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Movement skill mastery in a clinical sample of overweight and obese children

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2 **children**

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1   **Abstract**

2   This study describes the prevalence of fundamental movement skill (FMS) mastery and advanced

3   skill proficiency among treatment-seeking 6-10 year-old children with overweight/obesity. One

4   hundred and thirty-two participants (8.4±1.0 years, BMI 24.2±3.1 kg/m^2, 55% female, 76.5%

5   obese) were assessed on 12 FMS and compared with a normative sample. The prevalence of FMS

6   mastery was significantly lower among children categorized as overweight/obese for all skills

7   across all age groups (all $p<0.05$). Excluding the leap for 6-7 year olds, differences between the

8   two samples remained when the prevalence of advance skill proficiency was examined for

9   children categorized as overweight/obese. Physical activity programs designed for children with

10   overweight/obesity need to address deficiencies in FMS proficiency as part of an overall strategy

11   to promote physical activity participation.

12   **Key words:** adiposity, exercise, motor activity, motor skills, pediatrics

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14   **Introduction**

15   Children categorized as overweight/obese are less active than their non-overweight peers, and

16   children who are least active have the greatest adiposity gains. One correlate of children's physical

17   activity is their FMS proficiency (1, 2). These skills are the building blocks for participation in

18   many physical activities, and include locomotor (e.g., running) and object-control (e.g. throwing)

19   skills. This study describes the prevalence of FMS mastery among children with

20   overweight/obesity, and extends previous research by examining a younger and larger child

21   sample, and by applying a validated and more comprehensive FMS assessment battery than have

22   previously been studied (3, 4).

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24   **Methods**

1   Data were collected as part of the Parenting Eating and Activity for Child Health (PEACH)

2   randomized controlled trial for the management of pediatric obesity (Australian Clinical Trials

3   Register [www.actr.org.au] 00001104) (5). Table I reports inclusion and exclusion criteria.

4   Families were recruited between June 2004 and May 2005 in Adelaide (n=86) and Sydney (n=83),

5   Australia. Of the 169 participating children categorised as overweight/obese (6), 146 completed

6   FMS assessments at baseline. Due to the age categories constructed in this study children under

7   six years (n=14) were excluded, leaving a final sample of 132. Ethics committees at Flinders

8   Medical Centre Clinical Research and the Children's Hospital at Westmead approved the study.

9   Parent informed written consent and child assent were obtained.

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11   < **Insert Table 1 here** >

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13   FMS were assessed using the Test of Gross Motor Development, 2nd edition (TGMD-2) (7). The

14   TGMD-2 comprises six locomotor skills and six object-control skills and has established validity

15   and reliability among 3-10 year-olds (7). Six trained assessors (three at each study site), completed

16   the assessments after demonstrating ≥90% inter-rater reliability on pre-coded videotapes, as

17   previously described (3, 4). The battery was administered in small groups (≤4) following

18   standardised procedures, instructions and demonstrations. Skills were performed twice and skill

19   components were scored as present ("1") or absent ("0") for each trial. For each skill, the

20   proportion of the sample exhibiting mastery (i.e., exhibiting all skill components during both

21   trials) and advanced skill proficiency (i.e., exhibiting all or all but one component during both

22   trials) was calculated and compared with the TGMD-2 normative sample (n=1208) (7) using chi-

23   square analysis in SPSS 16.0. The TGMD-2 normative sample is representative of the United

24   States (US) population in regards to geographic region, gender, ethnicity, rural or urban

25   residence, parent education and disability. Participants were categorized into age groups for the

26   analyses, with the groups formed by combining adjacent ages (e.g. 6 and 7 years) with the most

1   similar proportions of participants exhibiting mastery for each individual skill in the TGMD-2

2   normative sample (age groups for the underhand roll and striking a stationary ball: 7-8 years and

3   9-10 years; all other FMS: 6-7 years and 8-10 years). The prevalence of mastery for each age

4   group from the TGMD-2 normative sample was calculated by averaging the proportions for each

5   age. Results were considered statistically significant at $p<0.05$.

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7   **Results**

8   Baseline demographic and anthropometric data are presented in Table I. The prevalence of

9   mastery was significantly lower among children with overweight/obesity compared with the

10   normative sample for all 12 skills across all age groups (all $p<0.05$) (Table II). Excluding the leap

11   for 6-7 year-olds, differences remained when the prevalence of advanced skill proficiency in this

12   sample was compared with mastery in the normative sample.

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14   **< Insert Table 2 here >**

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16   **Discussion**

17   This study supports the findings of previous research suggesting that children with

18   overweight/obesity have lower FMS proficiency than is typical for their age (3, 4). To our

19   knowledge this is the first study to compare the prevalence of mastery of individual FMS

20   between a large clinical sample of children categorized as overweight/obese and normative data,

21   using a validated and comprehensive assessment battery . The difference in FMS mastery

22   exhibited in this sample compared with normative data was more prominent than has previously

23   been reported (3, 4), possibly because of the higher proportion of females, and that >75% were

24   categorized as obese.

25   Among children, FMS are beneficially associated with physical activity, cardiorespiratory

26   fitness and psychosocial outcomes (1), and childhood FMS proficiency appears to predict

1   physical activity and fitness in adolescence (1). Low FMS proficiency among children with

2   overweight/obesity might therefore act as a barrier precluding participation in adiposity-reducing

3   physical activity, perpetuating the cycle of unhealthy weight gain.

