ORIGINAL RESEARCH

Mastery of fundamental movement skills among children in New South Wales: prevalence and sociodemographic distribution

AD Okely[1] & ML Booth[2]

[1]Faculty of Education and Metabolic Research Centre, University of Wollongong, New South Wales, Australia. [2]Department of Paediatrics and Child Health, The University of Sydney at The Children's Hospital at Westmead, New South Wales Australia.

Fundamental movement skills form the foundation for many of the specific motor skills employed in popular sports and leisure activities. Little data exist on the prevalence and socioeconomic distribution of fundamental movement skill mastery among young children in Australia. This study process-assessed performance on six fundamental movement skills in a randomly selected sample of students from Years 1 through 3 in the Sydney metropolitan area of New South Wales. The prevalence and sociodemographic distribution of mastery and near mastery for each skill and each skill component is reported for boys and girls in each school year. The findings revealed that the prevalence of mastery and near mastery of each of fundamental movement skill was generally low. Boys performed significantly better than girls in the run and in the four object-control skills (throw, catch, kick, and strike) whilst girls performed better than boys in the skip. There was no consistent association between prevalence of skill mastery and socio-economic status (SES), with only the kick and vertical jump for boys and catch, dodge, and vertical jump for girls differing across SES tertiles. Based on these results, we recommend that adequate curriculum time, resources, and professional development continue to be devoted to fundamental movement skills in NSW primary schools.

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Introduction

The development of mastery of fundamental movement skills among children through quality physical education is a potentially important contributor to successful and satisfying participation in sport, games and leisure activities common in the community. Fundamental movement skills form the basis of the specialised skills employed in many popular sports and other leisure activities. Our research has shown that those who lack fundamental movement skills are more likely to experience frustration and difficulty in learning more advanced skills[1]; have lower levels of health-related fitness[2]; participate less in organised sports and games[3]; and have higher levels of adiposity[4]. In addition, those who lack fundamental movement skills are more likely to experience the consequences of "public failure" or ridicule from peers[5], discouraging them from participating in organised sports and possibly reducing the likelihood of the development of a physically active lifestyle[6].

Fundamental movement skills are a key component of primary school physical education programs and research suggests that they are taught in approximately 95% of primary schools[1]. The New South Wales Schools Fitness and Physical Activity Survey (NSWSFPAS) 1997 assessed qualitative performance of six fundamental movement skills (run, vertical jump, catch, overhand throw, forehand strike and kick) in a randomly-selected sample of New South Wales (NSW) school students in Years 4, 6, 8 and 10 and found (with the exception of one skill) that the proportion of students who displayed mastery (proficient in all components) of a skill did not exceed 40%[7]. In response to these results, the NSW Department of Education and Training (DET) developed a teacher resource to support the teaching of FMS in NSW primary schools and recommended that all DET primary schools devote one hour per week to FMS development.

The present study process-assessed the performance of six fundamental movement skills in a randomly-selected sample of students from school Years 1 through 3 in the Sydney metropolitan area of NSW. The skills assessed varied slightly across the Years and were selected from *Get skilled: Get active. A K-6 resource to support the teaching of fundamental movement skills*[8]. This resource, consistent with recommendations from the NSWSFPAS, broadened the number of fundamental movement skills to 12, to address the implied gender bias towards boys and to reflect more accurately the skills inherent in a wider range of sports and games in which children participate.

In addition to monitoring the fundamental movement skills proficiency of children, it is beneficial to examine the sociodemographic distribution of fundamental movement skills in the population. If poor fundamental movement skills are found to be more prevalent among some groups of children, resources may be more directed towards those groups. Booth et al[7] found that fundamental movement skill proficiency was positively and consistently related to socioeconomic status among girls, but not as consistently among boys. However, these findings were among upper primary school (Years 4 and 6) and secondary school (Years 8 and 10) students; little evidence exists on the associations between socioeconomic status and fundamental movement skill proficiency among younger students.

This paper presents baseline findings on the prevalence and sociodemographic distribution of skill mastery (displaying correct performance on all components of a fundamental movement skill) and near-mastery (displaying correct performance on all but one of the components of a fundamental movement skill) for boys and girls in Years 1 through 3. It is part of a larger longitudinal study of the impact of the introduction of the *Get skilled: Get active* resource and of recommendations for greater curriculum time and development. This study provides the first comprehensive indicators of the proportion of young children in NSW who have mastered key fundamental movement skills and a benchmark against which progress may be measured.

