Development Characteristics of Fundamental Movement Skills of Children Aged 3-6 Years: A Systematic Review and Meta-Analysis

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Abstract

Objectives: Using the method of meta-analysis to compare and analyze the development characteristics of children’s FMS in countries with different development levels from the perspective of gender. Methods: We searched the PubMed, EBSCOHost, Embase and Web of Science databases for studies published up to April 5, 2021, empirical studies on the FMS of children aged 3-6 were included. Two researchers independently screened and extracted data according to inclusion and exclusion criteria. RevMan 5.4.1 software was used for meta-analysis to analyze the mastery level of global children’s FMS. Results: Finally, 18 articles were included. Results of the meta-analysis showed that whether in developed or developing countries, there was no statistical significance in comparing locomotor skill scores of boys and girls (all P > 0.05); however, both in developed countries and developing countries, the scores of object control skills generally appears that boys are better than girls (Developed: 0.48 [95% CI 0.40, 0.56], Z=1.74, P<0.05, I²=0%; Developing: 0.53 [95% CI 0.30, 0.76], Z=4.53, P<0.05, I²=81%). Conclusion: From the perspective of gender, the developmental characteristics of FMS in children showed consistent patterns in countries with different development levels. There is no difference in the mastery of locomotor skills among children of different genders, but there is a significant difference in the mastery of object control skills, and boys are significantly better than girls.

Keywords: Children, fundamental movement skills, meta-analysis.

1. INTRODUCTION

PA brings many health benefits to children. It is not only important to maintain physical health, such as heart and lung health and better weight status (Lubans et al., 2010), but also to support cognitive and social development in childhood. However, insufficient PA will have a negative impact on children in many aspects (Okely et al., 2001). The study found that preschool children should take PA for at least 3 hours a day (Wood et al., 2020), but the compliance rate is only 42% - 50% (Pate et al., 2015). Studies have shown that sports skills can promote PA, which lays a solid foundation for a person’s lifelong sports activities (Stodden et al., 2008). FMS is the basic ability and skill for children to perform a series of organized basic movements (Wick et al., 2017), it is the basis of complex PA and more professional motor skill (Bardid et al., 2016), it includes locomotor skills (such as running and jumping) and object control skills (such as catching and kicking), it plays a vital role in using more professional and complex skills in playing, games and sports (Wick et al., 2017). Studies have shown that overweight or obese children are often positively correlated with the ability of FMS (Logan et al., 2012). Children aged 3-6 are the key age group for the development of FMS (Gallahue & Donnelly, 2007). However, in recent years, the development of children’s FMS shows a downward trend (Bryant et al., 2014), which needs extensive attention. However, FMS does not develop naturally. It takes time to learn and practice before it can be mastered (Stodden et al., 2008).

As for the description of influencing factors of children’s FMS, previous studies have shown that there are obvious differences in children’s mastery of FMS in different countries, but whether the development law of boys and girls in different countries is consistent has not been studied. Taking this as the starting point, this paper uses the meta-analysis tool to analyze the currently published studies on children’s FMS, in order

to provide some references for the future research of FMS.

2. METHODS

2.1 Search Strategy

Three English databases including PubMed, EBSCOhost, EMBASE and web of science were searched on April 5, 2021. The key words used in the search were: child, children, preschoolers, fundamental movement skills, fundamental motor skills, gross motor, physical activity and TGMD.

Title, abstract and keyword search fields were searched using the following search strategy: child OR children* OR preschoolers* AND fundamental movement skills* OR fundamental motor skills* OR gross motor* OR physical activity* AND TGMD.

2.2 Inclusion Criteria

2.2.1 Type of Study

The evaluation of children’s mastery of FMS is based on on-site evaluation or video evaluation.

2.2.2 Type of Participants

The participants were healthy children aged 3-6.

2.2.3 Research Design

The study was divided into boys’ group and girls’ group.

2.2.4 Measuring Tools

Children’s mastery of FMS was evaluated by the TGMD-2 evaluation tool.

2.2.5 Type of Outcome Measure

Includes the raw scores for locomotor skills and object control skills.

2.3 Data Extraction

According to the research needs, two searchers independently extracted the relevant indicators included in the literature. The extracted contents mainly include: first author, publication period, sample size, research location, gender, age, outcome index and other relevant data.

2.4 Statistical Considerations

This paper uses Revman 5.4.1 software for meta-analysis, the outcome indicators of the included literatures were continuous variables, and the standard mean difference (SMD) and its 95% confidence interval (95% CI) were selected as the effect size indicators. At the same time, $I^2$ value was used to test the heterogeneity among the studies. When $I^2 < 50\%$, there was no significant heterogeneity among the studies. Fixed effect model was used. On the contrary, random effect model is used. The subgroups were merged in the same way.

3. RESULTS

3.1 Search Results

We obtained 678 articles through three data retrieval, and obtained 3 articles from the pearling of reference list, 681 in total. It was imported into the document management software Note Express 3.2.0.7535, and 342 articles were included after removing the duplicate articles. After reading the title and abstract of the article, 34 articles were left. After further reading, 18 articles (19 studies) were included (Fig-1).

