Applied Studies in Agribusiness and Commerce – APSTRACT
Agroinform Publishing House, Budapest

SCIENTIFIC PAPERS

SOMATIC DEVELOPMENT AND SOME MOTOR PERFORMANCES OF YOUNG GIRLS BASED ON AGE AND BIRTH SEASON

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Abstract: There are numerous publications in the literature reporting physical development and motor performances of children of different ages based on sex and various environmental factors. However, there are not many publications on the birth season effect.

The aim of the study was to evaluate the differences among children in physical development and motor performances based on age and birth season.

Physical development described by body height and body weight, in addition to motor performance indicators including the twenty-metre dash, standing broad jump, six minutes of continuous running, throwing with a stuffed ball, and obstacle race-tests were studied. The survey included the participation of 426 girls. From the group the seven-, eight-, and nine-year olds numbered 148, 191, and 87 respectively. The group of girls who were born in winter, spring, summer and autumn numbered 114, 110, 89 and119 respectively. The tested data were evaluated with unitrate analyses of variance using SPSS statistical package. Mean value, standard error, standard deviation and coefficient of variation were calculated. The significance of differences between mean values was evaluated using "t" test. Differences with an error below 5% were considered to be significant. Furthermore, a correlation analysis was used to evaluate the relationship between season of birth, body development and motor-related performance data. Age, body height, body weight, throwing a stuffed ball in one hand, twenty-metre dash, six minutes of continuous running, and obstacle race-test are interdependent variables of development and motor performances of young girls of this age.

Data from the study results show that the children group included in the tests was quite homogenous in body height, but heterogeneous in body weight and motor performances. Physical development and four of the five evaluated sport skills were affected by the birth season. Development and motor performances of the summer- and autumn-born girls are generally better than those born in winter or spring. Differences are significant except for the obstacle race-test. Age, body height, body weight, throwing with a stuffed ball in one hand, twenty-metre dash, six minutes of continuous running, and the obstacle race-test seem to be interdependent variables of development and motor performances of young girls of this age.

Key words: body height, body weight, conditional tests

Introduction

The relationship between human development and different environmental effects has been the subject of various publications. According to Stemmler (1976) the development of children's talents is influenced by several exterior and interior effects, and it is supposed that the children can be selected for sport activity at this young age. The environmental effects are summarized and attributed as biological and social influences by *Wolanski* (1981). There are several scientists who have studied the physical development and motor performance of children of different ages based on environmental factors. *Farmosi et al.* (1986) found a definite environmental influence in studying primary school girls. Some authors have reported that season of birth may have an effect on mental and physical development at a young age and later as well. According to *Fitt* (1941), there are slight advantages in various aspects of development, enjoyed by children born in summer, including intelligence. *Orme* (1962) found a preponderance of summer-born and autumn-born individuals. *France and Wiseman* (1966) reported that the performance of the children, on whom were performed eighteen educational guidance test varied according to the season of the year. Autumn-born children had slightly higher scores than those born in spring. *John* (1962) found a significantly higher proportion of summer-born children among retarded readers than would have been expected. *Williams et al. (1970),* studying season of birth and cognitive development, found that certain groups of handicapped children contain a high number of those born in summer. *Mihály (*2001) reported that children born in summer had better school achievement than those born in autumn.

As for the season effect in sport performance, *Dudink (1994*) found a significant relationship between birth date and success in tennis and soccer. He reported that in the Netherlands most football players were born in the first quarter of the competition year. He has also published the fact that Canadian hockey players born between January and June were more likely to participate in minor league hockey for top teams than players born from July to December. His results suggested that younger children in any age group participating in a sporting activity may be disadvantaged. *Edwards* (1994), found a birth-date effect for fast bowlers but not for spin bowlers. A closer analysis of the data concerning soccer players by season (*Rollin* 1994) show that the birth-date effect is true for goalkeepers, defenders, midfield players and forwards. But the average height of goalkeepers and defenders was significantly greater than that of the general population. In their study of cricket players, only fast bowlers showed a birth season effect, even though spin bowlers and batsmen were significantly taller than average. *Farmosi (*2002), studying obstacle race-test results in 7–9 year old children, found that winter-born boys and spring-born girls performed better than average.

It is not easy to explain the effect of birth season on cognitive and sport development. According to *Williams et al.* (1970), there can be two alternative explanations. One, the "term of entry effect" suggests that children born in summer spend shorter time in their nursery school than children born at other times of the year. The other explanation, the "age group effect", suggests that children born in autumn are the oldest in their school group. There can be an age effect, which means that older children are generally better developed than younger ones.

