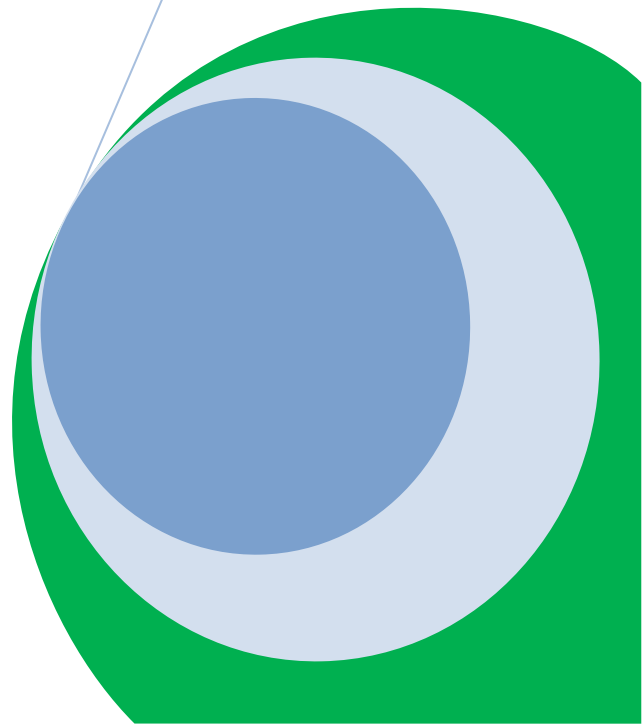


Fundamental movement skill competence among 10-11 year old children: Year 2 PEPASS Physical Activity Project

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Dr Lawrence Foweather
Physical Activity Research Officer
Liverpool John Moores University



The PEPASS Project: Fundamental Movement Skills

1. Introduction

- 1.1 In early childhood, children begin to learn a group of skills called fundamental movement skills (FMS). Such skills are classified as locomotor skills, object-control skills or stability skills. Locomotor skills include skills such as hopping, skipping, jumping and running. Object-control skills are kicking, catching and throwing, whilst examples of stability skills include dynamic balance or turning.
- 1.2 FMS are the building blocks of movement, forming the basis of more advanced and specific specialised actions, and representing the foundation for future participation in physical activity and sport^{1,2,3}. For example, the badminton smash, tennis serve, javelin throw, and basketball/netball shoulder pass are advanced versions of the overarm throw. Consequently, failure to master FMS may hinder development of specialised sport skills, and provide a barrier to participation in later life as children will not have the necessary skills to be active.
- 1.3 Research has shown that children who are highly skilled are more active than less skilled children^{4,5,6}. In addition, skill competence is associated with numerous other health benefits, including increased participation in organised sport⁷, higher levels of fitness^{4,8}, reduced risk of overweight or obesity^{4,6,9} and higher perceived competence⁴.
- 1.4 Descriptive studies conducted in Australia have revealed worryingly low rates of FMS proficiency in children^{5,10,11}. Little is known about the current levels of skill proficiency of UK children. One recent study⁴ of 152 Liverpool primary school children (age 9-10) found that prevalence of proficiency in 8 FMS was low-moderate in boys (ranging from 23% to 61%) and low in girls (6% to 33%). Given the potential health benefits associated with skill competence, it was decided that the FMS proficiency within a sub-sample of Year 6 children (64 boys, 76 girls) involved in the PEPASS project in Wigan would be examined.

2. Methods

- 2.1 Six skills were assessed using a modified protocol (Department of Education and Training, NSW, 2000). This included **three locomotor skills** - the hop, vertical jump, and sprint run, and **three object control-skills** - the catch, kick, and overarm throw.
- 2.2 Two trained assessors analysed skill competence using video analysis and process-based methods (which focus on the way the skill is performed rather than the product of the performance). Table 1 describes the skill assessment task criteria used. A score was then calculated for each skill based on the total number of skill components performed correctly⁸.

2.3 The prevalence of **proficiency** in each skill was investigated to examine how many children pass through the skill proficiency barrier. It is not enough to simply be able to perform the skill; children need to master a skill to incur the benefits associated with skill proficiency². Proficiency was defined as possessing all, or all but one required component of a skill.

2.4 Gender differences were examined for skill proficiency and the number of skill components checked as present. In addition, a "total skill score" (sum of all 6 skills) summary variable was formed. Two further summary variables - "locomotor skills" (sum of hop, vertical jump, and sprint run) and "object-control skills" (sum of kick, catch, and throw) were created to investigate potential differences between different categories of movement skills.

