASQ-3, well above accepted values. These findings indicate there are very few false negatives, which is true for the sample population.

Positive predictive value (PPV) is the likelihood that a child who actually has a delay tests positive. Like the sensitivity, PPV is low for all components and for similar reasons. Negative predictive value is the likelihood that a child who is typically-developing tests negative. Consistent with the results for specificity, the ASQ-3 performed well secondary to the sample population.

Unlike specificity, sensitivity, PPV, and NPV, likelihood ratios are not linked to the population and prevalence. Rather, these are based on individuals and can be a better reflection of the test's performance. Likelihood ratios can be more helpful to clinicians when looking at a patient in their presence.[24]

The positive likelihood ratio (PLR) corrects the true positive rate by the false positive rate. The PLR is very low for gross motor with a conclusive decrease in the likelihood for the delay by using the ASQ-3 GM screen. This means the ASQ-3 would be likely to change your opinion if you used the test for fine motor but not for gross motor. The PLR is very high for fine motor, with a positive test being more than 12 times as likely to be seen in someone with the delay compared to someone without a motor delay. This demonstrates a conclusive increase in the likelihood of identifying a fine motor delay by using the ASQ-3 FM.[24] This is a surprising finding for the researchers and one that is unique in comparison to the current literature.

The negative likelihood ratio (NLR) corrects the true negative rate by the false negative rate. In looking at gross motor's likelihood ratios being just above 1, a negative result on the ASQ-3 GM represents no change in the likelihood of the child having a developmental delay or disability with or without use of the screen. The NLR for fine

motor interprets to a minimal decrease in the likelihood of the disease if the test is

negative.[24]

CONCLUSION

Our results indicate that ASQ-3 scores might not correlate with PDMS-2 scores

for small or homogenous populations. In addition, the ASQ-3 is more likely to

confidently identify children who need further testing for a fine motor delay if they obtain

a positive test than for gross motor. The ASQ-3 is more likely to confidently rule out

children in need of further testing for a gross motor delay with a negative test compared

to fine motor. Further studies of diagnostic accuracy are needed that focus on motor

components of the ASQ with more diverse populations and larger sample sizes.

Table 1. Sample demographic data.

Characteristic	Number	Percentage (%)
Gender		
Male	22	64.7
Female	12	35.3
Ethnicity		
White	23	67.6
Other including biracial, multiracial, Asian	7	20.6
Black/African American	1	2.9
Hispanic/Latino Origin	1	2.9
Born prematurely (by parent report)		
No	30	88.2
Yes	4	11.8
Parents believe their child is developing like other children their age		
Yes	32	94.1
No	2	5.9
Parents believe their child behaves like other children their age		
Yes	31	91.2
No	3	8.8
Children receiving health or developmental services		
Yes	6	17.6
No	28	82.4

Table 2. Descriptive statistics for ASQ-3 and PDMS-2 quotient scores (N=27)

Statistic	ASQ-3 Gross Motor	ASQ-3 Fine Motor	PDMS-2 Gross Motor Quotient	PDMS-2 Fine Motor Quotient
Mean	53.89	44.81	91.59	98.33
Median	60.00	50.00	89.00	100.00
Mode	60.00	50.00	85.00	106.00
Standard Deviation	10.22	14.84	13.54	15.03
Minimum	20.00	15.00	61.00	67.00
Maximum	60.00	60.00	115.00	127.00
Range	40.00	45.00	54.00	60.00

Table 3. Descriptive statistics for ASQ-3 and PDMS-2 quotient scores continued (N=27).

Statistics	ASQ-3 Gross Motor	ASQ-3 Fine Motor	PDMS-2 Gross Motor Quotient	PDMS-2 Fine Motor Quotient
No/% below set cutoff	2	2		
No/% highest possible	16	5		
No. >1SD below mean			4	2
No. >2SD below mean			2	2

Table 4. Associations between ASQ-3 and PDMS-2 scores (N=27).

	PDMS-2 Motor Quotient	
	GMQ	FMQ
ASQ-3 Gross Motor	r= 0.322 p= 0.102	r= 0.205 p= 0.304
ASQ-3 Fine Motor	r= 0.265 p= 0.182	r= 0.296 p= 0.134

*=statistically significant at p< 0.05

Table 5. Contingency table of diagnostic accuracy with 95% confidence intervals between ASQ-3 Gross Motor and PDMS-2 Gross Motor.