Whichever explanation is correct, more research has to be done to find new information regarding birth year effect amongst children of different ages.

To gain more information about the physical development and motor performance of children and the birth season effect, we organised an experiment. In this experiment, body height, body weight and five athletic sport performances were evaluated among the 7–9 year-old primary school girls. In our opinion, these athletic abilities are the most general movement-related abilities, as they are based on walking, running, jumping and throwing. These activities can be well-measured by using motor tests.

The objective of our study was to get answers to the following questions:

1. How the body height and body weight of young girls influenced by their age?

2. Is the body height and body weight of young girls influenced by their birth season?

3. What is the age effect on some of the motor performances?

4. Are there any birth-season effects on some of the motor performances?

5. What kind of relationship can be found among physical development, motor performances and age of young school girls?

This paper gives a summary of the results of 7–9 year old girls who attended the same school.

Materials and methods

The study was done within the framework of The Development Study Programme of Tessedik Sámuel College in Szarvas (now: Szent István University, Faculty of Pedagogy) in a primary school. There were 426 girls in the test altogether who were evaluated for physical development and for different motor performances. The distribution of the girl group was as follows: the seven-, eight-, and nine-year olds numbered 148, 191, and 87, respectively and the group of girls who were born in winter, spring, summer and autumn numbered 114, 110, 89 and 113, respectively. Body height and body weight of the girls was measured to describe their physical development.

In studying their motor performances, twenty-metre dash, standing broad jump, six minutes of continuous running, throwing with a stuffed ball, and an obstacle race-test were processed. The study was organised by, and both body measurement and motor test data were measured by the same teachers.

Details of the tests were as follows:

20 m dash: 20 metres straight line was marked with starting- and finishing-line in the sport hall. Behind the starting line a running out possibility place was remained for the children. Children had to start from behind the starting-line by word of command from standing position ad had to run with the utmost speed as far as 20 metres distance. Time was measured by stop clock with punctual of tenth sec. Stop clock was started at the time of word of command and stopped when the child's chest reached the horizon of finishing line. Two-two children were tested at the same time.

Standing broad jump: Jumping was started from behind the jumping line and finished at the sponge arrival place. Distance was measured with punctual of cm perpendicularly between the running line and the hind arrival mark. Each child had two running possibilities. The better results were used for the evaluation.

Six minutes of continuous running: Test took place in a 20 x 10 m spot. The starting line was at the 20 metres line. To the corners of spot marking buoys were placed. Children had to run round the buoys continuously for 6 minutes. Instead of running, walking or stopping was prohibited. During the running circles were counted. Children had to stop when whistle was heard. The last circle was measured with punctual of metre. The full distance in metres was obtained as follows: 60 × number of circles + last circle distance.

Throwing with a stuffed ball: The weight of the ball was 1 kg. Children were standing small astraddle behind the throw-line facing the throw-direction. Ball was thrown with swing by anterior deep holding knee-band, incline forward. A small jump during the throw was allowed. Each child had two throwing possibilities. The better results were used for the evaluation. Punctuality of measuring was 10 cm.

Obstacle race-test: The obstacle field was as follows: There were 5 medicine-balls 1.5 metres away from starting line. Further balls were placed 1–1-metre away. At the last medicine ball there were 50 cm high obstacle followed by a small kindergarten table. There was an other 40 cm high obstacle at the other side of the test field. Between the obstacles two balls were placed in 2.5 metres distance. There was 2 metres distance between the balls. In front of the finishing-line there was a gymnastic carpet placed.

Children started the test after a command signal. They had to run among the medicine balls, later got through under the first obstacle. Then they had to jump up to the table to creep trough on it and got down on the other side of the table. After tuning the children had to step over the second obstacle then run back and change the two balls. Making way ahead children had to roll over the carpet, then stand up and run as far as the final line. One practice was allowed for children before the competition. Time of performance was measured with punctual of 0.1 sec.

Unitrate analyses of variance were used by SPSS programme to estimate the birth season and the age effect. Mean value, standard error, standard deviation and coefficient variation were calculated and "t" test was used for the evaluation of significance of differences between the main values. Above 95% reliability (P<0.05) was considered to be significant. Correlation analysis was used for the evaluation of the relationship between the physical development and different motoric test results. Phenotypic correlation coefficients were used to describe the magnitude and correlation of the relationships. Factor analysis was used for grouping the development and motor performance features into factors containing the interdependent variables.