Table 1. Fundamental movement skill assessment tool.

Skill	Task	Criteria
Hop	Hop as fast as you can over a distance of 10m	<ol style="list-style-type: none"> 1. Support leg is bent in preparation and then straightens to push off 2. Takes off and lands on forefoot 3. Swing leg moves in rhythm with support leg 4. Able to hop on both right and left legs 5. Head and trunk stable with eyes focused forward 6. Arms bent and move to assist leg action
Vertical Jump	Jump and touch the wall as high as you can	<ol style="list-style-type: none"> 1. Eyes focused forwards or upwards throughout the jump 2. Crouch with knees bent and arms behind the body 3. Forceful upward thrust of arms as legs straighten to take off 4. Legs straighten in the air 5. Contact ground with front part of feet and bend knees to absorb force of landing 6. Balanced landing with no more than one step in any direction
Sprint run	Run a distance of 30m as fast as possible	<ol style="list-style-type: none"> 1. Lands on balls of feet 2. Eyes focused forward, head and trunk stable throughout the run 3. High knee lift (thigh almost parallel to the ground) 4. Knees bend at right angles during the recovery phase 5. Arms bent at least 90 degrees 6. Arms driving forward and back in opposition to legs
Catch	Catch a tennis ball thrown underarm from a distance of 10m	<ol style="list-style-type: none"> 1. Eyes are focused on the ball throughout the catch 2. Feet move to put body in line with object 3. Hands move to meet ball 4. Hands and fingers positioned correctly to catch the ball 5. Catch and control the ball with hands only (well-timed closure) 6. Elbows bend to absorb force of the ball
Overarm throw	Throw a tennis ball overarm as far as possible towards a target area	<ol style="list-style-type: none"> 1. Eyes are focused on the target throughout the throw 2. Stand side-on to the target 3. Arm moves in a down-ward and backward arc 4. Step towards the target with foot opposite throwing arm during the throw 5. Hip then shoulders rotate forward 6. Throwing arm follows through down and across the body
Kick	Kick a size 4 ball towards a target as hard as possible	<ol style="list-style-type: none"> 1. Eyes are focussed on the ball throughout the kick 2. Forward and sideward swing of arm opposite kicking leg 3. Step forward with non-kicking foot placed near the ball 4. Hip extension and knee flexion of at least 90 degrees during preliminary kicking movement 5. Contact the ball with the top of the foot (a "shoelace" or instep kick) 6. Kicking leg follows through high towards the target after ball contact

3. Results

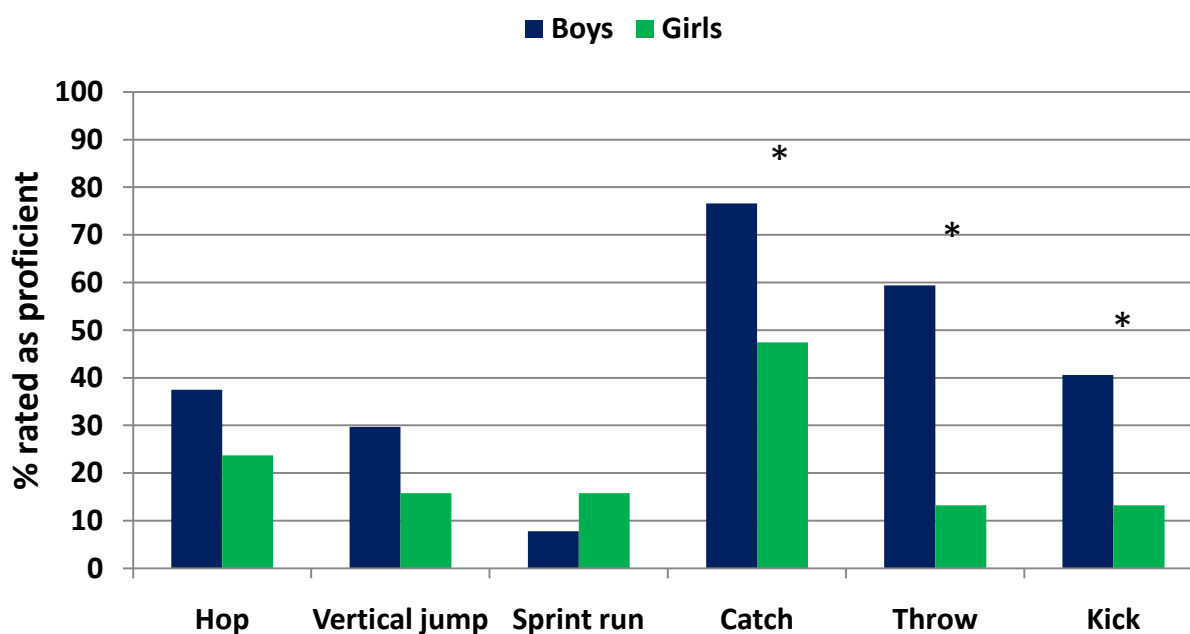
3.1 Figure 1 shows the percentage of children rated as proficient in FMS (Table data shown in the Appendix). In boys, levels of FMS proficiency did not exceed 60% in five out of six skills. Prevalence of proficiency was low in the sprint run (8%) and vertical jump (30%), moderate in the hop (38%), kick (41%) and throw (59%), and high in the catch (77%).

