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Comparisons of Gross Motor Development of American and Chinese Preschoolers Children: A Pilot Study

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The purpose of the present study was to examine similarities and differences in the development of gross motor skills among four-year-old American and Chinese children. One hundred (53 boys and 47 girls) four-year-old children from Memphis, Tennessee, US (24 boys and 26 girls) and from Rizhao, Shandong Province, China (29 boys and 21 girls) were tested on six gross motor skills selected from the Test of Gross Motor Development-2 (TGMD-2). The results of a 2 (groups) ×2 (gender) ANOVA showed a significant group difference on running, kicking, and catching skills ($p < 0.05$) with American children having better performance in running and kicking, but with Chinese children having better scores in catching. Girls performed better in hopping skills than boys, but boys performed better in kicking. Further investigations are needed using the full scale of the TGMD-2 on children at multiple locations to confirm the findings. The implications for early childhood educators are discussed.

Keywords: early childhood, gross motor skills, a comparative study, TGMD-2

Introduction

Physical movement is essential for healthy development during early childhood (Bresson & King, 2022; Cameron, Cottone, Murrah, & Grissmer, 2016; Morrison, 2015; NAEYC, 2019; Piek, Dawson, Smith, & Gasson, 2008; Rivkin, 2014; Taverna, Tremolada, Tosetto, Dozza, & Zanin Scaratti, 2020). Preschoolers enjoy running, jumping, chasing, swinging, and throwing and catching balls. Such gross motor activities can positively contribute to their physical and cognitive development (Bresson & King, 2022; Copple & Bredekamp, 2009; Furmanek, 2014; Kostelnik, Soderman, Whiren, & Rupiper, 2015; NAEYC, 2019; Niemisto et al., 2019). Gross motor skills refer to many variations of fundamental movements typically developed during early childhood, including running, throwing and retrieving balls, riding tricycles, sliding, jumping, and chasing others (Bresson & King, 2022; Copple & Bredekamp, 2009; Izumi-Taylor, Li, & Ro, 2023; Pica, 2013). However, physical maturation does not guarantee preschoolers' development of gross motor skills (Epstein, 2014), and they cannot

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learn those motor skills through just playing (Gallahue, 1995; Logan, Robinson, Wilson, & Lucas, 2012; Manross, 2000; Pica, 2013). Adequate physical activities that promote children's gross motor skills are important to retain healthy bodies because it was found inactivity is one of the biggest causes of obesity in young children (Bresson & King, 2022; Dow, 2010; Izumi-Taylor & Morris, 2007; Morrison, 2015; Williams et al., 2008). Therefore, preschoolers need teachers' help and appropriate physical environments in developing gross motor skills (Bresson & King, 2022; Izumi-Taylor et al., 2023; NAEYC, 2019; Sari & Izzah, 2021).

Teachers, physical education teachers, and parents can provide opportunities for children to experience and practice their gross motor skills (Bresson & King, 2022; Logan et al., 2012) because preschoolers are active learners who need to move and learn from moving (Bresson & King, 2022; Morrison, 2015; Parlakian & Lerner, 2010; Sisson & Lash, 2017). Children are innately drawn to moving around their environments, and they consequently promote their physical and cognitive development (Battaglia, Alesi, Tabacchi, Palma, & Bellafiore, 2018; Bresson & King, 2022; Cameron et al., 2016; Gandotra et al., 2022; Gomes, 2021; Taverna et al., 2020). Research evidence has shown that children's gross motor development is also impacted by family and environmental factors (Niemisto et al., 2019; Sari & Izzah, 2021; Zheng, Ye, Korivi, Liu, & Hong, 2022). Generally, school is the main environment where many children actively participate in physical activities (Bailey, 2006; NAEYC, 2019), and such authentic environments encourage children's creativity through those activities. It is helpful for educators to promote children's gross motor development at this critical stage of life (Edwards, Bayless, & Ramsey, 2009; NAEYC, 2019; Sari & Izzah, 2021). Moreover, socio-economic and cultural differences play an important role in children's gross motor skill development (Bardid et al., 2016; dos Santos, Pacheco, Basso, & Tani, 2016; Downing, 2017). However, focused comparative studies of children's gross motor skills are limited.