		PDMS-2 Gross Motor		
		>1SD Below Mean	Within 1SD Mean	
ASQ-3 Gross Motor	Score < Cutoff	0	2	Positive Predictive Value 0 (0-0.78)
	Score > Cutoff	4	21	Negative Predictive Value 0.84 (0.84-0.90)
		Sensitivity 0 (0-0.39)	Specificity 0.91 (0.91-0.98)	
		Positive Likelihood Ratio 0 (0–20.66)	Negative Likelihood Ratio 1.10 (0.62-1.10)	

Table 6. Contingency table of diagnostic accuracy with 95% confidence intervals between ASQ-3 Gross Motor and PDMS-2 Gross Motor.

		PDMS-2 Gross Motor		
		>2SD Below Mean	Within 2SD Mean	
ASQ-3 Gross Motor	Score < Cutoff	0	2	Positive Predictive Value 0 (0-0.72)
	Score > Cutoff	2	23	Negative Predictive Value 0.92 (0.92-0.98)
		Sensitivity 0 (0-0.72)	Specificity 0.92 (0.92-0.98)	
		Positive Likelihood Ratio 0 (0–32.36)	Negative Likelihood Ratio 1.09 (0.29-1.09)	

Table 7. Contingency table of diagnostic accuracy with 95% confidence intervals between ASQ-3 Fine Motor and PDMS-2 Fine Motor

		PDMS-2 Fine Motor		
		>1SD or > 2SD Below Mean	Within 1SD or 2SD Mean	
ASQ-3 Fine Motor	Score < Cutoff	1	1	Positive Predictive Value 0.50 (0.03-0.96)
	Score > Cutoff	1	24	Negative Predictive Value 0.96 (0.92-1.00)
		Sensitivity 0.50 (0.03-0.96)	Specificity 0.96 (0.92-1.00)	
		Positive Likelihood Ratio 12.50 (0.35–265.85)	Negative Likelihood Ratio 0.52 (.05-1.06)	

Figure 1. Research participants**.**

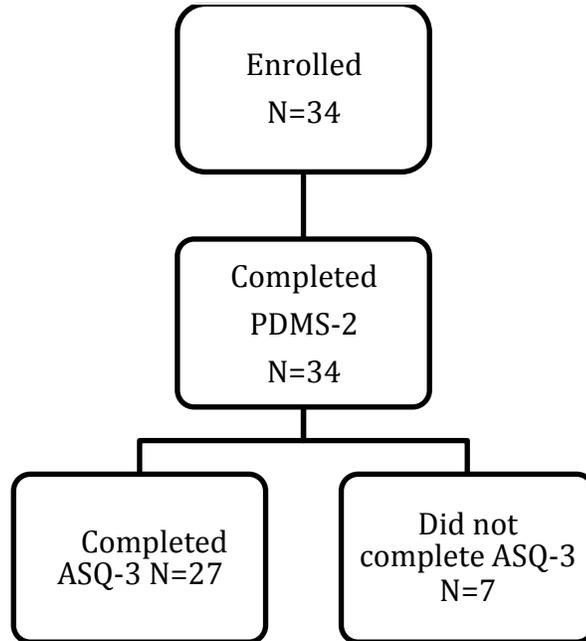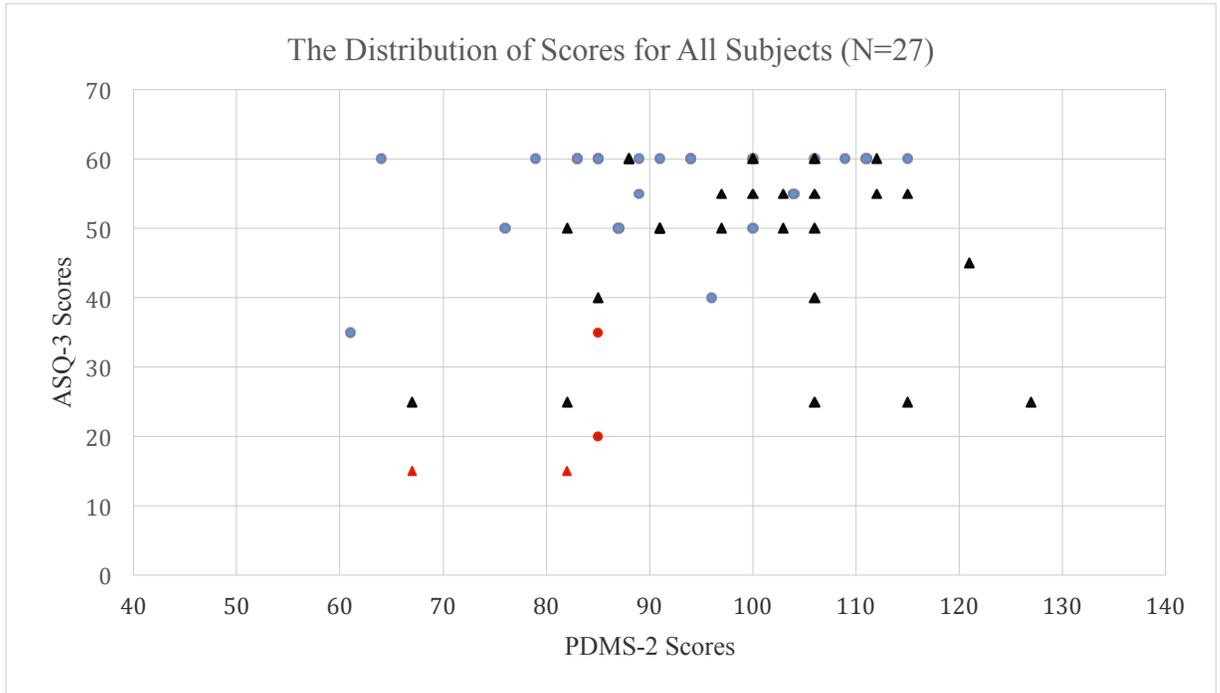**Figure 2.** Distribution of scores for all subjects.