3.2 In girls, prevalence of proficiency did not exceed 25% in five skills; Prevalence of proficiency was low in the hop (24%), vertical jump (16%), sprint run (16%), throw (13%) and kick (13%), though around 1 in 2 girls were advanced at catching (48%). Catching and throwing represented boys' best skills, whilst girls performed best at hopping and catching. Prevalence of proficiency at specific components for each individual skill can be seen in the Appendix.

3.3 Figure 1 also shows that significantly more boys than girls were classified as proficient in the catch, throw and kick. However, no statistically significant gender differences were observed in the hop, vertical jump and sprint run skill assessments.

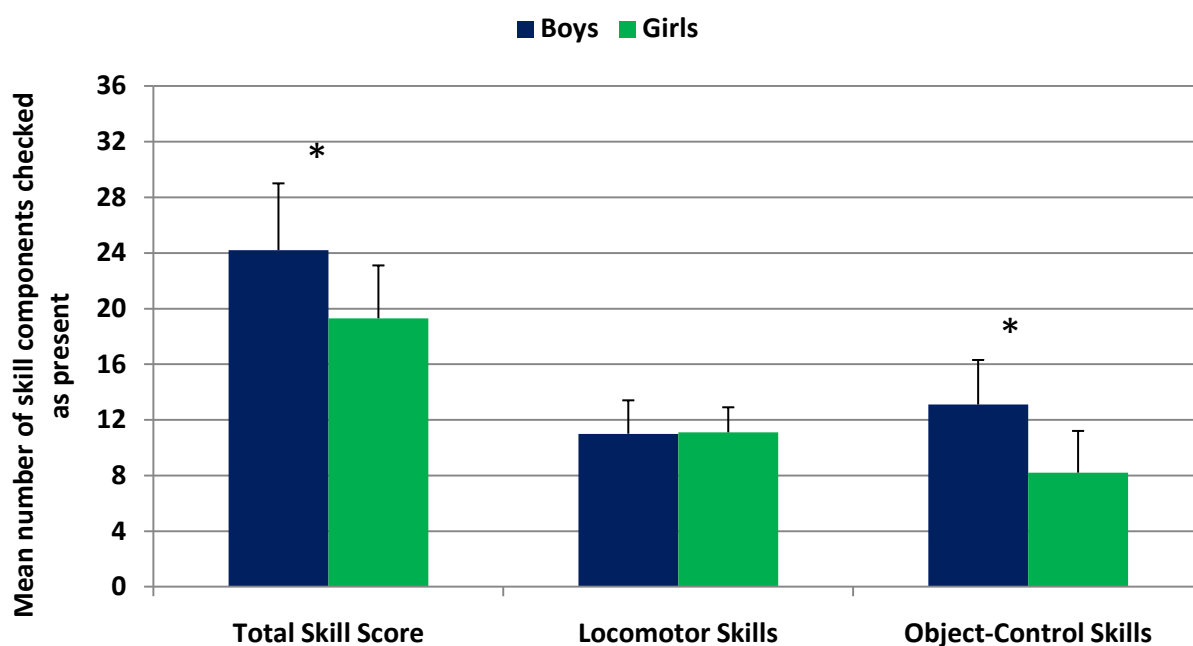
3.4 Figure 2 shows the mean number of skill components checked as present for each of the FMS composite scores (see the Appendix for individual skills). Overall, boys possessed significantly more skill components than girls (total skill score). When skills are divided into locomotor skills and object-control skills categories, gender differences only exist in object-control skills - there were no differences between boys and girls for locomotor skills.