The Purpose of the Study

The purpose of the current pilot study was to examine similarities and differences in the development of gross motor skills among American and Chinese children at age four. Four year olds were chosen because they are becoming more mature and have greater control of their bodies than three year olds (Gonzalez-Mena, 2014; Morrison, 2015). Also, they are beginning to work on motor skills, including balancing, hopping, and jumping; thus, understanding their physical and motor development enables educators to recognize why active learning is crucial to preschoolers (Morrison, 2015). At the age of four, children continue to work on the skills that they began as three year olds (Gonzalez-Mena, 2014; NAEYC, 2019). Findings from this study could support educators in better understanding the ways in which they shape and apply their beliefs about the importance of gross motor skills to preschoolers.

As cultural beliefs, perceptions, and values can sway the goals of education (Izumi-Taylor & Ito, 2017), each country has its own ways of supporting young children's gross motor skills. Examining such development in the two different nations might provide best practices of early childhood education regarding physical education. Specifically, while quite a few previous related studies made comparisons with existing data, this study was conducted to address the following research questions using testing results of children on six selected items of TGMD-2: (1) Are there significant differences in the development of gross motor skills in American and Chinese children aged four? (2) Are there gender differences in gross motor skills? This article first outlined the contexts concerning gross motor development of preschoolers in China and the US, comparative studies of gross motor skills using six selected test items from TGMD-2, followed by a report on the study, analyses of findings,

and discussions of implications and limitations for early childhood education.

Gross Motor Development of Preschoolers in China and the US

Early childhood education has become a focus in education reforms all over the world, and many Asian countries have tried to reform their early childhood education to prepare for global competitiveness (Li, Park, & Chen, 2017). Specifically, China has made dramatic changes in order to educate children for global competitiveness. China and the US are two countries with quite different socio-economic and cultural backgrounds. In China, the National Bureau of Sports and Physical Activities have issued the *Handbook of Standards for Physical Fitness Assessment* which includes an Early Childhood section (The Standards, 2003). This Handbook emphasizes the importance of promoting learning through physical activities and play, as well as fundamental skill development for children. In Hong Kong, one study has found that preschoolers' gross motor skills were affected by the schools' physical environments (Chow & Louie, 2013). Children from schools with plenty of open space for play and structured physical activity lessons have performed better in gross motor skills.

In the United States, although no standards are prescribed by governmental early childhood educational guidelines, the National Association for the Education of Young Children's position statements declare that early childhood teachers must provide children with both indoor and outdoor environments that are conducive to their fine and gross motor development (NAEYC, 2019). Likewise, Copple and Bredekamp (2009) articulate that all domains of development and learning (i.e., physical, social, emotional, and cognitive aspects) are important, and they are closely interrelated. Because of the growing obesity problem in the US, early childhood educators are urged to provide many opportunities for children to engage in more physical activities every day (Bresson & King, 2022; Morrison, 2015; Sisson & Lash, 2017). Generally, children aged four years should be able to walk backward toe to heel, jump forward 10 times without falling, walk up and down stairs independently, and turn somersaults (Martin & Fabes, 2009). Overall, it appears both countries do not have strict physical activity curricula, no specific standards, or guidelines mandated by their governments (Downing, 2017).

Comparative Studies of Gross Motor Skills Using the TGMD-2

Previous studies found different socio-economic and cultural backgrounds have contributed to children's gross motor skill development (Bardid et al., 2016; Chow, Hsu, Henderson, Barnett, & Lo, 2006; dos Santos et al., 2016; Downing, 2017; Qiaou & Li, 2013). For example, a study by Goodway and colleagues (Goodway & Branta, 2003) has reported that 77.4%~93.5% of U.S. children (mean age of 4.9 years) from low socio-economic classes experience motor difficulties when tested on the Test of Gross Motor Development—2nd edition (TGMD-2) (Ulrich, 2000). A recent study has examined actual and perceived motor competence levels of Belgian and US preschoolers, using TGMD-2 (Brian et al., 2018). The findings have indicated that Belgian children performed significantly higher than US children on both locomotor and object control skills. This study also has found some school environmental differences in gross motor skills related to school physical activity policies in the two countries. Children from different countries do not reach the same skill mastery levels even though fundamental skills are practiced in different cultures (dos Santos et al., 2016).