Results and discussion

Results for body height and body weight according to age are summarized in *Table 1,* while that of according to birth season in *Table 2.* Based on the data it can be seen that as regards body height, girl groups are fairly homogenous with small differences: cv% is below 10%, while in body weight the children group which was studied is quite heterogeneous, with a cv% of 20–30% or more.

Data show that the average body height of the girls belonging to the different age groups is 128.61 cm, and the average body weight is 26.87 kg. The results are similar to the findings of *Farmosi* (2007), who found an average height of 128.78 cm, and an average weight of 27.23 kg for girls of the same age in Hungary. However, our data are a little bit higher than (by 1.35 cm and 1.67 kg) those of *Eiben et al.* (1988), found nine years before our study in the same country.

Table 1. Statistics of physical development of studied school girls according to age

Age classes (yrs)	Number of school girls	Body height (cm)			Body weight (kg)		
		Mean value	Standard deviation	cv%	Mean value	Standard deviation	cv%
7	148	121.82	6.53	5.36	23.53	5.09	21.63
8	191	130.56	7.56	5.79	28.23	5.90	20.90
9	87	135.87	8.33	6.13	29.54	6.80	23.02
Total	426	128.61	9.11	7.08	26.87	6.33	23.56
Significancie		7-8 8-9 7-9 P<0.01			7-8 8-9 7-9 P<0.01		

Table 2. Statistics of physical development of studied school girls according to birth season

Birth season	Number of girls	Body height (cm)			Body weight (kg)		
		Mean value	Standard deviation	cv%	Mean value	Standard deviation	Cv%
Winter	114	127.52	7.94	6.23	25.83	5.92	22.90
Spring	110	125.69	8.87	7.06	24.96	5.32	21.31
Summer	89	130.91	8.62	6.59	*28.20*	6.29	22.31
Autumn	113	130.73	9.88	7.56	**28.71**	6.96	24.26
Overall	426	128.61	9.11	7.08	26.87	6.33	23.56
Significance		Summer-Spring Autumn-Spring Summer-Winter Autumn-Winter (P<0.01)			Autumn-Spring Summer-Spring Autumn-Winter Summer-Winter (P<0.01)		

The highest average *body height* of the children was found in the group born in summer, however, the autumn-born girl group showed similar results. Their weight was significantly (P<0.01) bigger than that of those girls born in winter and in spring. The winter- and spring- born girls were shorter by 3.4-5.2 than those born in summer or autumn.

The highest *body weight* was found in the group born in autumn, but just a non-significantly slightly lower weight was found for the summer-born group. The groups born in winter or spring were lighter than summer- or autumn-born children by 2.9–3.6 kg. The differences are significant (P<0.01).

As for the season effect on the height and weight of children of a given age, it is not easy to give an appropriate explanation because there are inconsistent results in the literature. Some authors found that winter- and spring-born children were heavier and taller, while others reported that summer- and autumn-born ones were taller and heavier than those born in other seasons. Our results seem to correspond to those findings that summer- and autumn-born children are to some extent taller and heavier at 7–9 years of age than those born in winter and spring.

Table 3 contains the motor performance results according to age. The results show big differences among children. Generally the elder children have better results in all of the five motoric tests than the younger ones. Age groups were quite heterogeneous (cv%>21.20–32.79) in case of all motoric test results.

The motor performance results according to birth season are summarized in *Table 4.* As can be seen from the table, the group of examined girls was quite heterogeneous within all sport activity types, with a cv from 17 to 23%.

The average results for the *twenty-metre dash* were 5.34 s, which is similar to the findings of *Farmosi* (2002), (5.31 s), while the best results (5.20 s) were found with summer-born girls. Between this best result and the worst results of spring-born girls, the difference is 0.32 s, which is a significant (P<0.05) difference. The average *standing broad jump* of 117.47 cm was similar to the results found by *Farmosi* (2002), of 118.95 cm for the same age group. The best results in this motor performance, 122.09 cm, were reached by the autumn-born girls, performing significantly (P<0.05) longer jumps than the winter- and spring-born ones. The difference between