Figure 1. Percentage of children classified as 'proficient' at FMS



Note. Proficient = possessing all or all but one required components of a skill

Figure 2. FMS summary variables: Mean number of skill components checked as present



4. Discussion

- 4.1** The large proportion of children rated as non-proficient in this sample is similar to results from studies of Australian children^{5, 10, 11} and recent findings in Liverpool primary school children⁴. The results suggest that there is significant potential to improve fundamental movement skill competence among children of this age.
- 4.2** The low levels of proficiency in most skills is concerning given that children have the capacity to master most fundamentals by 8 years of age (Payne & Isaacs, 2002). However, the development of fundamental movement skills is not automatic, in order to reach proficiency in FMS children need frequent encouragement; access to equipment and facilities; high quality instruction using developmentally-appropriate activities; opportunities to practice and refine the skills; and an appropriate learning environment¹².
- 4.3** Prevalence of proficiency in the vertical jump, hop and sprint run did not exceed 40% for boys or girls. This is important, as past research has shown that competence in locomotor skills in childhood is associated with lower levels of body fat, reduced BMI, and a smaller waist circumference^{4, 9}. It is also important that object-control skills are developed, as research has shown that children who are proficient in object-control skills go on to be fitter, more active adolescents^{13, 14}.
- 4.4** Gender differences in object-control skills may reflect the different activities which children typically participate in at this age. More boys play ball sports than girls and so have further

opportunities to develop skills such as kicking, catching and throwing¹¹. Conversely girls are more likely to participate in activities such as dance which do not reinforce object-control skills. Differences are also formed in unstructured settings such as school playtime.

4.4 This explanation supports the view that gender differences are environmentally and culturally induced, rather than biological. If similar opportunities for instruction, practice, encouragement, and feedback are provided to both boys and girls then observed gender differences can be reduced⁹.

5. Recommendations

5.1 For skill development, the nature of the physical activity is important - in order to improve skill competence, children need to be provided with opportunities for practice and instruction. Multi-skill clubs appear to provide a means for children to develop competence in movement skills and children should be encouraged to attend multi-skill club programmes at schools. However, as many children do not enrol in afterschool programmes, to influence motor skill development in all children it may be necessary to target primary school Physical Education (PE) programmes⁴.

5.2 Many primary classroom teachers lack confidence, time and resources necessary to run effective PE programmes. As many children are not reaching skill proficiency then professional development courses could be offered to primary school teachers to improve their confidence and competence at delivering activities to promote such skills. As well as children learning skills, the primary PE curriculum has a number of other objectives, including the promotion of physical activity. It is important that teachers who target physical activity do not do so at the cost of motor skill development

5.3 Early childhood (3-8 years) represents a 'window of opportunity' for FMS development¹². Whilst it is possible to enhance older children's skills levels, improvements are more difficult due to children having already established a movement form. Therefore young children should be targeted and provided with opportunities for skill development.

5.3 Girls performed less well than boys at object-control skills. Therefore, it is important to ensure that girls are provided with sufficient opportunities for skill development and access to equipment necessary to develop such skills. Remedial programmes could be offered if girls fail to reach skill proficiency.

5.4 It is vital that children develop competence in locomotor skills as they appear to be a key determinant of children's physical activity, fitness and body fatness⁴. It is pertinent to note that childhood object-control skill competence predicts physical activity and fitness in adolescence^{13,14}, so children need to learn all forms of movement skills.