Bardid and colleagues (Bardid et al., 2016) have reported different results between Belgian children aged three and eight years compared to the US references sample using the TGMD-2 to assess the motor competence of children. Belgian children have had lower levels of motor competence than the US children, in addition to the age and gender differences observed in the test performances. Another comparative study conducted in three different countries (i.e., Portugal, China, and the US) used the TGMD-2, have found that American children

scored the highest mastery level in all ages followed by children from China and children from Portugal, respectively (dos Santos et al., 2016).

Preschoolers' gross motor skills in China, Japan, and the US have been examined by using the three selected test items of TGMD-2, and it has been found that American and Japanese children scored significantly higher in running than Chinese children (Downing, 2017). Japanese children have performed significantly higher in hopping than their American and Chinese counterparts. Chinese children were better in catching and scored higher than American and Japanese children. There were no gender differences among these children. These findings appear to be associated with each country's school curriculum (Downing, 2017).

Gender Differences in Gross Motor Development

Although gross motor development for preschool boys and girls go through the same sequence (Navarro-Paton et al., 2021), girls are more likely to show lower levels of object control and manipulation skills than boys (Morrison, 2015; Zheng et al., 2022). Typically, boys have higher object control skills (throwing, catching, and kicking) compared to girls (Hardy, King, Farrell, Macniven, & Howlett, 2010; Zheng et al., 2022), and boys have better overall motor proficiency than girls at the age of 6.8 years (Pienaar & Kemp, 2014). Others have found that boys scored higher in object control skills than their female counterparts (Bardid et al., 2016; Hume et al., 2008). Gender differences in specific motor skills are also observed in an English study with 168 preschoolers (Foulkes et al., 2015), showing that boys performed better on the kick than girls, while girls performed better at the run and hop than boys. However, girls tend to better perform fine motor skills and balance than boys (Morrison, 2015). It is also revealed that some studies found no gender difference between motor skills execution of boys and girls (Hume et al., 2008; Kirk & Rhodes, 2011; O'Dwyer, Foweather, Stratton, & Ridgers, 2011).

Many factors influence boys' and girls' gross motor development (Spessato, Gabbard, Valentini, & Rudisill, 2013), and such factors include opportunities for sports activities, encouragement from parents and guidance for physical activity (Gallahue, Ozmung, & Goodway, 2013), school curricula, gender-specific roles, and biological differences (Bardid et al., 2016). However, differences between boys and girls may be minimal before puberty (Pica, 2013; Spessato et al., 2013).

Method

Participants

The participants consisted of 50 four year olds from the southwestern United States (M = 24, F = 26) and 50 from Shandong Province, China (M = 29, F = 21). The respondent pool was selected through convenience of access and availability (Hatch, 2007). Each school had an initial consultation with the headmaster in addition to a parents' meeting. In the American school, the children engaged in individual activities in spacious classrooms and ample outdoor physical activities every day. The Chinese children followed group-oriented activities, and the school offered limited spaces in outdoor environments which were overcrowded, compared to the American school. Relative to the access granted to the American children, the Chinese children's outdoor access was limited and discouraging because of the frigid temperature.

The Institutional Review Board at the University of Memphis granted approval for the study. Parents were informed that children's participation was voluntary, and non-participation would not negatively affect their school performance. An informed consent was signed by each child's parent/guardian before the testing

started.

Measuring Instrument

TGMD-2 is a widely used standardized test instrument, which is a criterion and norm-referenced test battery (Ulrich, 2000). The test includes 12 fundamental motor skills that are divided into two subtests, i.e., six "Locomotor Subtest" skills and six "Object Control Subtest" skills. We selected six out of 12 skills for the effectiveness and feasibility considerations for this pilot study, given the fact of a special age group of young children who were used as subjects. Specifically, the following six skills were selected: Run, Hop, Horizontal Jump (Locomotor), and Stationary Dribble, Catch, Kick (i.e., Object Control).