![Flow diagram of the study selection process](image-url)
3.2 Study Characteristics

A total of 19 studies were included, most of which were cross-sectional studies, of which 11 were from developed countries and 8 from developing countries. There were 2005 boys and 1938 girls in the locomotor skill assessment, 2209 boys and 2153 girls in the object control skill assessment, and the age ranged from 3 to 6 years. There are 14 articles on TGMD-2 and 4 articles on TGMD-3 (Table 1).

<table>
<thead>
<tr>
<th>Authors</th>
<th>Country</th>
<th>Level</th>
<th>Age</th>
<th>N</th>
<th>Boy</th>
<th>Girl</th>
<th>Design</th>
<th>Outcome</th>
</tr>
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<tbody>
<tr>
<td>Alessandro et al., 2018</td>
<td>Brazil</td>
<td>developing</td>
<td>5-6</td>
<td>158</td>
<td>82</td>
<td>76</td>
<td>CS</td>
<td>TGMD-2</td>
</tr>
<tr>
<td>Aye et al., 2017</td>
<td>Myanmar</td>
<td>developing</td>
<td>5</td>
<td>472</td>
<td>237</td>
<td>235</td>
<td>CS</td>
<td>TGMD-2</td>
</tr>
<tr>
<td>Aye et al., 2018</td>
<td>Japan</td>
<td>developed</td>
<td>5</td>
<td>60</td>
<td>34</td>
<td>26</td>
<td>CS</td>
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</tr>
<tr>
<td>Behan et al., 2019</td>
<td>Ireland</td>
<td>developed</td>
<td>5-6</td>
<td>367</td>
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<td>LM:200</td>
<td>CS</td>
<td>TGMD-3</td>
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<tr>
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<td>4-5</td>
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<td>133</td>
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<td>Freitas et al., 2018</td>
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<td>3-6</td>
<td>314</td>
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<td>159</td>
<td>CS</td>
<td>TGMD-2</td>
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<td>TGMD-2</td>
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<tr>
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<td>5-6</td>
<td>216</td>
<td>102</td>
<td>114</td>
<td>CS</td>
<td>TGMD-2</td>
</tr>
<tr>
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<td>developed</td>
<td>3-5</td>
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<td>3-6</td>
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</tbody>
</table>


3.3 Meta-Analysis Results

3.3.1 Gender differences in locomotor skills

Fig 2 shows the forest plot of comparison of the locomotor skills scores of boys and girls in developed and developing countries. Through the meta-analysis of 12 studies (1076 boys, 1027 girls) in developed countries and 7 studies (929 boys, 911 girls) in developing countries, the results show that whether in developed or developing countries, there is no difference in the mastery of locomotor skills between boys and girls (All P > 0.05).
3.3.2 Gender differences in object control skills

Fig 3 shows the forest plot of comparison of the object control skills scores of boys and girls in developed and developing countries. Through the meta-analysis of 12 studies (1280 boys, 1242 girls) in developed countries and 7 studies (929 boys, 911 girls) in developing countries, the results show that in both developed and developing countries, boys have better mastery of object control skills than girls, and all of them were statistically significant (Developed: 0.48 [95% CI 0.40, 0.56], Z=11.74, P < 0.05, I²=0%; Developing: 0.53 [95% CI 0.30, 0.76], Z=4.53, P < 0.05, I²=81%).

Fig 2: Forest plot of locomotor skills scores

Fig 3: Forest plot of object control skills scores

3.4 Sensitivity analysis and risk assessment

Sensitivity analysis was performed on 19 included studies, and the results were relatively stable after each study was eliminated in turn.

Funnel plot analysis of the included studies shows that the symmetry of the two dimensions of locomotor skills (Fig 4) and object control skills (Fig 5) is good, suggesting that the risk of bias may be small.
4. DISCUSSION

A large number of studies have shown that there are gender differences in children’s FMS, but whether the results are consistent in countries with different levels of development has not been discussed. This meta-analysis included 18 articles, including 19 studies, the results show that there is no gender difference in the mastery of locomotor skills, but there is gender difference in the mastery of object control skill, and boys are better than girls. This shows that there is no regional difference in gender difference in FMS.

This result may be due to the physiological differences between boys and girls, which has been suggested by Butterfield et al. (Butterfield et al., 2012), it may also be influenced by family environment, teachers, society and so on (Garcia, 1994; Thomas & French, 1985). It is generally encouraged boys should take part in more control sports and girls should develop dance sports (Payne & Isaacs, 2017; Fagot & Leinbach, 1989; Hardy et al., 2012). Other studies have shown that children’s FMS can be improved through intervention (Barnett et al., 2010), which can show that gender differences can be reduced through intervention.

This paper compares the children in developed and developing countries, but it is difficult to rule out the heterogeneity of family income. The heterogeneity of object control skills development of children in developing countries is relatively high, which needs further discussion.
5. CONCLUSION

From the perspective of gender, the developmental characteristics of FMS in children showed consistent patterns in countries with different development levels. There is no difference in the mastery of locomotor skills among children of different genders, but there is a significant difference in the mastery of object control skills, and boys are significantly better than girls.

Disclosure statement: The authors declare that no conflicts of interest.

Funding
This study was supported by the grant (Y202045737) from Education Department of Zhejiang Province. The authors are thankful to Zhejiang Normal University for the support.

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