6. References

1. Clark, J. E., & Metcalfe, J. S. (2002). The mountain of motor development: A metaphor. In J. E. Clark & J. H. Humphrey (Eds.), *Motor development: Research and reviews* (Vol. 2, pp. 163-190). Reston, VA: National Association of Sport and Physical Education.
2. Seefeldt, V. (1980). Developmental motor patterns: Implications for elementary school physical education. In C. Nadeau, W. Holliwell, K. Newell & G. Roberts (Eds.), *Psychology of motor behavior and sport* Champaign, IL: Human Kinetics.
3. Wickstrom, R. (1983). *Fundamental Motor Patterns* (3 ed.). Philadelphia: Lea & Febiger.
4. Fowweather, L. (2010). The effect of interventions on fundamental movement skills, physical activity and psychological well-being among children. Thesis (PhD). Liverpool John Moores University.
5. Hume, C., Okely, A., Bagley, S., Telford, A., Booth, M., Crawford, D., et al. (2008). Does weight status influence associations between children's fundamental movement skills and physical activity? *Research Quarterly for Exercise and Sport*, 79(2), 158-165
6. Wrotniak, B. H., Epstein, L. H., Dorn, J. M., Jones, K. E., & Kondilis, V. A. (2006). The relationship between motor proficiency and physical activity in children. *Pediatrics*, 118(6), e1758-1765.
7. Okely, A. D., Booth, M. L., & Patterson, J. W. (2001b). Relationship of physical activity to fundamental movement skills among adolescents. *Medicine and Science in Sports and Exercise*, 33(11), 1899-1904.
8. Okely, A. D., Booth, M. L., & Patterson, J. W. (2001a). Relationship of cardiorespiratory endurance to fundamental movement skill proficiency among adolescents. *Pediatric Exercise Science*, 13, 380-391.
9. Okely, A. D., Booth, M. L., & Chey, T. (2004). Relationships between body composition and fundamental movement skills among children and adolescents. *Research Quarterly for Exercise and Sport*, 75(3), p238-244.
10. van Beurden, E., Zask, A., Barnett, L. M., & Dietrich, U. C. (2002). Fundamental movement skills--how do primary school children perform? The 'Move it Groove it' program in rural Australia. *Journal of Science and Medicine in Sport*, 5(3), 244-252.
11. Booth, M. L., Okely, A. D., Denney-Wilson, E., Hardy, L., Yang, B., & Dobbins, T. (2006). *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2004 Full Report*.
12. Gallahue, D. L., & Donnelly, F. C. (2003). *Developmental Physical Education for All Children* (4 ed.). Champaign, IL: Human Kinetics.
13. Barnett, L.M., van Buerden, E., Morgan, P.J. Brooks, L.O. & Beard, J.R. (2008a). Does childhood motor skill proficiency predict adolescent fitness? *Physical Fitness and Performance*, 2137- 2144.
14. Barnett, L.M., van Buerden, E., Morgan, P.J. Brooks, L.O. & Beard, J.R. (2008b) Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health*, 1-8.

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APPENDIX

Figure 1. Gender differences in mean number of skill components checked as present