A gym measuring at least 65 feet by 40 feet was used in each of the three test locations in the two countries. In addition, four cones and two playground balls (one of which was about 8-in. to 10-in. diameter for dribbling and kicking test, and another one of which was about 4-in for catching test) were used.

Data Collection

Each test skill includes three-five performance criteria (Ulrich, 2000). Scoring is based on the presence (1) or absence (0) of each performance criteria. Two trials of each skill are scored using a checklist. The sum of these scores for the six skills is the total score, ranged from 0 to 24, with a higher score indicating greater proficiency.

All assessors involved in the study were first trained by using the video clips specially made for this study to become familiar with the performance criteria and scoring procedure. The practice sessions included watching a video clip which depicts skill execution, scoring the performance, and discussing questions related to performance criteria and so on. The training continued until the required 90% agreement among multiple assessors had been met, then the data collection started.

Children were tested in a small group of two or three. They were brought to the testing area and asked to remove their shoes to take height and weight measurements first. The participants were then sent to the test station. They were given a demonstration of the test skill, and were instructed to do exactly what they just had observed. Each child completed two test trials for each of the six test skills. The assessor evaluated the participant using a grading system ("✓" for yes, "×" for no) based on performance criteria. As children completed six test items, they returned to their classroom.

Data Analysis

The average score of the two test trials for each of the six test skills was calculated for each of the children. This test performance score was used for further data analyses. First, descriptive statistics were conducted with both genders for each of the two groups (i.e., American and Chinese preschoolers). Second, a 2 (group) × 2 (gender) was conducted on test performance scores for each of the six test skills to examine if there would be any significant differences on test performances between the groups and the genders. Cohen's D effect size was also computed to examine the strength of the effects. Significance was set at an alpha level of 0.05.

Results

A total of 100 children completed the study. Table 1 presents the group means of test scores and standard deviations in boys and girls of the two different cultural background groups.

Table 1

Group Means and Standard Deviations of the Performance Scores for the Six Test Skills in Boys and Girls of the Two Groups

	Run	Hop	H-Jump	Dribble	Kick	Catch
American						
Boys (*n*=24)	3.5 ±0.66	2.02 ±1.5	2.29 ±1.24	1.67 ±1.42	3.56 ±0.76	1.54 ±0.66
Girls (*n*=26)	3.67 ±0.42	2.60 ±1.62	2.59 ±1.09	1.50 ±1.34	3.15 ±0.89	1.73 ±0.59
Total (*n*=50)	3.59 ±0.55	2.32 ±1.57	2.45 ±1.16	1.58 ±1.37	3.35 ±0.85	1.64 ±0.62
Chinese						
Boys (*n*=29)	2.55 ±0.90	2.38 ±1.09	1.53 ±0.69	1.36 ±1.19	1.52 ±0.59	3.07 ±.77
Girls (*n*=21)	2.88 ±0.84	3.07 ±1.33	2.64 ±0.78	1.88 ±1.33	1.33 ±0.70	2.74 ±0.78
Total (*n*=50)	2.69 ±0.88	2.67 ±1.24	2.00 ±0.91	1.58 ±1.27	1.44 ±0.64	2.90 ±0.78
Total						
Boys (*n*=53)	2.98 ±0.92	2.12 ±1.29	1.87 ±1.04	1.50 ±1.30	2.44 ±1.22	2.35 ±1.03
Girls (*n*=47)	3.32 ±0.75	2.81 ±1.50	2.62 ±0.95	1.67 ±1.34	2.34 ±1.22	2.18 ±0.84
Total (*n*=100)	3.14 ±0.86	2.50 ±1.42	2.23 ±1.06	1.58 ±1.31	2.40 ±1.22	2.27 ±0.95

Note: The max scores: Run—4, Hop—5, Horizontal Jump—4, Dribble—4, Kick—4, Catch—3.