Methods

Sample selection

Proportional random sampling of Department of Education and Training (DET) primary schools was conducted by the Australian Council for Educational Research (ACER) from those schools that intended to use the *Get skilled: Get*

active resource. The NSWSFPAS found that there were no differences in the prevalence of skill mastery, for either girls or boys, between those attending urban or rural schools, so only schools in the Sydney Metropolitan Region of NSW were included in the sampling frame to avoid the costs of long distance travel. In addition, special schools and schools with enrolments of fewer than 180 students were excluded from the sample to avoid the costs of visiting schools with low student numbers.

Eighteen primary schools were selected with the likelihood of selection being proportional to the size of the student enrolment. The ACER provided a list of all schools, with the selected schools highlighted. Selected schools which declined to participate in the study were replaced with the next school on the list. Once a school agreed to participate, classes were selected at random to participate. Within each school, one class was chosen at random from each of Years 1 through 3. Wherever possible, roll class lists (or other class lists in which students were not graded) were used as the basis for random selection of classes.

Data were collected by two teams of five teachers (one team of five per school) seconded from NSW DET primary schools for the project. All field team members underwent five days of training in fundamental movement skill assessment before data collection. Data were collected in schools over a two week period during school term 1, 1999. The University of Sydney Human Research Ethics Committee approved the study and the ethical guidelines laid down by this committee were adhered to throughout the study. Written consent from parents/carers was required for students to participate in the study.

Fundamental movement skill measurement

The following fundamental movement skills were assessed: hop, skip, side gallop, overarm throw, kick (stationary ball) and leap (Year 1); leap, kick, two-hand strike, dodge, sprint run, and catch (Year 2); static balance, sprint run, vertical jump, catch, kick (stationary ball), and overarm throw (Year 3). The components of these skills are presented in Table 3. The selection of these skills was based on the DET's planning guide for programming and teaching fundamental movement skills. The methods for assessing these skills have been described in detail elsewhere[8]. Briefly, each skill was composed of observable, behavioural components that together constitute a mature performance of the skill. Process-oriented assessments of fundamental movement skills were used in preference to product-oriented assessments because they identify more accurately specific topographical aspects of the movement[9]. The components of each skill were assessed by field staff by scoring each component as present or absent on four out of five trials. That is, if a student demonstrated the skill component on four out of five trials, they were recorded as possessing that skill component. Field staff were required to reach a 90% inter-observer agreement criterion for all skills on pre-coded videotapes. The reliability and validity of the skills and their components have been previously established[10].

The conventional method of reporting the results of fundamental movement skills are to report the proportion of students who have mastered all components of the skill[11,12]. However, one shortcoming of this reporting format is that it is difficult to judge what proportion of students might be close to

achieving mastery. Consequently, another format (near-mastery) in which the proportion of students who have mastered all but one component of each skill is reported. This format has been used effectively in previous studies[7].

For the purpose of planning skill development or educational programmes, it can be helpful to know the proportion of students who displayed each component of each skill. These two presentation formats (overall skill mastery/near-mastery and skill component mastery) are complementary and both will be used.

Sociodemographic measures

Students' date of birth (used to calculate age), school year, gender and postcode of residence were collected from school records. Postcode of residence was used as a proxy for socioeconomic status (SES). Each postcode was assigned an SES score using the Australian Bureau of Statistics Index of Relative Socioeconomic Disadvantage[13]. This allowed students to be ranked according to SES and, based on this score, grouped into SES tertiles.

Data entry and analysis

Data were double entered by a commercial data entry company and analyses were conducted using Statistical Analysis Systems (SAS). Students' performance was recorded as either displaying or not displaying each skill component. Analyses were not weighted because the sampling method adopted was designed to provide an approximately self-weighted sample. Prevalence estimates were computed for each school year separately for boys and girls. Confidence intervals take into account the design effect resulting from the cluster sampling and are thus wider than would be the case under the usual assumption of simple random sampling. Tests of significance (to test for differences by gender and SES) were used to determine whether observed differences were larger than would be expected through random variability. These tests were performed by fitting the marginal model of the Generalised Estimating Equation (GEE) model implemented by the Proc GENMOD procedure in SAS to the data, to take into account the clustering by school. For gender differences, separate models were fitted for each school year and age was adjusted for in each model. For SES differences, school years were combined to provide a larger sample size for those skills that were tested in more than one school year and separate models were fitted for boys and girls. A composite test to assess the significance of SES was performed by running the above model with and without SES and taking the difference in deviance and degrees of freedom. These values were then interpreted for significance by consulting a critical values of chi-square table. Age and school year (coded as a categorical variable) were adjusted for in each model.

