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Gross Motor Development in Children Aged 3–5 Years, United States 2012

Brian K. Kit[1], **Lara J. Akinbami**[1], **Neda Sarafrazi Isfahani**[1], **Dale A. Ulrich**[2]

[1]Division of Health and Nutrition Examination Surveys, National Center for Health Statistics, Centers for Disease Control and Prevention, 3311 Toledo Road, Hyattsville, MD 20782, USA

[2]Movement Science Program, Center on Physical Activity & Health in Pediatric Disabilities, University of Michigan, Ann Arbor, USA

Abstract

Objective: Gross motor development in early childhood is important in fostering greater interaction with the environment. The purpose of this study is to describe gross motor skills among US children aged 3–5 years using the Test of Gross Motor Development (TGMD-2).

Methods: We used 2012 NHANES National Youth Fitness Survey (NNYFS) data, which included TGMD-2 scores obtained according to an established protocol. Outcome measures included locomotor and object control raw and age-standardized scores. Means and standard errors were calculated for demographic and weight status with SUDAAN using sample weights to calculate nationally representative estimates, and survey design variables to account for the complex sampling methods.

Results: The sample included 339 children aged 3–5 years. As expected, locomotor and object control raw scores increased with age. Overall mean standardized scores for locomotor and object control were similar to the mean value previously determined using a normative sample. Girls had a higher mean locomotor, but not mean object control, standardized score than boys ($p < 0.05$). However, the mean locomotor standardized scores for both boys and girls fell into the range categorized as "average." There were no other differences by age, race/ Hispanic origin, weight status, or income in either of the subtest standardized scores ($p > 0.05$).

Conclusions: In a nationally representative sample of US children aged 3–5 years, TGMD-2 mean locomotor and object control standardized scores were similar to the established mean. These results suggest that standardized gross motor development among young children generally did not differ by demo- graphic or weight status.

Keywords

Child development; Child; Preschool; United States/epidemiology; Health Surveys

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Introduction

Gross motor development during early childhood is important in fostering greater interaction with the environment (Ulrich 2000). Identifying children with motor delays “allows for timely referral for developmental interventions as well as diagnostic evaluations and treatment planning,” and may mitigate negative impact on the development of subsequent skills (Noritz et al. 2013). Previous population-based epidemiologic studies have been conducted to quantify the prevalence of developmental delays, including motor delays (Boyle et al. 2011; Rosenberg et al. 2008). However, to our knowledge, differences in gross motor development by demo- graphic, socio-economic, and anthropometric characteristics, associations which may be of interest, have not been described using a nationally representative sample. Further, measured assessment of gross motor skills in a nationally representative sample of pre-school aged children in the US has never previously been performed in National Health and Nutrition Examination Survey (NHANES).

The TGDMD-2 is comprised of two subtests (locomotor and object control) that measure gross motor development of the muscles of the trunk, arms and legs for children aged 3–10 years. It can be used for a variety of purposes, including to identify children with delays in gross motor skill development, to assess an individual’s progress, and to serve as a measurement instrument in research involving gross motor development (Ulrich 2000). The TGMD was initially developed in 1985 to address shortcomings in motor behavior assessment instruments, including lack of standardization, difficulty in identifying specific aspects of movement that were deficient, lack of referenced interpretation, and inability to make inter-individual comparisons (Ulrich 2000). The TGMD-2 (second edition) was developed in 2000 in response to test reviews from the first edition and is a criterion- and norm-referenced measure (Ulrich 2000). This study evaluated TGMD-2 results to describe differences in motor skills by sociodemographic characteristics and weight status, factors commonly available in the clinical setting, among US children aged 3–5 years.

Methods

The NNYFS

The NHANES National Youth Fitness Survey (NNYFS) was conducted in 2012 by the Division of Health and Nutrition Examination Surveys of NCHS (Borrud et al. 2014). The NNYFS used the survey design for NHANES, which is a probability sample of the civilian noninstitutionalized US population (Centers for Disease Control and Prevention/ National Center for Health Statistics/Division of Health and Nutrition Surveys 2013). A total of 1640 children and adolescents aged 3–15 years were interviewed (a response rate of 79.4% among those selected) and 1576 were examined (a response rate of 76.3% among those selected). The TGMD-2 was conducted among children aged 3–5 years (Borrud et al. 2014; Centers for Disease Control and Prevention/National Center for Health Statistics/Division of Health and Nutrition Surveys 2012).