The Distribution of Scores for All Subjects (N=27)

- ● = Subject's ASQ-3 GM scores by PDMS-2 GMQ

- ▲ = Subject's ASQ-3 FM scores by PDMS-2 FMQ

- ● = Subject's ASQ-3 GM scores below cutoff

- ▲ = Subject's ASQ-3 FM scores below cutoff

New SoPAC Abstract Submission

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TITLE: ABILITY OF THE AGES and STAGES QUESTIONNAIRE -THIRD EDITION TO IDENTIFY CHILDREN IN NEED OF COMPREHENSIVE MOTOR EVALUATION

PURPOSE: The Ages and Stages Questionnaire Third Edition (ASQ-3) is a widely used screening tool designed to identify children who need comprehensive developmental assessment. Its accuracy for identifying children in need of additional motor assessment has not been determined. The purposes of this study were to establish concurrent validity between ASQ-3 gross motor (GM) and fine motor (FM) scores and their corresponding Peabody Developmental Motor Scales – Second Edition (PDMS-2) quotients, and to examine the diagnostic accuracy of the ASQ-3 using the PDMS-2 as a gold standard reference test.
NUMBER/DESCRIPION OF SUBJECTS: The sample included 27 children aged 18-59 months (mean=41.52 months) with and without known disabilities.
MATERIALS/METHODS: This was a secondary analysis of a previous study in which both ASQ-3 and PDMS-2 data were collected, and ASQ-3 data were not analyzed. The Pearson Correlation Coefficient was used to examine relationships between ASQ-3 GM and FM scores and their corresponding PDMS-2 motor quotients. Diagnostic accuracy was calculated for the ASQ-3 GM and FM scores compared to the PDMS-2 gross motor

quotient (GMQ) and fine motor quotient (FMQ). Contingency tables (2x2) were used to calculate sensitivity (SN), specificity (SP), positive and negative predictive values (PPV/NPV), and positive and negative likelihood ratios (PLR/NLR). All values were calculated using one and two standard deviations (1SD/2SD) below the norm as a construct for delay, as eligibility requirements vary across states.

RESULTS: There were no significant correlations between ASQ-3 scores and PDMS-2 scores. The ASQ-3 was found to have high SP in identifying children who need further motor testing (SP for GM=0.91; SP for FM=0.96). ASQ-3 also showed low sensitivity (SN=0) for identifying children in need of further testing for gross and fine motor delay. Predictive values for GM were as follows: PPV at 1 and 2SD=0, NPV at 1SD=0.84, NPV at 2SD=0.92. Predictive values for 1 and 2SD FM were as follows: PPV=0.5 and NPV=0.96. Likelihood ratios for GM were as follows: at 1SD PLR=0, NLR=1.10; at 2SD PLR=0, NLR=1.09. Likelihood ratios for FM were as follows: at 1SD and 2SD PLR =12.5, NLR= 0.52.

CONCLUSION: The ASQ-3 performed best for correctly identifying children in need of further assessment of fine motor skills, since children who scored below the ASQ-3 FM cutoff also scored below norms on the PDMS-2 FMQ. The ASQ-3 demonstrated limited accuracy for identifying children in need of further assessment of gross motor skills, since children who scored below the ASQ-3 GM cutoff scored at or above the mean on the PDMS-2 GMQ. Study limitations included a small and homogenous population with low prevalence of motor delay.

CLINICAL RELEVANCE: Clinicians should carefully consider the purpose of conducting screening and importance of correctly allocating limited resources in deciding whether or not to use the ASQ-3 as a means of identifying children in need of comprehensive motor assessment.

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Research in Progress

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