

# AGE AND SEX DIFFERENCES IN THE MOTOR PERFORMANCE OF 6 THROUGH 11 YEAR OLD CHILDREN

## 6-11 YAŞ ÇOCUKLARININ FİZİKSEL PERFORMANSINDA YAŞ VE CİNSİYET FARKLILIKLARI

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### ABSTRACT

*This study examined the effects of age and sex on motor performance of 6 through 11 year old children. The subjects were 273 randomly selected healthy children enrolled in an elementary school in Ankara. The data were analyzed for age and sex differences by using two way analysis of variance (ANOVA). The Scheffe post-hoc analysis procedure was used to test the differences between all possible pairs of means where a significant F-ratio was obtained. The results of the ANOVA showed significant age and sex main effects on three (Standing Broad Jump, Sit-Ups, Shuttle Run) of the four tests. However, no significant age and sex main effects were obtained on the Sit and Reach test. The results also indicated that there were no significant age/sex interactions on all the motor test items. Overall, results indicated that increases in the mean performance for boys and girls were observable with each advancing age level in this study. There is also some evidence showing the effects of sex differences after age 9.*

### ÖZ

*Bu araştırma 6-11 yaş çocuklarının yaş ve cinsiyetinin fiziksel performanslarına etkilerini incelemektedir. Araştırma için Ankara'da bir ilköğretim okuluna kayıtlı 273 sağlıklı çocuk seçkisiz yöntemle saptanmıştır. Yaş ve cinsiyet ile ilgili veriler çift yönlü varyans çözümlemesi yöntemiyle (ANOVA) çözümlenmiştir. Tüm ortalamalar arasındaki olası farklılıkları sınamak için Scheffe çözümleme işlemi kullanılmış ve anlamlı bir farklılık elde edilmiştir. ANOVA sonuçları yapılan dört testten üçünde (Standing Broad Jump, Sit-Ups, Shuttle Run) yaş ve cinsiyetin temel etkilerinin anlamlı olduğunu göstermiştir. Ancak testlerden birinde (Sit and Reach test) yaş ve cinsiyete göre aynı anlamlı fark görülmemiştir. Sonuçlar tüm fiziksel test öğelerinde yaş-cinsiyet etkileşimi olmadığını göstermiştir. Genelde bu çalışmanın sonuçları erkek ve kız çocukların ortalama performanslarındaki artışın ilerleyen yaş düzeylerinde gözlenebilir olduğunu göstermiştir. 9 yaşın üstündeki çocuklarda cinsiyetin etkisini gösteren kanıt bulunmaktadır.*

### INTRODUCTION

The motor performance of children should be of great concern to all and not just the physical educators and physicians. Considerable emphasis has been placed on the study of motor performance in the adolescent, adult and skilled performer. The literature is replete with information dealing with their performance levels, biomechanics, and neurophysiological capabilities, but relatively little has been done with preschool and elementary school children.

The elementary school years are important for human development. The period of childhood from the 6th through 11th years of life is typified by a slow but steady increase in physical growth. During these years there is a regular improvement in motor abilities of children. Within this age range a variety of complex tasks can be

mastered. In addition to that, a number of structural changes are evidenced and there are regular increases in bone growth and muscle quality (Cratty, 1979). Furthermore, one's basic body build is established during this period (Schurr, 1980).

Research evidence over the past 40 years indicates that the trend in motor performance of elementary school age children is toward improvement with age for both boys and girls with the average performance of boys usually exceeding the average performance of girls at each age level (Morris, Williams, Atwater and Wilmore, 1982; Espenschade and Eckert, 1980; Cratty, 1979; Wickstrom, 1977; Singer, 1973; Govatos, 1959). Most of the researchers argued that motor ability (agility, flexibility, muscular endurance, power, strength and coordination) improves as age increases (Haywood, 1986;