TGMD–2 Description

The detailed methods used to develop the TGMD-2 can be found elsewhere (Ulrich 2000). The locomotor subtest, which measures gross motor skills that require fluid coordinated movements to move the center of gravity from one point to another, assesses six skills: running, galloping, hopping, leaping, horizontal jumping, and sliding. The object control subtest, which measures gross motor skills involved in projecting or receiving objects, assesses six skills: striking a stationary ball, stationary dribbling, catching, kicking, overhand throw and underhand roll. For each of these twelve skills, there are between three and five criteria for a total of 48 criteria for the locomotor (24 criteria) and object control (24 criteria) subtests (Ulrich 2000). The typical duration of the TGMD-2 is 15–20 min. To facilitate valid interpretation and scoring of a child's performance, an illustrated guide with detailed description of each subtest item was provided to the examiner.

In developing the TGMD-2, scores for each subtest were normalized using a sample of 1208 children aged 3–10 years from ten states. Comparisons between the selected sample of children and the US school-aged population based on US Census data confirmed similar distribution by geographic area (Northeast, Midwest, South, and West), sex, urban/rural residence, and educational attainment of parent (Ulrich 2000). Results were used to develop norms for the TGMD-2 subtests. Smoothed cumulative frequency distributions of the raw scores from the normative sample were used to develop standardized scores for each subtest. The mean score for each subtest is ten and the standard deviation is three, with scores between 8 and 12 considered "average." In the normative sample, the mean standard score was also ten for boys and girls and each race/Hispanic group, except for African American children in the locomotor domain, where the mean standard score was 11 (Ulrich 2000). Content validity, criterion-prediction, and construction-identification validity were also previously assessed, and are described elsewhere (Ulrich 2000).

Procedures of TGMD–2 in the NNYFS

The developer of TGMD-2 (Dale A. Ulrich) provided consultation on the component for the NNYFS. Eligible participants were aged 3–5 years who did not have physical limitations requiring a wheelchair; amputations of the leg, foot, or arm; paralysis of one or both arms or hands; or surgery of the hand, arm, shoulder or leg in the past 3 months. Participants who were unable to follow instructions and repeat demonstrations of skill sets were also excluded (Centers for Disease Control and Prevention/National Center for Health Statistics/Division of Health and Nutrition Surveys 2012).

Standardized procedures were followed to allow comparison of scores to the TGMD-2 normative sample described above. These included giving an accurate demonstration and verbal description of the skill to the participants prior to performing the skills; providing a practice trial to confirm understanding; providing an additional demonstration of the skill if the child did not understand the performance criterion; and administering two test trials with performance scores for each trial as outlined in the guide (Ulrich 2000).

Examiners were trained in administering the TGMD-2 prior to the start of NNYFS, and quality control checks were made by NHANES survey operations staff during field visits.

Two trials were performed for each criterion, with a score of 1 for expected performance and 0 for failure to execute the performance criterion. Children who refused to perform a skill received a missing value for that skill. A score for each performance criterion was generated by summing the results of the two trials. Raw locomotor and object control scores were calculated by summing the results of the 24 locomotor and 24 object control criteria, respectively. Raw scores were then standardized using TGMD-2 published performance criteria by age for locomotor and by sex and age for object control. Standardization by age and/or sex facilitates comparisons between groups because it accounts for the differences in age and/or sex. Additional factors, including lifestyle characteristics of the parents, were not included in the standardization process. Six-month age brackets based on age at the time of examination were used for age standardization of scores, per TGMD-2 guidelines (Ulrich 2000).