Results

Response rates

Of the 18 schools initially invited to participate in the study, seven declined the invitation. Six of the schools were replaced with alternative schools. Data collection (N=1288) was completed before a replacement for one school could be found. The response rates by school year for students were in excess of 90%. The majority of cases of non-participation (>75%) were due to absenteeism on

the day of testing, rather than refusal to participate. The mean ages of students in school years 1, 2, and 3 were 6.2, 7.2, and 8.2 years, respectively. Fifty-two percent of the students were boys.

Mastery/near mastery

School Year group and sex

Table 1 shows the proportion (95% CI) of boys and girls in each school year who displayed advanced skills (mastery or near-mastery) for each of the fundamental movement skills.

	Year 1			Year 2			Year 3	
	Boys (n=203)	Girls (n=206)		Boys (n=225)	Girls (n=203)		Boys (n=237)	Girls (n=214)
Kick	8.9	1.9	Kick	16.9	1.0	Kick	35.0	3.7
	(5.0-12.8)	(0.1-3.5)		(12.0-21.8)	(-0.4-2.2)		(28.6-38.7)	(1.5-6.9)
Throw	4.4	0	Strike	13.8	1.5	Throw	21.9	3.7
	(1.6-7.2)	(NA)		(9.9-19.1)	(-0.3-2.9)		(16.6-27.2)	(1.2-6.4)
Leap	2.0	1.9	Leap	2.2	4.5	Vertical jump	16.9	22.4
	(0.3-4.1)	(0.1-3.5)		(0.4-4.4)	(1.6-7.2)		(11.8-21.2)	(16.8-28.0)
Hop	12.3	12.1	Run	25.3	12.8	Run	33.8	19.2
	(7.2-15.4)	(7.6-16.0)		(19.4-30.8)	(8.1-17.3)		(26.7-38.7)	(13.8-24.4)
Side gallop	24.6	19.9	Catch	48.0	23.6	Catch	61.6	45.8
	(20.8-32.2)	(15.8-26.4)		(40.6-53.6)	(17.9-29.5)		(54.6-67.0)	(39.1-52.5)
Skip	14.3	24.8	Dodge	7.6	5.9	Balance	61.2	67.8
	(10.6-19.8)	(18.2-29.2)		(3.4-10.0)	(2.7-9.1)		(54.6-67.0)	(61.2-73.8)

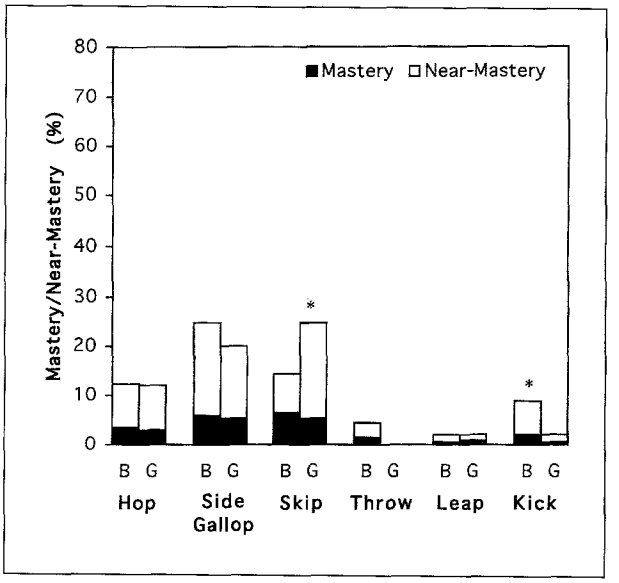
Table 1: Proportion (%) and 95% confidence intervals of boys and girls in each school year who displayed advanced skills (mastery or near mastery) of each fundamental movement skill.

Year 1

The proportion of boys and girls from Year 1 who displayed mastery or near-mastery in each of the six fundamental movement skills is shown in Figure 1. Except for the leap, mastery/near-mastery was higher in most of the locomotor skills (hop, side gallop, skip) compared to the object-control skills (throw, kick). The highest prevalence of mastery for a skill was approximately 7%; only the side gallop and skip were greater than 5%. Between 8% and 20% of students displayed near-mastery in three of the skills (hop, side gallop, skip); in addition, around 8% of boys displayed near-mastery for the kick. Apart from the kick, gender differences in mastery levels were quite small (less than 2%) although this may be a reflection of lower mastery levels per se. Gender differences did become more pronounced in the near-mastery levels in four of the six skills (side gallop, skip, throw, and kick).