Gallahue, 1982; Zaichkowsky, Zaichkowsky and Martinek, 1980). Performance of children on motor ability rapidly accelerates linearly across childhood, and until puberty boys' performance is slightly higher. At puberty, female performance levels off, whereas male performance continues to improve and may even accelerate (Thomas and French, 1985). During early childhood sex differences begin to exist in motor performance because at this period the child starts to play his or her sex roles (Thomas and French, 1985). They tend to select different types of games. Game preference causes excellence in girls in hopping, skipping, galloping and causes excellence in boys in jumping and throwing. The sex differences of a variety of tasks become apparent with the late childhood years. Boys are better than girls in running speed, agility, jumping and strength (Zaichkowsky et al., 1980; Cratty, 1979) while girls are better than boys in balance (Broadhead and Bruininks, 1982).

Researchers have studied the motor performance of elementary school age children in different countries (Chatterjee, Mandal and Das, 1993; Aponte, French, and Sherrill, 1990; Ostyn, Simons, Beunen, Renon and Gerwen, 1980; AAHPER, 1976). Few studies have been conducted on the physical characteristics and motor performance of children in Turkey (Ergun, Baltacy, Gariei, and Tuğrul, 1994; Erden, Toker, Açıkada, and Hazır, 1994; Toker, Erden, and Ediz, 1994; Güzel, 1989; Sevimay, 1986; Gökmen, 1981; Neyzi, Yalçındağ, and Alp, 1973).

Therefore, the purpose of the present study was to evaluate the performance of Turkish children (ages 6 through 11) on a variety of motor skills to determine the extent to which motor performance was related to age and sex. Four tests were selected to represent motor skills, specifically: Standing Broad Jump, Sit Ups, Shuttle Run and Sit and Reach.

## **METHOD**

### **Subjects**

The study population consisted of 1220 students (646 boys and 574 girls) in grades one through five in an urban elementary school in Ankara (Turkey) representing the middle income socioeconomic level. The subjects were 273 Turkish boys (132) and girls (141), aged 6 through 11. Age was defined by the subject's last birthday and

determined from the school register. The mean age in months for the 6, 7, 8, 9, 10 and 11 year olds were 80.10, 90.30, 101.53, 113.02, 125.04 and 134.91, respectively. The number of children in each of the 12 age/sex groups varied from 11 to 33. The subjects were selected randomly from students who are not physically and/or mentally handicapped. They were in reasonably good health.

### **Procedure**

Pilot testing and technician training sessions were conducted to refine test administration procedures and to objectify verbal directions. A complete description of the motor performance test items, including administrative procedures can be found in EUROFIT handbook (1993). For convenience and clarification, a brief description of each of the motor performance tests follows. The tests are presented in the order in which they were administered.

**Sit and Reach :** Reaching forward as far as possible from a seated position.

**Standing Broad Jump:** Jumping for distance from a standing start

**Sit-Ups (knee-bent) :** Maximum number of sit-ups achievable in 30 seconds

**Shuttle Run (10x5 m):** A running and turning (shuttle) test at maximum speed.

These test items were selected in terms of their suitability under field research conditions and availability of instruments.

### **Analysis of Data**

Mean and standard deviation, which are descriptive statistics were used to determine the distribution of the age, height, weight and motor performance scores. The data were analyzed for age and sex differences using two way analysis of variance (ANOVAs). The Scheffe post-hoc analysis procedure was used to test differences between all possible pairs of means where significant F-ratio was obtained. The alpha levels were set at .05.

## **RESULTS**

The mean values and standard deviations for the physical characteristics (height and weight) and the motor performance test items (Standing Long Jump, Sit-Ups, Shuttle Run, and Sit and Reach) for each of the 6 through 11 year old groups of girls and boys are given in Tables 1 and 2, and Figures 1 through 6.