Table 3. Statistic of motor performance of studied school girls according to age

Age classes (yrs)	Number of school girls	20 m dash (sec)			Standing broad jump (cm)			6 min. of cont. running (m)			Throwing with a stuffed ball (m)			Obstacle race-test (sec)		
		Mean value	**Standard Deviation**	**cv%**	**Mean value**	**Standard Deviation**	**cv%**	**Mean value**	**Standard Deviation**	**cv%**	**Mean value**	**Standard Deviation**	**cv%**	**Mean value**	**Standard Deviation**	**cv%**
7	148	5.47	1.19	21.76	104.93	19.86	18.93	713.12	209.18	29.33	3.18	0.87	27.36	24.09	6.70	27.81
8	191	5.31	1.00	18.83	119.69	20.51	17.14	843.23	282.83	33.54	4.04	1.06	26.24	23.09	6.89	29.84
9	87	5.12	1.27	24.80	133.91	23.68	17.68	838.87	221.43	26.40	5.01	1.52	30.34	21.51	6.42	29.85
Total	426	5.33	1.13	21.20	117.47	23.46	19.97	797.14	254.14	31.88	3.94	1.29	32.79	23.12	6.78	29.31
Significance		N.S.			7-8 8-9 7-9 P<0.01			7-8 7-9 P<0.01			7-8 8-9 7-9 P<0.01			7-8 8-9 7-9 P<0.05		

Table 4. Statistics of motor performance of studied school girls according to birth season

Birth season	Nor of girls	20 m dash (s)			Standing broad jump (cm)			6 minutes of continuous running (m)			Throwing with a stuffed ball (m)			Obstacle race-test (s)		
		Mean value	**Standard Deviation**	**cv%**	**Mean value**	**Standard deviation**	**cv%**	**Mean value**	**Standard Deviation**	**cv%**	**Mean value**	**Standard deviation**	**cv%**	**Mean value**	**Standard deviation**	**cv%**
Winter	114	5.38	1.18	21.87	115.11	22.32	19.39	*809.67*	258.97	31.98	3.91	1.30	33.20	*23.13*	6.98	30.19
Spring	110	5.52	1.25	22.71	113.95	24.98	21.92	749.38	236.18	31.52	3.68	1.26	34.21	23.69	7.15	30.19
Summer	89	5.20	1.03	19.75	*118.97*	23.42	19.68	**871.26**	278.90	32.01	**4.18**	1.34	31.99	23.62	6.16	26.08
Autumn	113	5.26	0.90	17.07	**122.09**	22.50	18.43	772.60	233.76	30.26	*4.03*	1.25	30.99	**22.14**	6.63	29.93
Overall	426	5.34	1.10	20.62	117.47	23.46	19.97	797.14	254.14	31.88	3.94	1.29	32.79	23.12	6.78	29.31
Significance		Summer-Spring (P<0.05)			Autumn-Spring, Autumn-Winter (P<0.05)			Summer-Spring, Summer-Autumn (P<0.01)			Summer-Spring (P<0.01), Autumn-Spring (P<0.05)			(P>0.05)		

the best and spring-born girls' worst (113.95 cm) average is 8.12 cm. The average of *the six minutes of continuous running activity* was 797.14 m, which is a little bit shorter than the one *Farmosi* (2002) obtained (818.36 m). The best results (871.26 m) were obtained by the summer-born girl group, which are significantly (P<0.05) longer than the result of the performance of the spring- and autumn-born girls. The spring-born group (girls) performed the worst (794.34 m). The difference between the best and worst average is 121.88 cm. The overall mean result in *throwing with a stuffed ball* was 3.94 m, similar to what *Farmosi* (2002) reported (3.90 m). Summer-born girls achieved the best results (4.18 m) which were only a little bit better than the performance of autumn-born girls. The spring-born group had the worst performance. The superiority of summer- and autumn-born groups to the spring born ones is significant (P<0.05. or P<0.01), and the difference is 0.15–0.5 m. The average performance in *the obstacle race-test* was 23.12 s, which is the same as the one *Farmosi* (2002) reported (3.90 s). The best result (22.14 s) was achieved by the autumn-born group, while the worst performance was turned in by the spring-born group. The difference between the two means mentioned was only 1.55 s, which is not significant (P>0.05). The birth season effect is a little bit different from the findings of *Farmosi* (2002), who reported that for the girls, the best result was achieved by spring-born girls, however, in the boy group the winter-born children had the best results.

Considering together the five motor performance test results, the summer-born group was in first place three times, and the autumn-born group twice. Second place was taken once by the summer-born group and once by the autumn-born ones. Last place was taken three times by the spring-born groups and twice by the winter-born ones. When taken together with some results contained in the literature, it can be said that girls born in summer and autumn had generally better motor performance than those born in winter and spring.