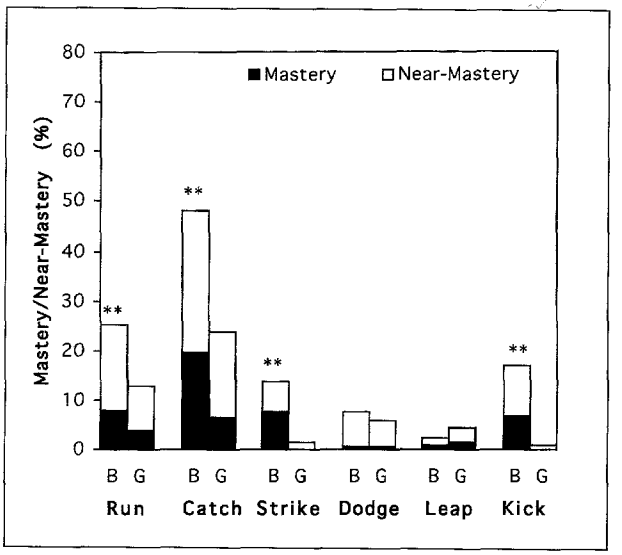
Year 2

Figure 2 displays the proportion of boys and girls from Year 2 who displayed mastery or near-mastery in each of the six fundamental movement skills. Mastery/near-mastery for both boys and girls was highest in the catch and run. Boys had much



* *indicates a significant between-groups difference at P = 0.05.*

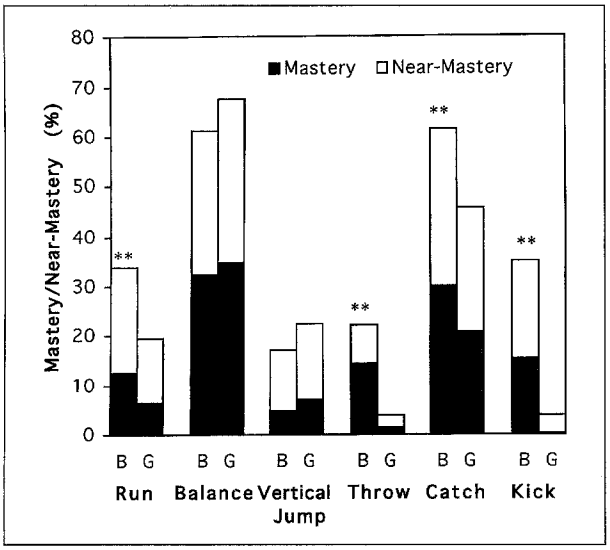
Figure 1: Proportion of Year 1 boys (B) and girls (G) displaying mastery and near-mastery.



** *indicates a significant between-groups difference at P = 0.01.*

Figure 2: Proportion of Year 2 boys (B) and girls (G) displaying mastery and near-mastery.

higher levels of mastery/near-mastery in the run, catch, strike, and kick. There were minimal differences between boys and girls in the dodge and leap although the low mastery/near-mastery levels may mask any real gender differences. Almost half of the boys and one quarter of the girls displayed mastery/near-mastery for the catch and one quarter of the boys displayed mastery/near-mastery for the run. Mastery/near-mastery levels were less than 20% for both boys and girls for all skills except the catch and the run for boys.



** *indicates a significant between-groups difference at P = 0.01.*

Figure 3: Proportion of Year 3 boys (B) and girls (G) displaying mastery and near-mastery.

Year 3

The proportion of boys and girls from Year 3 who displayed mastery or near-mastery in each of the six fundamental movement skills is shown in Figure 3. For boys and girls, mastery/near-mastery was highest in the static balance and catch. Gender differences in mastery/near-mastery were greatest for the object-control skills (throw, catch, strike, and kick) with boys displaying higher levels. Girls were more proficient in the balance and vertical jump. More than 60% of boys and girls displayed mastery/near-mastery for the balance and more than 60% of boys and almost half of the girls displayed mastery/near-mastery for the catch. Mastery/near-mastery levels were greater than 20% for boys and girls for all skills except the vertical jump for boys and the throw and kick for girls.

Socioeconomic status

Table 2 shows the proportion of boys and girls in each SES tertile who displayed advanced skills for each of the fundamental movement skills. Among boys, the positive association between SES tertile and advanced skills was significant for the kick and vertical jump with a trend approaching significance for the catch. For each of these, boys in the high SES tertile had a greater proportion of advanced skills compared with those in the low and medium SES tertile. Among girls, there was a significant and positive association between SES tertile and advanced skills for the catch, dodge, and vertical jump. For the catch and vertical jump, girls in the high SES tertile had a significantly greater proportion of advanced skills compared with those in the low and medium SES tertile. For the dodge, girls in the medium and high SES tertile had a greater proportion of advanced skills than those in the low SES tertile. For both boys and girls, the associations were clearly not significant for all other skills and suggest that SES was not associated with advanced skills.