**Table 1**

Means and Standard Deviations for Height, Weight and Motor Performance Test Items of Girls

		Age					
		6	7	8	9	10	11
N		18	31	29	28	23	12
Height	X	116.03	120.50	123.26	131.13	135.02	140.63
	SD	3.36	4.98	20.44	6.06	6.73	6.48
Weight	X	21.56	24.14	26.08	29.88	32.70	34.65
	SD	2.07	2.74	3.99	6.36	6.65	7.69
Standing Broad Jump	X	97.36	108.48	112.21	126.21	132.04	133.17
	SD	15.35	13.81	24.45	21.12	15.16	16.45
Sit-Ups	X	6.94	10.03	11.83	11.79	13.04	12.50
	SD	3.75	4.81	3.92	5.74	3.72	5.58
Shuttle-Run	X	27.44	27.41	26.90	25.98	26.17	25.58
	SD	1.58	2.25	2.06	2.08	1.65	2.03
Sit and Reach	X	18.11	18.73	18.59	18.64	18.61	20.50
	SD	4.38	5.36	6.00	4.83	4.65	6.02

**Table 2**

Means and Standard Deviations for Height, Weight and Motor Performance Test Items of Boys

		Age					
		6	7	8	9	10	11
N		11	33	28	17	32	11
Height	X	119.09	122.14	123.02	123.32	137.91	140.64
	SD	5.88	10.41	21.16	28.94	4.79	6.10
Weight	X	24.51	23.35	26.37	28.73	34.02	33.66
	SD	4.67	2.52	4.09	4.45	5.60	4.58
Standing Broad Jump	X	97.82	107.68	121.54	141.53	141.97	143.82
	SD	11.86	11.89	20.06	15.91	16.70	18.97
Sit-Ups	X	7.18	10.67	13.14	15.24	15.12	17.09
	SD	5.00	4.46	4.13	3.27	4.27	3.78
Shuttle-Run	X	26.65	26.07	26.36	24.46	24.57	26.11
	SD	1.83	2.48	2.45	1.82	1.82	2.19
Sit and Reach	X	18.55	19.38	18.21	16.65	15.34	18.91
	SD	3.24	3.76	6.04	6.39	5.77	5.97