Our results seem to correspond to those findings which reported that there are birth-season effects on the physical development and motor performance of children *(Farmosi et al.* 1968).

The results of correlation analysis are summarized in *Table 5.* As can be seen from the data, birth season, age, body height, body weight, and the different motor performances loosely or moderately correlate with one another. Close to a zero (–0.04 to 0.05) and non-significant correlation was found between the birth season and the aforementioned motor performances. These results are similar to the results of *Williams et al.* (1970), who found a -0.05 to 0.06, non-significant (P>0.05) correlation between the season of birth and the evaluated developmental variables. Despite these data, the mentioned authors have considered a relationship between month of birth and the developmental levels of children, as there are multivariate effects, including a birth-season effect, on developmental stages. In their opinion, due to multivariate effects, the effect of birth season can't be seen clearly.

As for the correlation coefficients between age and the five motor performances, they are from –0.11, (loose) to 0.45

Table 5. Correlation coefficients between of studied traits

	20 m dash	**Standing broad jump**	**6 minutes of con-tinuous running**	**Throw-ing with a stuffed ball**	**Obstacle race-test**
Birth Season	-0.04 NS	0.03 NS	0.04 NS	0.05 NS	0.05 NS
Age	**-0.11 P<0.05**	**0.45 P<0.01**	**0.20 P<0.01**	**0.51 P<0.01**	**-0.15 P<0.01**
Body height	-0.16 NS	**0.32 P<0.01**	**0.21 P<0.01**	**0.51 P<0.01**	**0.12 P<0.01**
Body weight	-0.04 NS	**0.15 P<0.05**	0.04 NS	**0.36 P<0.01**	-0.07 NS
20 m dash		-0.25 P<0.01	-0.40 P<0.01	-0.18 P<0.01	0.39 P<0.01
Standing broad jump			0.29 P<0.01	0.36 P<0.01	-0.20 P<0.01
6 minutes of continuous running				0.34 P<0.01	-0.17 P<0.01
Throwing with a stuffed ball					-0.21 P<001

NS= Non Significant
P<0.01, P<0.05 = Significant

(medium), and all of them are significant (P<0.01, or P<0.05). This result seems to confirm the birth season effect by the "age group effect" theory (*Williams et al.,* 1970), mentioned before. It means that there are age differences between children born in different seasons at the given time, when development and sport performances are being recorded.

Body height and body weight show a significant (P<0.01, or P<0.05) correlation with the motor performances in six cases out of ten. The values of the significant correlations are from 0.12 to 0.51, which means in general that the better developed the evaluated children are, the better their motor performances are.

The correlation between the different motor performances is significant (P<0.0) in all cases. These results suggest that girls who were good or better at some motor performances, generally were good or better at other performances, too, than their counterparts.

As there were significant relationships among different developmental and motor performance traits, a factor analysis was applied for the grouping of the variables. Variance components obtained by factor analysis are summarized in *Table* 6. Data show that total variance was mostly influenced by the age of the children in each birth season group. The proportion of individual variance of the age from total variance is 37–39%. The age is followed, in order, by body height, body weight, twenty metre dash, standing broad jump, six minutes of continuous running, throwing a stuffed ball and an obstacle race-test.

Table 7 shows the factors of eight developmental and motor performance variables according to birth season. The results show that variables were grouped into two factors for winter-, summer-, and autumn-born children and into three factors for spring-born ones. The first factor contains

Table 6. Total variance explained by principial component analysis

Birth season		Winter			Spring			Summer			Autumn		
Variancie component		Total	Indi-vidual	Cumu-lative	Total	Indi-vidual	Cumu-lative	Total	Indi-vidual	Cumu-lative	Total	Indi-vidual	Cumu-lative
			%			%			%			%	
1.	Age	2.97	37.15	37.15	3.03	37.85	37.85	3.14	39.27	39.27	3.01	37.58	37.58
2.	Body height	1.60	19.99	57.14	1.42	17.72	55.56	1.64	20.57	59.84	1.63	20.41	57.99
3.	Bodyweight	0.95	11.88	69.03	1.12	13.94	69.51	0.94	11.74	71.58	0.95	11.86	69.85
4.	20 m dash	0.72	8.96	77.99	0.80	10.06	79.57	0.73	9.14	80.72	0.71	8.89	78.74
5.	Standing broad jump	0.59	7.40	85.39	0.62	7.75	87.33	0.67	8.40	89.21	0.57	7.20	85.93
6.	6 minutes of continuous running	0.51	6.32	91.71	0.41	5.14	92.47	0.39	4.82	93.94	0.49	6.12	92.06
7.	Throwing with a stuffed ball	0.46	5.72	97.43	0.39	4.92	97.40	0.33	4.11	98.05	0.36	4.47	96.53
8.	Obstacle race-test	0.21	2.57	100.00	0.21	2.60	100.00	0.16	1.95	100.00	0.28	3.47	100.00