	Boys				Girls			
	Low SES (% advanced skills)	Med SES (% advanced skills)	High SES (% advanced skills)	Composite Chi-Square statistic based on GEE model (adjusted for age, school; 2df)	Low SES (% advanced skills)	Med SES (% advanced skills)	High SES (% advanced skills)	Composite Chi-Square statistic based on GEE model (adjusted for age, school; 2df)
Hop	18	8	12	1.87	12	7	17	2.26
Side gallop	23	27	24	0.16	23	13	22	5.33
Skip	18	12	13	0.70	29	17	27	2.72
Throw	7	7	13	4.17	1	1	2	0.29
Leap	1	1	2	0.47	2	1	3	2.94
Kick	16	19	27	6.07*	4	1	2	3.90
Run	17	21	23	0.29	9	13	10	1.08
Catch	34	35	45	5.51	18	19	31	14.21**
Strike	8	171	6	2.23	2	1	1	0.26
Dodge	8	6	9	0.56	0	7	8	6.72*
Balance	61	54	69	4.22	74	60	72	3.46
Vertical jump	13	7	30	19.36**	16	17	32	7.16*

*: p-value at 0.05 significant level; **: p-value at 0.01 significant level

Table 2 The proportion of boys and girls in each socio-economic status (SES) tertile who displayed mastery or near mastery (Advanced Skills) of each fundamental movement skill.

Skill component mastery

Year 1

The proportion of boys and girls from Year 1 who mastered each skill component is shown in Table 3. There were only small differences between boys and girls in the proportion who performed each component of the hop, side gallop, and leap. About 40% to 50% of students possessed components 1, 3, and 4 of the hop, about 30% performed component 2 correctly and 12% correctly performed component 5. Most boys and girls possessed component 2 of the side

gallop and 25% to 50% of boys and girls displayed components 1, 3, 4, and 5. In the leap, approximately 25% of boys and girls possessed components 1, 2, and 5, a little more than 10% performed component 6 correctly and about 5% correctly performed components 3 and 4. Almost all students correctly performed the first component of the throw and, although between 20% and 50% of boys correctly performed components 2, 4, and 6, substantially fewer girls did so. In the kick, almost all boys and girls performed component 1 correctly. Almost 60% of boys and 25% of girls performed component 3 correctly. Between 17% and 34% of boys correctly performed components 4, 5, and 6 with substantially fewer girls showing correct performance of these components. In the skip, about 40% of boys and girls performed component 4 of the skip but there were substantial differences in the proportion of boys and girls who correctly performed components 1, 2, and 3 of the skip. Approximately 75% of girls and 55% of boys correctly performed components 1 and 3, and 31% of girls and 17% of boys correctly performed component 2.

Year 2

The proportion of boys and girls from Year 2 who mastered each skill component is shown in Table 3. Nearly all students performed components 1 and 3 of the catch correctly. Approximately 80%, 65%, and 50% of boys correctly performed components 4, 5, and 2, respectively. However, substantially lower proportions of girls correctly performed these catch components. In the strike, almost all students correctly performed component 2 and over two-thirds of boys (and somewhat fewer girls) correctly performed components 1 and 4. There were substantial differences in the proportion of boys and girls who correctly performed components 3, 6, and 7 of the strike. Approximately 45% of boys and 15% of girls correctly performed components 3 and 7, and about 25% of boys and 5% of girls correctly performed component 6. Almost all students correctly performed component 1 of the kick and almost 65% of boys (and 32% of girls) correctly performed component 3. Between 35% and 45% of boys correctly performed components 4 and 6 and about 25% of boys correctly performed component 5. However, only small proportions of girls correctly performed components 4, 5, and 6 of the kick. For the dodge, mastery of each skill component was quite low and there were only very small differences between boys and girls in the proportions that correctly performed each component of the dodge. Approximately 35% of students performed component 2 correctly and about 15% correctly performed components 1, 3, and 5. In the run, over two-thirds of students correctly performed the second component. Although approximately half of the boys correctly performed the third and fourth components, fewer girls did so. The same pattern occurred with components 1 and 5 of the run with about 33% of boys and 20% of girls displaying correct performance. In the leap, just over 40% of boys and girls correctly performed component 2. Although more boys correctly performed component 5 of the leap (48% compared to 33%), more girls performed component 1 correctly (36% compared to 32%). About 20% of boys and girls correctly performed component 6.