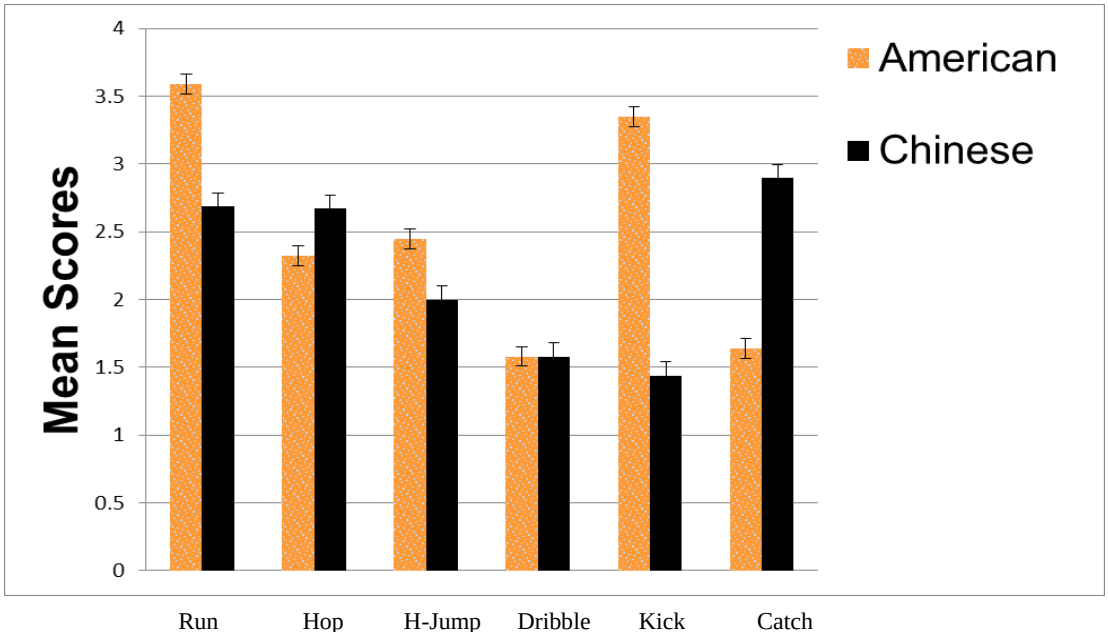

Figure 1. Group means of the performance scores for the 6 test skills in the two groups.

The results of ANOVA showed a significant Group effect ($p < 0.05$) on run, kick, and catch skills, $F_{(1, 96)}$ = 35.1, ES = 1.05; $F_{(1, 96)}$ = 168.6, ES = 1.57; and $F_{(1, 96)}$ = 76.6, ES = 1.33 respectively. Specifically, for the run and kick test, American children scored significantly higher than the Chinese children regardless of gender, and it was the opposite for the catch skill (Figure 1). In addition, a gender effect on the hop and kick test was revealed, $F_{(1, 96)}$ = 5.1, ES = 0.49 and $F_{(1, 96)}$ = 3.96, ES = 0.08 respectively with $p < 0.05$. Girls scored significantly higher for the hop test, but boys performed significantly better for the kick test. Finally, an interaction between Group and Genders was found for the jump skill test, $F_{(1, 96)}$ = 4.2, $p < 0.05$. The follow-up test showed that Chinese girls performed significantly better than Chinese boys (ES = 1.22), however, no such a gender difference for American children was observed. No other significant effect was detected.

Discussion

This study examined similarities and differences in the development of American and Chinese children's gross motor skills and focused on following two questions: (1) are there significant differences in American and Chinese children's gross motor skills? And (2) are there gender differences in gross motor skills? Each research question was discussed accordingly.

Existence of Similarities and Differences in American and Chinese Children's Gross Motor Skills

The results of this study revealed significant differences between the American and Chinese children in three of the six testing skills. For the locomotor skills (i.e., running and kicking) American children performed better than Chinese children, but Chinese children were better at catching. These findings appeared to be consistent with the fact that different school environments influenced these participants' gross motor skill development even at very young ages (Bresson & King, 2022; dos Santos et al., 2016; Downing, 2017; Morrison, 2015; NAEYC, 2019; Niemisto et al., 2019; Zheng et al., 2022). The Chinese school's outdoor environments were limited while the American school offered ample spaces and freedom to explore outdoors. Providing safe and adequate physical outdoor environments to move and explore freely is one of the most important factors in the development of preschoolers' gross motor development (Bresson & King, 2022; Edwards et al., 2009; Izumi-Taylor et al., 2023; Pica, 2013; Rivkin, 2014).