Statistical Methods

Means and standard errors are reported overall and by sex; age (3, 4, or 5 years); race/ Hispanic origin (non- Hispanic white, non-Hispanic black, Hispanic, or other); poverty status (ratio of family income to poverty level ratio (FIPR) categorized as <1.85, ≥1.85, or missing income information); and weight status categories based on body mass index (BMI) percentiles for age using measured height and weight. The FIPR cut-point of 1.85 was used because it represents the income criteria for reduced priced school lunch (Federal Register 2009). The 2000 Centers for Disease Control and Prevention growth charts (Kuczmarski et al. 2002) were used to define weight status categories (underweight [BMI < 5th percentile], normal weight [BMI 5 to <85th percentile], overweight [BMI 85th to <95th percentile], and obese [BMI ≥ 95th percentile]). Prevalence of the children aged 3–5 years with very poor, poor, below average, average, above average, superior, and very superior locomotor and object control subtests are also reported, defined based on the TGMD-2 criteria (Ulrich 2000). Based on these criteria, the standard score range for very poor, poor, below average, average, above average, superior, and very superior are as follows: 1–3, 4–5, 6–7, 8–12, 13–14, 15–16, and 17+. To assess the statistical reliability of estimates, a relative standard error (RSE) was calculated by dividing the standard error by its respective prevalence estimate (Johnson et al. 2013). Instances where RSE > 0.30 are demarcated in Fig. 1 and should be interpreted with caution. We expected the mean standard scores for locomotor and object control to be within the range of standard scores considered “average,” between eight and twelve (Ulrich 2000).

Statistical analyses were performed using SAS software, version 9.3 (SAS Institute Inc.), and SUDAAN software, version 11.0 (RTI). Examination sample weights, which account for the complex survey design and survey non-response, were used to obtain estimates representative of the civilian, non-institutionalized US population. Standard errors were calculated using Taylor Series Linearization to account for the complex sample design. Confidence intervals were calculated using the approach described in Korn and Graubard (Korn and Graubard 1998). Differences between groups were tested with a t-statistic. Statistical significance was determined at a P value of <0.05 without adjustment for multiple comparisons. The larger the number of statistical tests performed, the higher the likelihood of error where, by chance, some tests will be statistically significant.

Missing Data

Of the 352 children aged 3–5 years who were examined, 329 had complete data for locomotor and object control (93.5% unweighted). By subtest, for locomotor 330 (93.8% unweighted) had complete data and for object control 338 (96.0% unweighted) had complete data. Of the 352 eligible, 6 (1.3% unweighted) were excluded from the protocol for the following reasons: safety exclusion, based on meeting protocol exclusion criteria (n= 2); participant or parent refusal for the TGMD-2 component (n= 3); and mechanical malfunction of the computer (n= 1). Among the remaining 17 children with incomplete data for locomotor and/or object control, 1 had incomplete data for object control but complete data for locomotor; 9 had incomplete data for locomotor but complete data for object control, and 7 had incomplete data for both. Children with complete data for one component (locomotor or object control), but not the other, were included only in the subtest analyses for which there were complete data. A sensitivity analysis was conducted and reported in the results to examine the impact of assuming a score of zero for those participants excluded from the protocol and for the incomplete items.

Results

Of the 339 children with complete data for locomotor and/or object control, the sample sizes were 107, 113, and 119 for 3, 4, and 5 year-old children, respectively. Approximately 15% were obese and 49% were low-income (FIPR < 1.85). We compared our reported estimates with America's Children in Brief: Key National Indicators of Well-Being (Federal Interagency Forum on Child and Family Statistics), to ensure our estimates were similar to other national estimates. These published estimates demonstrated that 53.7, 14.1, and 23.2% of children 0–17 years were non-Hispanic white, non-Hispanic black, and His- panic and 43.7% had income of below 200% poverty level (estimates for 185% not reported). Because the age group and income classification differ from our study, exactly the same estimates were not expected but overall, our estimates are similar to these published estimates. Additional details of the sample sizes and sample characteristics are reported in Table 1.

Table 2 shows raw locomotor and object control scores by demographic and weight status. As expected, there was an increase in locomotor and object control mean raw scores ($p < 0.05$ for linear trend in both) with age: for example 3 year olds had a mean locomotor score of 20.5 versus 33.6 for 5 year olds. Differences in raw scores between groups may reflect differences in the age distribution between subgroups and should be interpreted with caution.

Compared to girls, boys had a lower mean locomotor raw score by 2.9 points and a higher mean object control raw score by 3.6 points. Non-Hispanic black children had mean locomotor and object control raw scores of 3.9 and 1.9, respectively, higher than non-Hispanic white children. There were no differences by weight status or income in the locomotor and object control raw scores.

Overall, the mean locomotor standardized score was 10 and the mean for each category was close to the value 10 (ranging from 9.4 to 10.8) (Table 3). Boys had a lower mean locomotor standardized score than girls (9.5 vs. 10.5, $p < 0.05$), but there were no significant differences in mean locomotor standardized scores by age, race/Hispanic origin, weight status category, or income.

For the object control subtest, the overall mean standardized score was 8.5 and the mean for each category was between 8.4 and 8.9. For example, the mean standard scores by age were 8.6 for 3 year olds, 8.4 for 4 year olds and 8.6 for 5 year olds. There were no significant differences by age, race/Hispanic origin, weight status category, or income in the mean object control standardized score.

The range of "average" results for both subtests are standardized scores between 8 and 12; thus the mean object control and locomotor standardized scores fell into the range categorized as "average."

Figure 1 shows the distribution of subtest standardized scores. The distribution of the locomotor subtest scores was generally symmetric but the object control subtest scores were skewed such that fewer children scored in the above average or superior categories. That is, the prevalence estimates of locomotor scores was 1.3% very poor, 7.6% poor, 15.8% below average, 54.8% average, 13.3% above average, 4% superior, and 3.3% very superior. On the other hand, the corresponding estimates for object control were 2.2% very poor, 7.3% poor, 24.9% below average, 61% average, 3.2% above average, 1.4% superior, and 0% very superior. For both subtests, approximately 9% of children aged 3–5 years had very poor or poor skills: 1.3% and 7.6% respectively for the locomotor subtest and 2.2% and 7.3%, respectively for the object control subtest.

A sensitivity analysis, in which excluded and missing cases were assigned a value of zero, showed similar results as found in the main analysis, but the increase in the percentage of children with poor performance reduced the mean standard scores. The mean standard score in the sensitivity analysis was 9.8 (rather than 10.0) for locomotor and 8.4 (rather than 8.5) for object control. In this sensitivity analysis, locomotor skills were distributed as follows: 2.5% very poor, 8.5% poor, 16.4% below average, 53.3% average, 12.5% above average, 3.7% superior, and 3.1% very superior. The distribution for object control scores in this sensitivity analysis was 3.3% very poor, 8.6% poor, 24.1% below average, 59.5% average, 3.1% above average, 1.4% superior, and zero very superior.

Discussion

Application of standard scores derived from a validated test of gross motor development based on the TGMD-2 normative sample to the nationally representative NNYFS sample allowed us to report robust estimates for locomotor and object control development among US children aged 3–5 years. We found that US children aged 3–5 years performed similarly to the established mean scores of the TGMD-2. Because this is a population-based study of a general US population, we anticipated that our study would yield similar findings as the normative sample used to develop the TGMD-2. While this overall result was expected, we also observed that standardized scores did not vary by race/ethnicity, poverty status, or weight status.

Previous studies of gross motor development and measures of adiposity have found an association (Benjamin Neelon et al. 2012; Mond et al. 2007; Morano et al. 2011), however, differences between our study and other studies in assessment of gross motor development and adiposity may have contributed to the different study findings. For example, two of these studies used the International Obesity Task Force to define obesity and assessed attainment of four specific milestones or performance on four standardized tests rather than 2000 CDC Growth Charts and the TGMD (Mond et al. 2007; Morano et al. 2011). The sub- group difference that did emerge in our study was a significantly higher standardized score for the locomotor subtest among girls. However, for both boys and girls, the mean scores were close to the value 10, the normalized mean value for this subtest on the TGMD-2, and within the range considered "average," thus the differences in mean scores may not be associated with clinical differences.

In the clinical setting, screening for developmental delays, including motor delays, is a recommended component of well-child care for all children (Council on Children with Disabilities et al. 2006). These results suggest systematic differences should not be anticipated between sociodemographic subgroups among preschool-aged children. At the same time, results suggest that nearly 10% of U.S. children could be anticipated to display poor or very poor gross motor development. The estimates from this study can be compared with the estimated 6% prevalence of developmental coordination disorder among school-aged children (Blank et al. 2012), a condition that is often comorbid with attention-deficit/hyperactivity disorder, autism spectrum disorder, and learning disabilities (Flapper and Schoemaker 2013; Harris et al. 2015). A clinical report from the American Academy of Pediatrics (AAP) emphasized that "gross motor delays are common," and that earlier identification of motor delays allows for timely referral, evaluation and intervention; thus, the report recommended formal gross motor developmental screening at well-child visits in early childhood (Noritz et al. 2013).

Our study is nationally representative and is population- based, rather than clinic-based, which allows for inferences regarding motor development among US children aged 3–5 years. A population-based assessment of gross motor development provides additional information because much of the previous literature in the United States on gross motor development has been based in specialty clinics and/or focused on specific disease processes (Arendt et al. 1999; Getchell et al. 2007; Haibach et al. 2014; Schott and Holfelder 2015). Gross motor development was assessed directly using strict study protocols rather than by parental recall of a physician diagnosed motor delay or parental questionnaires. To this end, our study provides complementary information to other population-based studies reporting developmental delays among US children, and may help inform screening of motor delays. However, our study protocols did not include assessments that are recommended subsequent to a positive motor delay screen, including a neurologic examination (Noritz et al. 2013). Additionally, in the clinical setting a positive motor delay screen at one time period may result in a subsequent screen in order to confirm whether the delay persisted. Our study included an assessment of motor skills at only one time period; thus we were unable to assess persistence of an abnormal result. In our analyses, a FIPR of 1.85 was used as the cut-point to dichotomize family income but other studies may use different income cut-points, limiting comparability. An additional limitation of our study is that the relatively small sample sizes did not allow for stratification of each of the variables by age or by groups that may be at risk for motor delays, including those who were born low birthweight and/or premature. The object control scores were skewed towards lower values, with the mean object control score in the "average" range nonetheless, but NHANES lacks the relevant data to explore the clinical significance of this finding, if any. Furthermore, a small number of participants (n = 6) were excluded from the TGMD-2, and some children did not complete components of the test. If those excluded or those with incomplete data had test scores consistent with motor delays (e.g., those with physical and/ or cognitive functioning difficulties) this would underestimate the percent with very poor or poor motor skills. To estimate the impact this may have had, we performed a sensitivity analysis in which these children were assigned a score of zero. The results of the sensitivity analysis demonstrated approximately 3% more children were categorized as having very poor and poor scores for both locomotor and object control. However, we know some of those excluded or with missing components did not have data because of external factors, including time limitations and mechanical malfunctions, unrelated to potential underlying motor delays.

In conclusion, in a nationally representative sample of children aged 3–5 years, mean locomotor and object control scores are similar to the established mean scores, and gross motor development scores among young children generally do not differ by demographic or weight status. Another implication of these findings is that programs serving pre- school children can anticipate that up to 10% of children from the general population may display poor or very poor gross motor development, and may require evaluation and/ or intervention referrals as recommended by the AAP clinical report (Noritz et al. 2013) on motor delays.

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Abbreviations

AAP	American Academy of Pediatrics
BMI	Body mass index
CDC	Centers for Disease Control and Prevention
CIW	Confidence interval width
FIPR	Family income to poverty level ratio
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NNYFS	NHANES National Youth Fitness Survey
RSE	Relative standard error
TGMD-2	Test of Gross Motor Development, second edition

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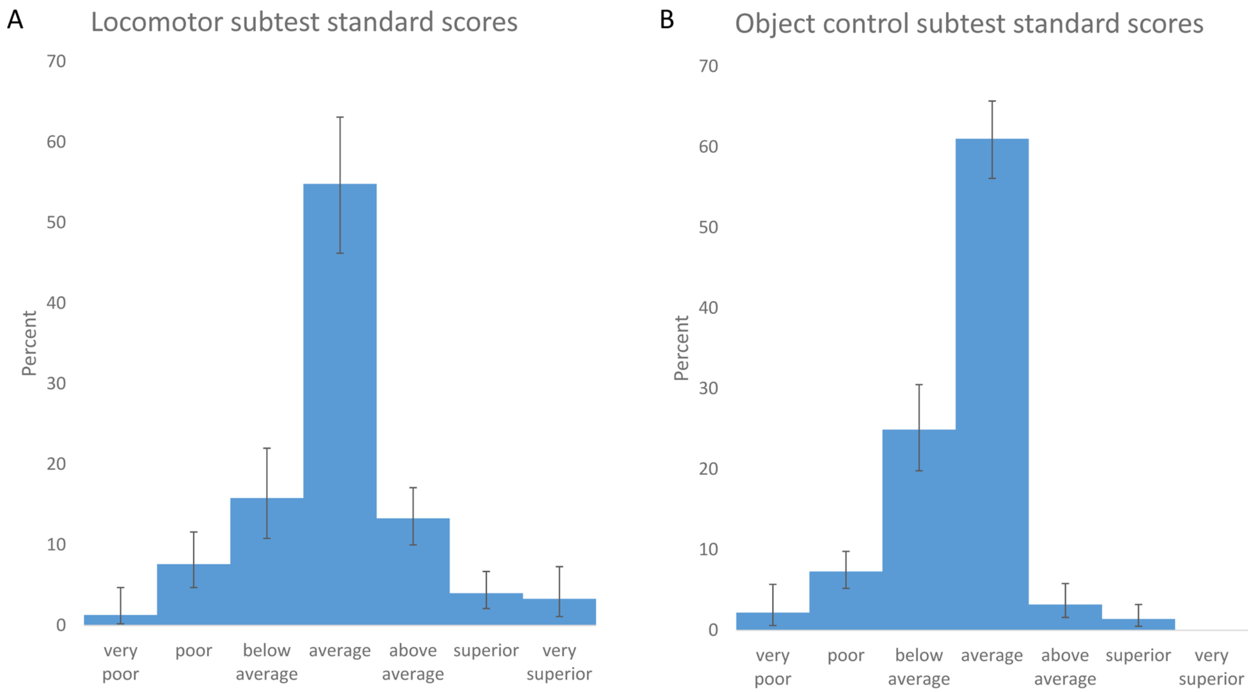

Fig. 1.

Subtest standard scores among US children aged 3–5 years, percent (bars indicate 95% confidence interval). Data source: CDC/NHANES National Youth Fitness Survey. Locomotor scores: 1.3% very poor, 7.6% poor, 15.8% below average, 54.8% average, 13.3% above average, 4% superior, and 3.3% very superior. Object control scores: 2.2% very poor, 7.3% poor, 24.9% below average, 61% average, 3.2% above average, 1.4% superior, and 0% very superior. Estimates were weighted using examination survey weights, and the standard was calculated accounting for complex survey design. Confidence intervals were constructed using Korn and Graubard method (1998). Estimates with a relative standard error (RSE, calculated standard error divided by percent) of >0.30 may be unreliable and should be interpreted with caution. In this figure, the RSE is >0.30 for very poor locomotor (RSE = 0.39), very superior locomotor (RSE = 0.64), very poor object control (RSE = 0.39), and superior object control (RSE = 0.47)

Table 1.

Sample sizes and distribution of the sample,[a] children aged 3–5 years, United States, 2012

	n	% (SE)
Age (years)		
3	107	31.5 (1.9)
4	113	35.1 (2.9)
5	119	33.3 (2.6)
Sex		
Boys	171	50.4 (2.4)
Girls	168	49.6 (2.4)
Race/Hispanic origin[b]		
Non-Hispanic white	134	53.5 (8.9)
Non-Hispanic black	70	15.0 (5.5)
Hispanic	116	25.1 (6.0)
Body mass index[c]		
Normal Weight	227	66.4 (2.3)
Overweight	52	16.5 (2.4)
Obese	53	15.2 (2.1)
Income[d]		
FIPR < 1.85	178	49.1 (3.3)
FIPR ≥ 1.85	133	44.9 (3.7)

Data source: CDC/NHANES National Youth Fitness Survey

[a]Estimates (except sample size) are weighted using examination survey weights, and standard error is calculated accounting for complex survey design.

[b]Children with race/Hispanic origin classified as "other" are included in overall estimates, but not separately reported.

[c]Weight status categories based on the 2000 CDC growth charts. Children with underweight are included in overall estimates, but not separately reported.

[d]Income categories based on family income to poverty level ratio (FIPR). A FIPR < 1.85 qualifies students for reduced priced lunch. Children with missing income are included in overall estimates, but not separately reported.

Table 2.