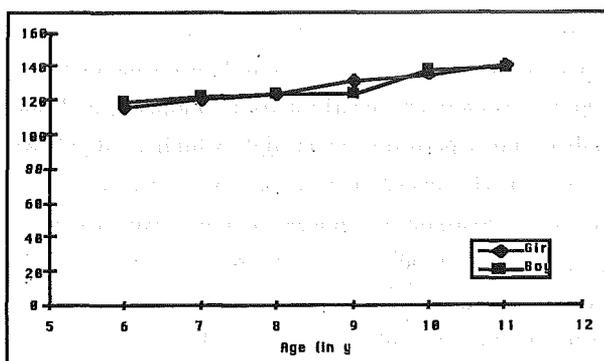


Figure 1. Mean Values of Height by Age and Sex

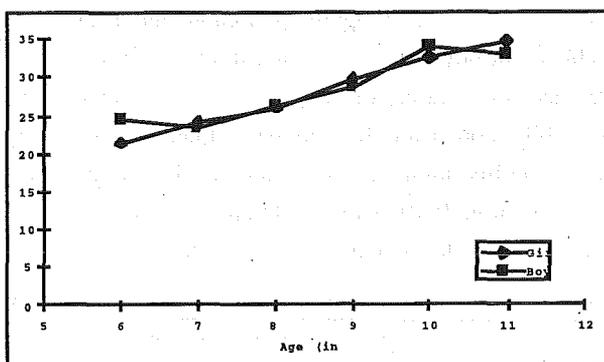


Figure 2. Mean Values of Weight by Age and Sex

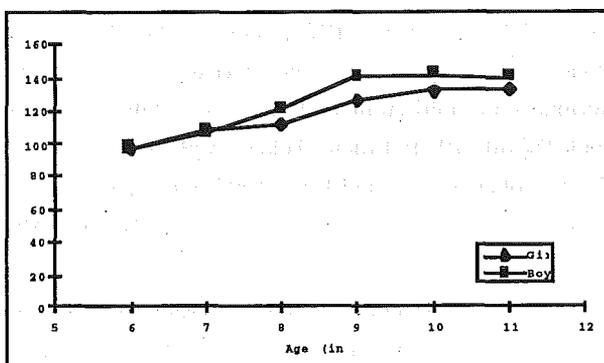


Figure 3. Mean Values of Standing Broad Jump Test by Age and Sex

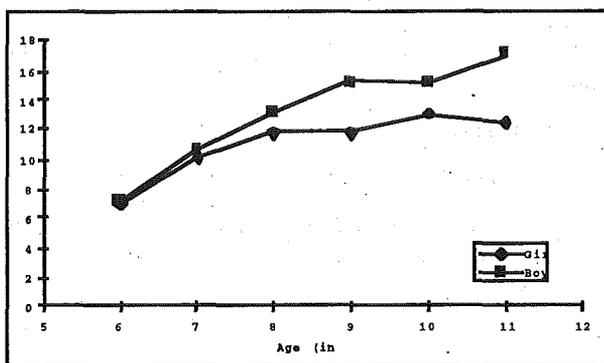


Figure 4. Mean Values of Sit-Up (30 sec) Test by Age and Sex

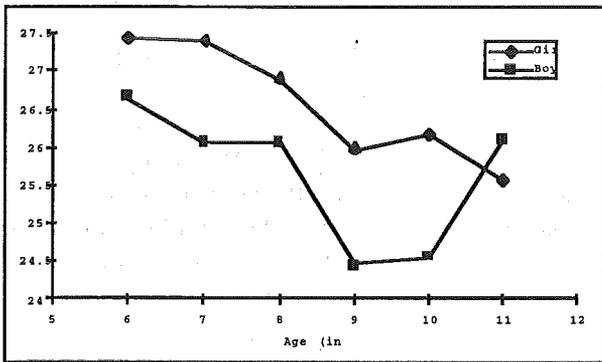


Figure 5. Mean Values of Shuttle Run (10x5m) Test by Age and Sex

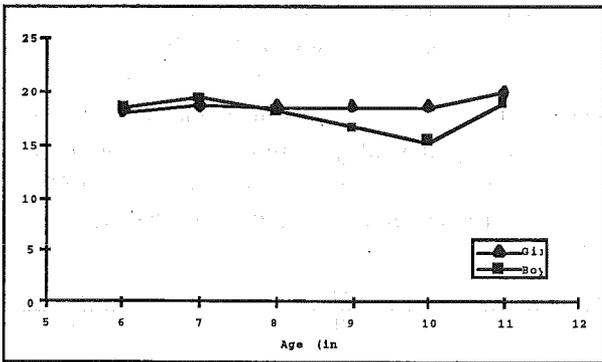


Figure 6. Mean Values of Sit and Reach Test by Age and Sex

Two way analysis of variance (ANOVA) tests (Table 3) revealed significant age and sex main effects on three of the four tests (Standing Broad Jump, Sit-Ups, Shuttle Run). According to the results of ANOVA, significant age and sex main effects were obtained on Standing Broad Jump ( $F_{age}=35.60$ ,  $df=5, 261$   $p<.05$ ;  $F_{sex}=10.60$ ,  $df=5, 261$   $p<.05$ ), Sit-Ups ( $F_{age}=13.84$ ,  $df=5, 261$   $p<.05$ ;  $F_{sex}=12.39$ ,  $df=5, 261$   $p<.05$ ) and Shuttle Run test ( $F_{age}=5.90$ ,  $df=5, 261$   $p<.05$ ;  $F_{sex}=10.30$ ,  $df=5, 261$   $p<.05$ ). However, no significant age and sex main effects were obtained on the Sit and Reach Test ( $F_{age}=1.39$ ;  $F_{sex}=2.16$ ). Analysis of variance test results also revealed that there was no significant age/sex interaction on all the motor test items.