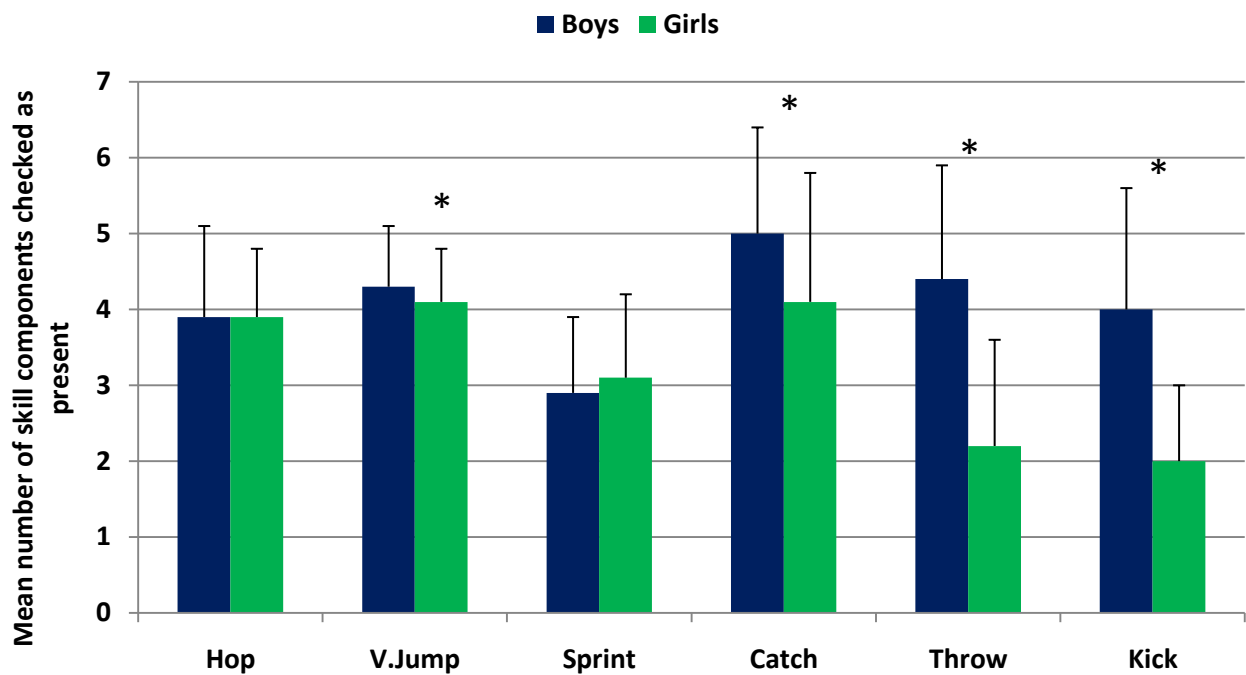


Table 1. Means & SD for number of skill components checked

Skill	Boys		Girls		Gender diff?
	Mean	SD	Mean	SD	P
Hop	3.9	1.2	3.9	0.9	0.90
V.Jump	4.3	0.8	4.1	0.7	0.03
Sprint	2.9	1	3.1	1.1	0.14
Catch	5	1.4	4.1	1.7	0.00
Throw	4.4	1.5	2.2	1.4	0.00
Kick	4	1.6	2	1	0.00
Total Skill Score	24.2	4.8	19.3	3.8	0.00
Locomotor Skills	11	2.4	11.1	1.8	0.90
Object-Control Skills	13.1	3.2	8.2	3	0.00

Prevalence of proficiency at fundamental movement skill components (Locomotor Skills)

Table 1. Prevalence of proficiency at the hop in boys and girls (%)

Skill component	Boys	Girls
1. Support leg is bent in preparation and then straightens to push off	85.9	88.2
2. Takes off and lands on forefoot	28.1	44.7
3. Swing leg moves in rhythm with support leg	67.2	64.5
4. Able to hop on both right and left legs	100	98.7
5. Head and trunk stable with eyes focused forwards	90.6	92.1
6. Arms bent and move to assist leg action	15.6	3.9

Table 2. Prevalence of proficiency at the vertical jump in boys and girls (%)

Skill component	Boys	Girls
1. Eyes focused forwards or upwards throughout the jump	100	100
2. Crouch with knees bent and arms behind the body	21.9	11.8
3. Forceful upward thrust of arms as legs straighten to take off	20.3	11.8
4. Legs straighten in the air	93.8	84.2
5. Contact ground with front part of feet and bend knees to absorb force of landing	98.4	98.7
6. Balanced landing with no more than one step in any direction	95.3	100

Table 3. Prevalence of proficiency at the sprint run in boys and girls (%)

Skill component	Boys	Girls
1. Lands on balls of feet	29.7	36.8
2. Eyes focused forward, head and trunk stable throughout run	96.9	97.4
3. High knee lift (thigh almost parallel to ground)	14.1	19.7
4. Knees bend at right angles during recovery phase	96.9	96.1
5. Elbows bent at least 90 degrees	17.2	35.5
6. Arms drive forward and back in opposition to legs	32.8	25

Prevalence of proficiency at fundamental movement skill components (Object-Control Skills)

Table 4. Prevalence of proficiency at catch in boys and girls (%)

Skill component	Boys	Girls
1. Eyes are focused on the ball throughout the catch	81.3	60.5
2. Feet move to place body in line with object	90.6	78.9
3. Hands move to meet ball	98.4	86.8
4. Hands and fingers positioned correctly to catch the ball	85.9	82.9
5. Catch and control ball with hands only (well-timed closure)	68.8	42.1
6. Elbows bend to absorb force of ball	79.7	60.5

Table 5. Prevalence of proficiency at the overarm throw in boys and girls (%)

Skill component	Boys	Girls
1. Eyes are focused on the target throughout the throw	65.6	92.1
2. Stand side-on to the target	81.3	18.4
3. Arm moves in a downward and backward arc	34.4	14.5
4. Step towards the target with foot opposite throwing arm during the throw	92.2	40.8
5. Hip then shoulders rotate forward	75	21.1
6. Throwing arm follows through down and across the body	89.1	36.8

Table 6. Prevalence of proficiency at the kick in boys and girls (%)

Skill component	Boys	Girls
1. Eyes are focused on ball throughout the kick	98.4	93.4
2. Forward and sideward swing of arm opposite kicking leg	62.5	3.9
3. Step forward with non-kicking foot placed near ball	60.9	38.2
4. Hip extension and knee flexion of at least 90 degrees during preliminary kicking movement	84.4	35.5
5. Contact the ball with top of foot (a "shoelace kick")	56.3	19.7
6. Kicking leg follows through high towards the target after ball contact	32.8	11.8