Different countries have varying physical activity guidelines for preschoolers, or even no strict governmental guidelines (Downing, 2017; NAEYC, 2019). In Hong Kong, preschoolers' gross motor skills were influenced by the schools' physical environments. Children from schools with plenty of open space for outdoor play performed better on gross motor skills (Bresson & King, 2022; NAEYC, 2019). A possible reason for American children outperforming Chinese children on locomotor skills could be related to greater participation in outdoor physical activities coupled with an emphasis on independence in activities of daily living at an early age compared to Chinese children (Bardid et al., 2016; Downing, 2017; Mayson, Harris, & Bachman, 2007; Morrison, 2015; NAEYC, 2019). The American children in this study appeared to be engaging in outdoor play activities freely, including running and kicking. These children had ample opportunities to choose outdoor play materials such as jumping, rolling, kicking, leaping, and crawling. Such play materials could support preschoolers' gross motor skills (Bresson & King, 2022; Morrison, 2015; Pica, 2013)

Existence of Gender Differences in American and Chinese Children's Gross Motor Skills

The current results indicated gender differences with American and Chinese girls scoring higher than American and Chinese boys in hopping, but boys performing better than girls at kicking. These findings were supported by the findings of Foulkes and others (Foulkes et al., 2015) which revealed that boys performed better on the kick than girls, while girls performed better at hopping than boys. In addition, Chinese girls did better in jump test performance than Chinese boys, but no such a gender difference for American children. While a few studies reported no gender differences in motor skills in very young children (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010; Downing, 2017; Hume et al., 2008; Kirk & Rhodes, 2011; O'Dwyer et al., 2011; Spessato et al., 2013), there were some studies reporting higher objects control skill proficiency in boys (Pienaar & Kemp, 2014; Zheng et al., 2022) but greater locomotor proficiency in girls (Hardy et al., 2010). Likewise, Zheng and colleges (Zheng et al., 2022) reported that age was the important factor influencing gender differences in proficiency in object control skills between boys and girls. This study also found that gender difference in children's proficiency in object control skill was more likely to be significant at age three, and the advantage

tended to favor boys.

Different test protocols could explain the conflicting results in the related research literature. For example, the present pilot study used a modified TGMD-2 test protocol to collect the data to examine how school environments could influence preschoolers' gross motor development (Bresson & King, 2022; Copple & Bredekamp, 2009; NAEYC, 2019).

Implications and Limitations

The findings of this study indicated that because both American and Chinese children's development of gross motor skills appeared to be related to their school physical activity guidelines and environments, educators need to provide adequate and spacious environments to preschoolers' gross motor development. Preschoolers need safe space to move freely and explore their capabilities. Since the Chinese children's outdoor environments were overcrowded, this could have impacted their physical development. Preschoolers require spacious outdoor environments in order to enhance their physical development. Additionally, as a part of physical activity guidelines, educators could focus on developing girls' object control skills as early as at age three since boys tend to develop these skills earlier than girls.

With new knowledge of early childhood education significantly impacting on the potential of teachers to connect around the globe, educators in China and the US could work together to expand their knowledge about how they can support children's gross motor development. By doing so, educators of both countries can understand how they may better help children's gross motor skills. Educators in each country can assess their own teaching guidelines and can reflect on their teaching styles in supporting children's gross motor development. The ways we care for our children may be different in both countries, but we certainly have a lot to offer to each other in the field of gross motor development.

The first limitation was that only six out of the 12 skills in the TGMD-2 were tested. Using all skills designated by the TGMD-2 could allow for a more thorough assessment of gross motor skill development. This could also allow the collected data to be compared with existing norms. The second limitation for this study was only one age group involved. Using different research teams to collect data in China and the US indicated another limitation. Although the two research teams used the same tools and procedures for training of evaluators, there could be slight discrepancies in scoring which could have led to a Type II error in the findings.

Future studies should include more locations and more different age groups to diversify representations of the sample. Video data collection should be considered to make assessments more objective and accurate. Finally, it would be beneficial to collect demographic data (e.g. socio-economic status, blended families) and to include children with special needs from different sociocultural backgrounds.

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