Year 3

The proportion of boys and girls from Year 3 who mastered each skill component is shown in Table 3. In the catch, most students performed

	Boys			Girls		
	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3
Kick						
1. Eyes focused on the ball throughout the kick	95.6	98.0	99.6	96.6	97.4	98.7
2. Forward and sideward swing of arm opposite kicking leg	6.9	16.1	28.1	1.9	1.8	3.8
3. Non-kicking foot placed beside the ball	57.6	63.5	74.6	23.3	32.0	49.4
4. Bends knee of kicking leg at least 90° during the backswing	32.0	45.5	63.8	12.6	9.6	24.5
5. Contact ball with top of the foot (a "shoelace" kick) or instep	16.7	26.0	40.8	4.4	5.3	8.4
6. Kicking leg follows through high towards the target area	21.2	34.9	52.7	10.2	9.2	19.0
Throw						
1. Eyes focused on target area throughout the throw	86.7		94.2	87.9		95.4
2. Stands side-on to target area	22.2		43.5	11.2		22.4
3. Throwing arm moves in a downward and backward arc	13.8		35.8	1.5		12.2
4. Step towards target area with foot opposite throwing arm	50.7		74.2	18.9		49.8
5. Hips then shoulders rotate forward	1.5		13.5	0		1.7
6. Throwing arm follows through down and across the body	33.5		53.1	9.2		25.7
Leap						
1. Eyes focused forward throughout the leap	26.1	31.8		32.0	36.4	
2. Knee of take-off leg bends	36.9	41.6		23.3	41.2	
3. Legs straighten during flight	5.4	7.5		4.9	14.5	
4. Arms held in opposition to the legs	4.4	11.4		6.8	9.2	
5. Trunk leans slightly forward	31.0	47.8		24.8	33.3	
6. Lands on ball of the foot and bends knee to absorb landing	12.8	18.4		10.2	18.4	
Run						
1. Lands on ball of the foot		32.5	35.8		14.5	27.0
2. Non-support knee bends at least 90° during the recovery phase		71.8	78.8		64.5	70.0
3. Head and trunk stable, eyes focused forward		45.9	56.5		43.9	51.9
4. Elbows bent at 90°		54.9	61.9		39.0	46.4
5. Arms drive forward and back in opposition to the legs		34.1	43.1		23.7	30.0
Catch						
1. Eyes focused on the object throughout the catch		96.9	98.5		95.6	97.9
2. Feet move to place the body in line with the object		48.6	60.0		28.5	48.1
3. Hands move to meet the object		94.1	98.5		91.2	97.0
4. Hands and fingers relaxed and slightly cupped to catch the object		76.9	88.5		61.8	80.6
5. Catch and control object with hands only (well-timed closure)		62.4	71.5		36.8	59.5
6. Elbows bend to absorb the force of the object		32.2	41.5		18.4	34.2
Hop						
1. Support leg bends on landing then straightens to push off	59.6			60.2		
2. Lands and pushes off on ball of the foot	27.6			30.1		
3. Non support leg bent and swings in rhythm with the support leg	40.4			48.5		
4. Head stable, eyes focused forward	38.4			41.3		
5. Arms bent and swing forward as support leg pushes off	11.8			12.6		
Side gallop						
1. Smooth rhythmical movement	49.8			51.9		
2. Brief period where both feet are off the ground	80.8			76.7		
3. Weight on the balls of the feet	36.0			33.5		
4. Hips and shoulders point to the front	26.1			26.7		
5. Head stable, eyes focused forward or in the direction of travel	35.5			35.4		
Skip						
1. Shows a rhythmical step-hop	60.1			78.6		
2. Lands on ball of the foot	16.7			30.6		
3. Knee of support leg bends to prepare for the hop	47.8			71.4		
4. Head and trunk stable, eyes focused forward	43.3			41.3		
5. Arms relaxed and swing in opposition to legs	15.3			20.4		