Table 3

Summary of Two Way ANOVA Results on the Motor Performance Test Items

Test Items	Source of Variation			
	Main Effect		Interaction	
	Age	Sex	Sex	Age
Standing Broad Jump	35.60*	10.60,	1.48	
Sit-Ups	13.84*	12.39*	1.18	
Shuttle-Run	5.90*	10.30*	1.20	
Sit and Reach	1.39	2.16	1.04	

\* $p<.05$

The Scheffe post-hoc analysis showed that older girls and boys (9, 10, 11) performed significantly better than younger boys and girls (6, 7, 8) on the Standing Broad Jump test. Significant sex differences occurred in the Standing Broad Jump test for 9 and 11 years old. At these ages the performance of boys were better than girls but at other ages boys and girls performed similarly.

In Sit-Ups 8, 9, 10 and 11 year old boys and girls performed significantly better than 6 years old boys and girls. On the other hand; 10 and 11 year old boys and girls' performance were better than 7 years old boys and girls. Although the main effect of sex was significant for this test the specific age groups in which sex differences clearly occurred were for 9 and 11 year olds where boys were better than girls.

Analysis of test scores on the Shuttle Run for boys and girls indicated that 10 year old boys and girls performed significantly better than 6,7 and 8 year old boys and girls. Also there was a significant difference between the performance of 9 and 6 year old boys and girls. The results indicated that 7, 9 and 10 year old boys performed significantly better than girls at these ages. At other ages, performance of boys and girls was similar.

On the Sit and Reach test, no significant differences occurred among the mean performance of any of the age/sex groups with the exception of 10 year old girls, who were more flexible than boys at the same age.

## DISCUSSION

The primary purpose of this study was to investigate the effects of age and sex on motor performance of 6-11 year old children.

Although significant age and sex differences were found on most of the motor tests, it appears that age generally was related more to performance than was gender. With increasing age the mean performance of boys and girls on Standing Broad Jump increased. This result is consistent with previous studies. Caskey (1968), Govatos (1959), Kane and Meredith (1952), Milne, Seefeldt and Reuschlein (1976) have indicated that with age the performance on standing broad jump increases (Thomas and French, 1985; Cratty, 1979). Based on the summary of a number of studies that contained data on the performances of children in the standing broad jump, Herkowitz (1978) concluded that there were consistent linear improvements in jumping distance between the ages of 5 and 11 years. Herkowitz further stated that the increase in jumping distance tends to be about four inches each year in these age groups. Data from the present

study (Table 1 and Table 2) showed mean gains in excess of six inches from 8 to 9 years of age, with more modest improvements of approximately four and three inches from 6 to 7 and 7 to 8 years of age respectively. The least improvement occurred from ages 10-11. With these results it is not possible to talk about consistent improvement between the ages of 6 to 11 years. The sex differences in the present study suggest that the boys surpassed the girls at the 9 and 10 year levels on the Standing Broad Jump test. The findings of present study partly confirmed the results of Govatos (1959) which showed that boys jumped significantly farther than girls at 7, 8, 9 and 11 years. Although Milne, Seefeldt, and Reuschlein (1976) found that boys jumped significantly farther than girls in first grade and second grade, little additional evidence was present in the literature to indicate significant sex difference in the jumping performance of children below the age of 8 years.