4   As the current sample consisted of treatment-seeking children, the findings might only be

5   generalizable to those children with overweight/obesity enrolling in weight management

6   programs. The use of US normative data may be a limitation but there are no normative

7   Australian data for the TGMD-2. However the majority of the FMS evaluated in the TGMD-2

8   are targeted in Australian primary school physical education curricula and used in popular sports.

9   Thus, it seems unlikely that the findings are due to cultural differences in the mastery of the

10   assessed skills.

11   Based on these results, we recommend that physical activity programs for children with

12   overweight/obesity address deficiencies in FMS proficiency in order to foster movement

13   capabilities required for adoption of an active lifestyle. Longitudinal research is required to

14   understand the causal and temporal nature of the relationships between FMS, physical activity,

15   and obesity among young people.

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22   **References**

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1   Table I   Inclusion and exclusion criteria for the PEACH study and descriptive characteristics
2   of participating children (n=132)[a]
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Inclusion Criteria	Exclusion Criteria	Descriptive Characteristic	Mean (SD) or % (n)
Aged 5-9 years[b] at initial baseline assessment	BMI z-score >4.0	Age (years)	8.4 (1.0)
Overweight or obese[c]	Known syndromal cause of obesity	Female	55.3 (73)
Pre-pubertal (Tanner Stage 1)	Taking medications influencing weight gain or loss	BMI (kg/m^2)	24.2 (3.1)
Care-giver able to attend sessions, read and understand English	Physical or developmental disability, chronic illness or significant dietary restriction	BMI z-score	2.7 (0.6)
	Sibling was enrolled in the study	Obese[c]	76.5 (101)

BMI: body mass index; [a] n=132 of 169 children enrolled in PEACH due to: children <6 years being excluded from current analyses (n=14), children unable to attend the FMS assessment (n=19), injury (n=3), incomplete data entry for FMS (n=1). There were no statistically significant differences between participants with and without FMS data for age, percentage girls, BMI, or BMI z-score (all p>0.05).[b] selected as they had not yet experienced a pubertal growth spurt and were post-adiposity rebound;[c] IOTF definitions (6).

Table II Prevalence (%) of FMS mastery[a] in the normative sample (9) and mastery and advanced skill proficiency[b] in the overweight/obese sample[c]

	6-7 years FMS mastery			6-7 years Advanced skill proficiency		8-10 years FMS mastery			8-10 years Advanced skill proficiency	
FMS	Normative (n = 311)	Overweight/obese (n = 39) (n)	P	Overweight/obese (n = 39) (n)	P	Normative (n = 565)	Overweight/obese (n = 93) (n)	P	Overweight/obese (n = 93) (n)	P
Locomotor										
Run	78	5 (2)	<0.001	13 (5)	<0.001	85	22 (20)	<0.001	31 (29)	<0.001
Gallop	43	3 (1)	<0.001	5 (2)	<0.001	55	3 (3)	<0.001	8 (7)	<0.001
Hop	37	0 (0)	N/A	0 (0)	N/A	51	3 (3)	<0.001	7 (6)	<0.001
Leap	25	10 (4)	0.028	13 (5)	0.067	45	7 (6)	<0.001	19 (18)	<0.001
Horizontal Jump	33	3 (1)	<0.001	8 (3)	0.001	44	7 (6)	<0.001	14 (13)	<0.001
Slide	60	15 (6)	<0.001	21 (8)	<0.001	81	37 (34)	<0.001	47 (44)	<0.001
Object-control										
Stationary basketball dribble	31	5 (2)	0.001	8 (3)	0.002	66	29 (27)	<0.001	41 (38)	<0.001
Catch	43	10 (4)	<0.001	18 (7)	0.001	77	43 (40)	<0.001	65 (60)	0.003
Kick	34	3 (1)	<0.001	5 (2)	<0.001	65	26 (24)	<0.001	39 (36)	<0.001
Overhand throw	25	8 (3)	0.010	10 (4)	0.028	52	18 (17)	<0.001	30 (28)	<0.001

	7-8 years FMS mastery			7-8 years Advanced skill proficiency		9-10 years FMS mastery			9-10 years Advanced skill proficiency	
FMS	Normative (n = 372)	Overweight/obese (n = 66) (n)	P	Overweight/obese (n = 66) (n)	P	Normative (n = 358)	Overweight/obese (N = 49) (n)	P	Overweight/obese (n = 49) (n)	P
Object-control										
Striking a stationary ball	38	11 (7)	<0.001	23 (15)	0.011	48	12 (6)	<0.001	27 (13)	0.002
Underhand roll	38	2 (1)	<0.001	5 (3)	<0.001	41	10 (5)	<0.001	20 (10)	0.002

FMS: fundamental movement skill; [a]FMS mastery: possessing all skill components during two trials; [b]Advanced skill proficiency: possessing all skill components or all but one component during two trials. This category was used for the overweight/obese sample and compared against the prevalence of FMS mastery in the normative sample; [c]the overweight/obese sample was compared to the same age group in the TGMD-2 normative sample for each skill; N/A: Not applicable as the prevalence of mastery/advanced skill proficiency for the overweight/obese sample = 0.