Table 3 Continued over page

	Boys			Girls		
	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3
Two-hand strike						
1. Stands side-on to target area		66.3			47.8	
2. Eyes focused on the ball throughout the strike		95.3			93.9	
3. Hands next to each other, bottom hand matches the front foot		42.0			22.8	
4. Step towards target area with front foot		67.1			37.7	
5. Hips then shoulders rotate forward		10.6			0.9	
6. Ball contact made on front foot with straight arms		23.9			4.8	
7. Follow through with bat around the body		44.7			11.8	
Dodge						
1. Change direction by bending knee and pushing off the outside foot		12.5			16.7	
2. Change of direction occurs in one step		32.9			36.8	
3. Body lowered during change of direction		17.6			18.9	
4. Eyes focused forward		2.7			1.8	
5. Dodge repeated equally well on both sides		12.2			12.3	
Static Balance						
1. Support leg still, foot flat on the ground			91.5			96.2
2. Non-support leg bent, not touching support leg			54.6			49.4
3. Head stable, eyes focused forward			60.0			70.0
4. Trunk stable and upright			67.3			76.8
5. No excessive arm movements			79.6			86.1
Vertical Jump						
1. Eyes focused forward or upward throughout the jump			48.1			58.6
2. Crouch with knees bent and arms behind the body			35.8			47.3
3. Forceful forward and upward swing of the arms			43.5			46.0
4. Legs straighten in the air			66.9			66.2
5. Lands on balls of the feet and bends knees to absorb landing			20.8			32.1
6. Controlled landing with no more than one step in any direction			57.3			67.9

Table 3: Proportion (%) of boys and girls in each school year who correctly performed each component of each fundamental movement skill

components 1, 3, and 4 correctly. Approximately 65% of boys and 55% of girls correctly performed components 2 and 5 and about 37% correctly performed component 6. With the overarm throw, almost all students correctly preformed the first component and almost three quarters of the boys and half of the girls performed component 4 correctly. Although approximately half the boys correctly performed components 2 and 6, substantially fewer girls did so. Between 14% and 36% of boys correctly performed components 3 and 5; however, only small proportions of girls correctly performed these components. In the kick, almost all students correctly performed components 1 and the majority of boys (and somewhat fewer girls) correctly performed component 3. About 58% of boys correctly performed components 4 and 6 and about 35% of boys correctly performed components 2 and 5. However, only small proportions of girls correctly performed components 2, 4, 5, and 6. In the run, about three quarters of the boys and girls in Year 3 possessed component 2 and about 50% of girls and 60% of boys displayed components 3 and 4. Approximately 40% of boys and 30% of girls correctly performed components 1 and 5 of the run. There were only small differences between boys and girls in the proportion that correctly performed each component of the static balance. Most students

correctly performed component 1, 75% to 85% correctly performed components 4 and 5 and 50% to 65% performed components 2 and 3 correctly. In the vertical jump, component 4 was performed correctly by more than two-thirds of students and the majority of girls (and somewhat fewer boys) correctly performed component 6. About 60% of girls and 50% of boys correctly performed component 1 of the jump and about 47% of girls and 40% of boys correctly performed components 2 and 3. A minority of both boys and girls correctly performed component 5.

Discussion

For boys and girls in all year groups the proportion of students who displayed mastery of a skill did not exceed 35% for any of the fundamental movement skills. Furthermore, in only one of the skills, static balance, did the proportion of boys and girls who displayed advanced skills (mastery or near-mastery) exceed 50%. These findings indicate only a low to moderate prevalence of mastery of fundamental movement skills among NSW lower primary school students. Similar representative studies of children from Australia[7,11,14] and the United States[9] have generally found a higher prevalence of mastery and near mastery among these age groups. There may be several possible explanations for this difference. First, Cooley[15] and Walkley[11] used videorecording to collect their data, thus permitting greater scrutiny of measurement precision. Second, although all of the instruments in these studies were process-oriented and involved almost identical assessment procedures to this study, some of the skills and some of the components for the same skills varied between batteries; hence, the differences could be attributable to these differences in instrumentation. Third, except for the Booth et al[7] study, all the others were from different states or countries and thus under different education departments. These differences may reflect variations in physical education curriculum and pedagogy in primary schools. Third, the differences may reflect a decline in fundamental movement skills among Australian children over the past 2-6 years. Irrespective of the reasons hypothesised for these differences, the fact still remains that the prevalence of fundamental movement skill mastery among children in NSW is low and in need of improvement.

It is difficult to determine what level of proficiency children in Years 1, 2, and 3 are capable of achieving. As previously mentioned, similar studies have generally reported higher levels, but differences in instrumentation and interpretation of scores make it difficult to provide recommended levels of achievement in each skill at varying ages. It has been suggested that children are developmentally able to master most fundamental movement skills by the age of six[16]. In this study, we found that, apart from the throw among Year 1 girls, all skills were mastered by some students by Year 1 (age of six). However, we are unaware of any normative or criterion-referenced standards for individual skills for these ages, which limits our ability to determine what is an acceptable score. This represents a major weakness in the field at present and there is an urgent need to develop such standards.