The Scheffe analysis on the Sit-Ups revealed that 8, 9, 10 and 11 year old boys and girls performed significantly better than 6 year old boys and girls, and 10 and 11 year old boys and girls' performance was better than 7 years old boys and girls' performance. The data indicated that both girls and boys improve a great deal between the ages 6 and 7 years, with smaller yearly increases afterwards (Table 1 and Table 2). The results on the Sit-Ups suggest that as age increases the performance also increases. The findings of present study is in agreement with earlier research results. Most of the researchers showed that sit-up was one of the measures of muscular endurance and with increasing age, muscular endurance improves, as a result, the number of Sit-Ups in a limited time increases (Gallahue, 1982). Thomas and French (1985) also suggested improvements in sit-up performance with age. In the Sit-Up test both boys and girls performed similarly at all ages except for 9 and 11 years. The results showed that 9 and 11 year old boys were significantly superior in sit-up compared to 9 and 11 year old girls. The results of the bent knee sit-up test administered as a part of both the AAHPERD Youth Fitness Test (1980) and the CAHPER Manitoba Physical Fitness Performance Test (1980) revealed that there were developmental changes in muscular endurance and boys and girls perform at nearly the same level until age 8, then boys begin to show superiority until puberty.

The results of the present study indicate that from ages 6 to 10 both boys and girls improve their average shuttle run times annually. Although the girls continue to improve their shuttle run times, there is a sudden decrease

in the performance of boys at age 11. This result indicates the same idea that shuttle run performance improves with age, as previous studies were concluded (Garcia and Garcia 1994; Thomas and French, 1985; AAHPER, 1980; Jensen and Fisher, 1975 ). Most of the studies revealed no significant sex differences in shuttle run performance until puberty (Gallahue, 1982) however the present study reveals that boys were superior than girls at three age levels (7, 9 and 11).

The analysis of variance test indicated that no significant main age and sex effect and sex/age interaction were found in Sit and Reach performance of 6-11 years old boys and girls. Unlike other motor tests, flexibility performance did not differ significantly with age. Boone and Azen investigated flexibility performance from 18 month children to 54 years old, and they concluded that with increasing age flexibility performance decreased (Haywood, 1986). Similar trend have been observed by Clarke (1975) and Leighton (1956). Whereas Chatterjee et al., (1993) concluded that with age sit and reach test performance improves. However, the present study showed that with increasing age the mean flexibility performance of boys and girls was approximately the same at all ages. Boys reached the lowest flexibility value at age 10. This result was consistent with Buxton, Kirchner and Phillips. They concluded that at 10-12 years old the flexibility performance of boys and girls was the lowest (Devries, 1966). On the other hand, Hupperich and Siegerseth's (1950) findings revealed that there was a general increase in flexibility until the girls approached the age of 12 years with a general decline thereafter. However, there were exceptions to this trend in the shoulder, knee and thigh where the girls showed a consistent decline in flexibility from 6 to 18 years. All these contradictory research results suggest that a general flexibility factor does not exist and that each major joint appears to have its own specific flexibility. Cultural differences and activity levels may influence flexibility scores rather than age and sex.

## CONCLUSION

Increases in the mean motor performances for boys and girls were observable with each advancing age level in this study except for the Sit and Reach test. These increases were more evident at various age levels for some of the motor skills measured such as for the jumping for girls between 8 and 9 years of age, and for boys between 7 and 8. There was a marked increase on the Sit-Ups for both boys and girls from 6 to 7 year age levels. Beyond age 8 the performance of both sexes tend to level off.

In many cases boys and girls seem to be equally ef-

fective in activities involving jumping and running up to age 9. However, both boys and girls perform similarly in Sit-Ups and Sit and Reach for all ages. Therefore, from a curriculum point of view there are strong indications that boys and girls may participate together in activities during elementary school years.

There was also evidence of sex differences after age 9. The difference between the performance of girls and boys could be a matter of motivation instead of purely physiological factors. A reasonable explanation may be encountered in child rearing differences between males and females. In particular, the child's family, peers, teachers, and coaches are potential sources for learning a gender role regarding motor skill performance. Although our culture has undergone radical changes in the last several years in its view of girls being involved in physical activity, it is apparent that there are often discrepancies in the opportunities, encouragement, and instruction that girls receive in vigorous physical activities.

Future research needs to examine what factors contribute to age/sex differences in the motor performance of preschool and elementary school children.

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