Table 7. Results of factor analysis according to birth season

Birth season		Winter		Spring			Summer		Autumn	
Components (Factors)		F1	F2	F1	F2	F3.	F1	F2	F1	F2
1.	Age	**0.723**	0.274	**0.793**	0.114	0.005	**0.700**	0.320	**0.774**	0.187
2.	Body height	**0.883**	0.002	**0.882**	0.007	–0.148	**0.913**	0.133	**0.858**	0.006
3.	Bodyweight	**0.779**	–0.234	**0.792**	0.005	–0.195	**0.861**	–0.197	**0.756**	0.160
4.	20 m dash	0.004	**0.737**	0.002	**–0.657**	0.569	–0.122	**0.762**	0.105	**–0.783**
5.	Standing broad jump	0.384	0.478	0.498	0.457	–0.009	0.339	**0.672**	0.372	0.401
6.	6 minutes of con-tinuous running	0.316	**0.607**	0.004	**0.870**	0.002	0.001	**0.692**	0.155	**0.745**
7.	Throwing with a stuffed ball	**0.665**	0.400	**0.575**	0.492	0.213	**0.691**	0.239	**0.684**	0.439
8.	Obstacle race-test	0.005	**0.726**	0.001	–0.001	**0.890**	–0.006	**–0.621**	–0.110	**0.701**

age, body height, body weight and throwing a stuffed ball, while the second factor consists of the twenty metre dash, six minutes of continuous running, and the obstacle race-test. The third factor in one case included only the obstacle race-test.

Conclusions

Based on the results it can be concluded that the examined children group was quite homogenous as for the body height, however there were big differences among children in body weight and motor performances.

Both the physical development and the motor performance were influenced by the age of the children. According to the significant differences it can be said that older, better developed children had generally better motor performances, than the younger and underdeveloped ones.

The results also show that both physical development and some motoric skills are influenced by the season of birth, however, the differences were not significant in each case. This finding corresponds with the results found in the literature that the physical development and motor performance of children can be influenced by many factors.

Girls born in summer and in autumn were better developed and had better athletic motor performances than those born in winter and in spring.

It seems that age, body height, body weight, throwing a stuffed ball in one hand, twenty metre dash, six minutes of continuous running, and the obstacle race-test, on the other hand, are interdependent variables of development and motor performances of young girls in this age.

As both the cognitive and physical development of children is very important, more attention has to be paid to these problems throughout a child's educational program. Further research has to be conducted in this field.

References

Dudink, A. (1994) Birth date and sporting success. Nature, Vol. 368. April 14, 592- 592

Edwards, S. (1996): Born too late to win? Nature, Vol. 370. July 21, 168-168

Eiben, O., Barabás, A., Pantó E. (1988): Adatok Vas megye ifjúságának biológiai fejélettzségéhez. Humanbiologia Budapstiensisi, Supplementum 4 1-48.

Erbaugh, S. J. (1984): The relationship of stability performance and the physical growth characteristics of preschool children. Research Quarterly for Exercise and Sport, 1; 8-16.

Farmosi, I., Nádori, L., Bakonyi, F. (1986): The somatic development and motoral performance of 12-year-old children considering factors of socio-cultural condition (order of birth, the number of family and the extent settlement). International Journal of Physical Education, Vol. 23, Issue 3. p. 15-19

Farmosi I. (2002): A születési évszak és a mozgásügyesség összefüggése hatéves gyermekeknél Magyar sporttudományi Szemle 1. 12-13.

Fitt, A. B. (1941) Seassonal Influences on growth, Function and Inheritance, Oxford University Press.

France, N. -Wiseman, S. (1966) Brithish Journal of Education and Psychology, Vol. 36, 210.

John, E. (1962) Researches and studies, No. 24, University of Leeds Institute of Education

Mihály, I. (2001): