

# Different Development of Fundamental Movement Skill Vary by Sex: Evidence from Chinese 6-year-old Children<sup>†</sup>

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**Abstract:** This study conducted to assess and explore the gender-based differences in gross motor skill development of 6-year-old Chinese children. All participants, 6 years of age (254 males and 262 females), from 7 kindergartens in Hangzhou, a city of Zhejiang Province, China. Gross motor skills, including six locomotor and seven object control skills, were assessed using the test of gross motor development, third edition (TGMD-3). All subjects performed two trials of each gross motor skill, and the performances were video-recorded and scored. Assessment procedures were performed according to the standardized guidelines of the TGMD-3. The score of locomotor ( $31.57 \pm 5.97$ ) was higher than that of object control ( $29.09 \pm 6.72$ ). Furthermore, boys had significantly higher object-control ( $p=0.010$ ) and Gross Motor Skill scores ( $p=0.033$ ) than girls. In the locomotor test, boys were better than girls in the run ( $p=0.000$ ) and girls were better than boys in the skip ( $p=0.031$ ). There are significant differences between boys and girls in the test of object control ( $p=0.002$ ), such as underhand throw ( $p=0.001$ ), two hand catch ( $p=0.006$ ), forehand strike self-bounced ball ( $p=0.042$ ), two-handed strike of a stationary ball ( $p=0.000$ ), kick a stationary ball ( $p=0.000$ ), and boys are better than girls. These results are partly consistent with those in other countries and regions but also have local characteristics. There are biological and sociological reasons for the gender differences in fundamental motor skills of 6-year-old children. It is recommended to strengthen the training of girls' object control motor skills and improve the moderate to vigorous-intensity physical activity (MVPA) among females.

**Keywords:** Children; Motor development; Locomotor; Object control; Assessment; Gender

## 1. Introduction

Physical activity brings a wide range of health benefits of life<sup>[1]</sup>. Although governments all over the world attach great importance of it, the physical activity of young people and children is still seriously insufficient<sup>[2]</sup>. However, women's physical inactivity is particularly problematic<sup>[3]</sup>. Stodden et al. propose the motor skills and physical fitness model, believing that the development of motor skills is the basis of promoting physical activity<sup>[4]</sup>, which has attracted much attention<sup>[5,6]</sup>. fundamental Motor Skills of children included Locomotor Skill (running, jumping, etc.) and Object Control Skill (bouncing ball, catching ball, etc.). Fundamental motor skills are positively correlated with many aspects of health<sup>[5]</sup>. Children with low fundamental motor skills tend to lack physical activity, have lower cardiopulmonary function, and are more likely to be obese<sup>[7]</sup>. As a result of regional differences, the study of fundamental motor skills, gender differences there are many different point of view, although the preschool private physical characteristics are similar, but many practice study found: preschool children the fundamental sports skills, there is a lot of gender differences. For China, a country with a

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large multi-ethnic population, ethnic and regional differences may also lead to inconsistencies in research results.

Early childhood connection is an important issue in preschool education all over the world. In order to promote the development of fundamental motor skills of children, scientific, reasonable and feasible courses should be designed according to the development of fundamental motor skills of children at the age of 6, and a sound motor skill learning and development system should be built.

Based on this, this study aims to use the revised Test of Gross Motor Development 3rd Edition (TGMD-3) to measure the fundamental motor skills level of 6-year-old children in urban Jinhua City, and to conduct in-depth analysis of the gender differences in fundamental motor skills of 6-year-old children.

## 2. Materials and Methods

### 2.1. Participants

**Table 1.** Participants Characteristics (N=516).

	Mean±SD		t	p
	Boys (n=254)	Girls (n=262)		
Age (years)	6.15±0.40	6.15±0.39	-0.094	0.925
Height (cm)	118.33±4.00	118.28±4.07	-0.140	0.889
Weight (kg)	22.19±3.37	21.97±3.19	-0.804	0.422
BMI (kg/m <sup>2</sup> )	16.14±1.52	15.94±1.51	-1.499	0.134

Random cluster sampling was used to recruit 516 healthy 6-year-old third-year kindergarten students from one local private kindergarten school in Hangzhou city, Zhejiang Province, China. The subjects were 254 boys and 262 girls (age, 6.15 ± 0.39 years; height, 118.31 ± 4.04 cm; weight, 22.08 ± 3.28 kg; body mass index [BMI], 16.04 ± 1.52 kg/m<sup>2</sup>). There were no gender differences in the age, height, weight and BMI of the selected children (table 1,  $p > 0.05$ ).

Exclusion criteria were, 1) known developmental disability, 2) obvious deformity and orthopedic injury in both upper and lower extremities within 6 months. 3) any illness during testing time.

Information on this study was provided with the Chinese version of the written information letter and by verbal explanation to the director of the school, teachers, parents or guardians, and students before their voluntary participation. Ethical approval was obtained from Faculty of Medicine ethics committee of Zhejiang Normal University (ZSDR2019013).

### 2.2. Gross Motor Skills

Gross Motor Development Test (TGMD) is a process-oriented test of gross motor skills of children aged from 3 to 10 years [20]. In 2000, it was revised to form the second edition of gross Motor Development Test (TGMD-2) [21]. In 2013, Dr. Ulrich revised TGMD-2, In 2015, TGMD-3 scoring form was open to use [24]. Previous studies using the TGMD-3 to assess the gross motor skill development of children in preschool and elementary school have been conducted in different countries [10,25,26,27,28], while the TGMD-3 has shown adequate reliability and validity among Children. The Test of Gross Motor Development, currently in its third edition (TGMD-3), is a valid and reliable tool for assessing 13 FMS (6 locomotor and 7 object-control skills) among children aged 3-10 years-old

During the test, the tester will first demonstrate the movement correctly once, and let the subjects watch it carefully. Then the subjects will complete the test independently according to the movements away the experimenter, and then conduct the second test. If the subject did not understand or perform the test correctly, the same tester provided

additional demonstrations, and all the actions were measured twice in a row. All skills were tested twice in a row, and each skill was rated on a scale of 3-5, A score of 1 was given for each performance criterion correctly performed and 0 for any absent or incorrectly performed criterion. There are 46 points for mobile skills and 54 points in object control skills, with a full score of 100.

### 2.3. Statistical Analysis

Descriptive statistics and Independent-samples T Test of were used to analyze the data. The significance level was set as  $p < 0.05$ . Data analysis was performed using IBM SPSS statistic version 21.0 for Windows.

## 3. RESULTS

### 3.1. Sex group Differences in FMS

**Table 2.** Comparisons of gross motor skills between boys and girls (N=516).

Skill	Mean±SD		t	p
	Boys (n=254)	Girls (n=262)		
Run	6.75±1.16	6.33±1.20	4.122	0.000
Gallop	5.66±1.49	5.54±1.51	0.939	0.347
Slide	5.08±1.69	5.13±1.57	-0.327	0.748
Skip	4.44±1.51	4.71±1.36	-2.177	0.031
Horizontal Jump	4.27±1.68	4.40±1.73	-0.887	0.374
Hop	5.37±1.73	5.46±1.55	-0.701	0.483
Overhand throw	5.20±1.81	5.21±1.70	-0.072	0.944
Underhand throw	4.45±2.11	3.87±2.00	3.318	0.001
Two Hand Catch	3.61±1.73	3.23±1.57	2.721	0.006
One Hand Stationary dribble	4.24±1.30	4.38±1.08	-1.377	0.169
Forehand Strike of Self-bounced Ball	3.81±1.31	3.60±1.15	2.030	0.042
Two Hand a Stationary Ball	3.64±1.92	2.91±1.65	4.794	0.000
Kick a Stationary Ball	5.42±1.63	4.86±1.61	4.009	0.000
Locomotor	31.57±6.06	31.57±5.88	-0.008	0.995
Ball Skills	30.12±7.83	28.05±6.45	3.37	0.002
FMS	61.75±11.73	59.70±10.60	2.15	0.033

As can be seen from the above table, there was almost no difference between boys and girls in the locomotor skills of 6-year-old children ( $P > 0.993$ ). The object control skill of girls was higher than that of boys ( $P = 0.001$ ). The gender difference in FMS was statistically significant ( $P = 0.032$ ). In the locomotor skill, boys were better than girls in the running ( $p=0.000$ ) and girls were better than boys in the skip ( $p=0.030$ ). In the object control skill, boys were better than girls in the underhand throw ( $p=0.001$ ), two hand catch ( $p=0.007$ ), forehand strike self-bounced ball ( $p=0.043$ ), two-handed strike of a stationary ball ( $p=0.000$ ), kick a stationary ball ( $p=0.000$ ).

## 4. Discussion

There are gender differences in some fundamental motor skills of 6-year-old children. The formation and development of the differences had biological and sociological reasons. It is suggested to strengthening the training of girls' object control motor skills and improve the level of Moderate-to-vigorous physical activity among females.

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