Locomotor and object control subtest raw score, children aged 3–5 years, United States, 2012

	Locomotor raw score		Object control raw score	
	n	Mean (SE)	n	Mean (SE)
Total	330	28.2 (0.5)	338	21.0 (0.30)
Sex				
Boys[a]	167	26.8 (0.9)	170	22.8 (0.6)
Girls	163	29.7 (0.6) **	168	19.2 (0.6) **
Age (years)				
3	100	20.5 (1.2)	106	15.7 (0.7)
4	112	29.7 (0.7)	113	20.4 (0.7)
5	118	33.6 (0.8) *	119	26.6 (0.9) *
Race/Hispanic origin[b]				
Non-Hispanic white[a]	132	27.2 (0.8)	133	20.6 (0.4)
Non-Hispanic black	70	31.1 (1.1) **	70	22.5 (0.5) **
Hispanic	110	29.8 (0.9)	116	22.1 (0.8)
Weight status[c]				
Normal weight[a]	219	28.7 (0.8)	227	21.1 (0.4)
Overweight	51	26.8 (1.2)	51	20.3 (1.1)
Obese	53	28.7 (1.2)	53	21.7 (1.3)
Income[d]				
FIPR < 1.85[a]	174	28.4 (1.0)	177	21.3 (0.7)
FIPR ≥1.85	129	28.2 (0.6)	133	20.8 (0.7)

Data source: CDC/NHANES National Youth Fitness Survey

Estimates (except sample size) are weighted using examination survey weights, and estimates of error (standard error) are calculated accounting for complex survey design.

* Significant linear trend across age groups

** Significant difference from reference group

[a] Denotes reference group for statistical comparisons.

[b] Children with race/Hispanic origin classified as “other” are included in overall estimates but not separately reported.

[c] Weight status categories based on the 2000 CDC growth charts. Children with underweight are included in overall estimates, but not separately reported.

[d] Income categories based on family income to poverty level ratio (FIPR). A FIPR < 1.85 qualifies students for reduced priced lunch. Children with missing income are included in overall estimates, but not separately reported.

Table 3.

Locomotor and object control subtest standard score, children aged 3–5 years, United States, 2012

	Locomotor raw score		Object control raw score	
	n	**Mean (SE)**	**n**	**Mean (SE)**
Total	330	10.0 (0.2)	338	8.5 (0.1)
Sex				
Boys[a]	167	9.5 (0.3)	170	8.6 (0.2)
Girls	163	10.5 (0.3)[**]	168	8.5 (0.2)
Age (years)				
3	100	9.4 (0.4)	106	8.6 (0.2)
4	112	10.5 (0.3)	113	8.4 (0.2)
5	118	10.0 (0.3)	119	8.6 (0.3)
Race/Hispanic origin[b]				
Non-Hispanic white[a]	132	9.6 (0.2)	133	8.4 (0.2)
Non-Hispanic black	70	10.8 (0.5)	70	8.8 (0.2)
Hispanic	110	10.4 (0.3)	116	8.9 (0.3)
Weight status[c]				
Normal Weight[a]	219	10.1 (0.3)	227	8.6 (0.2)
Overweight	51	9.9 (0.4)	51	8.4 (0.3)
Obese	53	9.8 (0.4)	53	8.5 (0.4)
Income[d]				
FIPR < 1.85[a]	174	10.0 (0.4)	177	8.5 (0.2)
FIPR ≥1.85	129	10.0 (0.2)	133	8.5 (0.3)

Data source: CDC/NHANES National Youth Fitness Survey

Estimates (except sample size) are weighted using examination survey weights, and estimates of error (standard error) are calculated accounting for complex survey design

[**] Indicates that boys have a lower mean score than girls. No significant linear trend by age and no significant differences between reference category and the other categories were observed

[a] Denotes reference group for statistical comparisons.

[b] Children with race/Hispanic origin classified as “other” are included in overall estimates, but not separately reported.

[c] Weight status categories based on the 2000 CDC growth charts. Children with underweight are included in overall estimates, but not separately reported.

[d] Income categories based on family income to poverty level ratio (FIPR). A FIPR < 1.85 qualifies students for reduced priced lunch. Children with missing income are included in overall estimates, but not separately reported.