Among students in Years 2 and 3, the catch and balance had the highest prevalence of mastery and near mastery which suggests that not a lot of effort may be required to increase these proportions to a more optimal level. For the rest of the skills and for Year 1 students, considerable attention is required to

increase the prevalence of mastery and near mastery.

For half of the skills assessed, we found significant differences between boys and girls in the prevalence of mastery/near mastery. Boys performed significantly better in all the object-control skills (catch, kick, throw, and strike). The results for the object-control skills are consistent with previous studies on Australian children of similar ages[11,15,17] and may reflect the amount of reinforcement children of this age receive to participate in sports and activities that utilise these skills. That is, the differences are likely to be environmental rather than biological and there is a good chance that these gender differences could be reduced if girls are provided with the same opportunities for instruction, practice, feedback and encouragement as boys[18,19]. However, there does appear to be evidence of some biological differences in the throwing ability between boys and girls at this age, due to boys having a lower triceps skinfold thickness, larger arm joint diameter and greater estimated amount of arm muscle mass[20].

Boys also performed significantly better on the run. Recent research on gender differences for this skill has produced equivocal findings. In a previous state-wide survey on older children (Years 4 and 6), we found no differences between boys and girls[7]. This absence of difference has also been reported in other studies[12,17], although others have found that girls perform better than boys[14] or that boys master the skill at a younger age than girls[21]. These results suggest that the gender differences on the run are not strong or consistent and may reflect local conditions and experiences.

We found that girls were more proficient in skipping than boys. This finding is consistent with other studies[21,22] and perhaps reflects different cultural expectations; girls are more likely to participate in games and activities that use skipping (eg, dance and gymnastics) thus having more opportunities for practice and encouragement[23].

Six of the skills did not demonstrate gender difference. Of these, five were locomotor (hop, side gallop, dodge, vertical jump, and leap) and one body management (balance). The findings for the locomotor skills are in agreement with several other studies of children this age[17,22], although the absence of differences in this study may have been masked by a floor effect for both genders for some of the skills (eg, leap, dodge and hop). The finding for the balance is consistent with others in similar-aged children[22,24]. A reason for this lack of difference may be that, although one might assume balancing to be consistent with dance and gymnastic-type activities popular among girls, the role of balancing ability is much more widespread and has been shown to be significantly related to the ability to perform other fundamental movement skills such as striking, at which boys are more proficient[22].

For boys and girls, only two and three of the 12 skills, respectively, showed significant association with SES. Interestingly, for all but one of these skills, boys and girls in the highest SES displayed significantly higher levels of mastery than the other two tertiles. This finding is consistent with a similar study by Booth et al[7] that found that mastery/near mastery of fundamental movement skills increased with increasing SES among boys and girls and may reflect these children having greater access to sports and physical activities in which these skills can be refined and practised. The fact that only a small

number of the skills were related to SES suggests that programmes to improve fundamental movement skills should not have a particular focus on schools within any particular SES area.

There are a number of limitations in this study that need to be noted. First, the use of near-mastery scores, whilst providing an additional reporting format, does have some shortcomings. Mathematically, it is easier to achieve near-mastery on skills with fewer components (eg, run and hop) than those with more components (eg, strike). It also assumes that all components are equally important (that is, students missing any one component are equally as close to mastering a skill) which may not be the case for some skills. Second, the design of the study (to evaluate the impact of a new teaching resource) meant that different skills needed to be examined in different years. As such, data were not available for some important skills in different school years.

On the basis of these results, it is recommended that adequate curriculum time, resources and professional development continued to be devoted to fundamental movement skills in NSW primary schools. The NSW DET has begun this process with the dissemination of the *Get skilled: Get active* resource[8] and through professional development for teachers. We recommend that teachers in middle- to upper-primary consider implementing a mastery motivational climate[25] within their fundamental movement skills lessons and that those teaching pre-school and lower-primary years incorporate Gallahue's framework of contextual, exploration, guided-discovery and practice stages when teaching fundamental movement skills[26]. Pedagogical factors such as adequate time set aside to practice the skill, optimal equipment-to-student ratios, specific skill instruction and effective feedback and encouragement should also be standard practice in the teaching and learning process. In addition, we recommend that fundamental movement skills training forms an integral part of physical education curriula in tertiary teacher education programmes in order to prepare pre-service teachers professionally. It is hoped that through increased emphasis in schools and teacher-training institutions that children will develop these skills and, as a result, their desire to use them in physical activities through their lives.

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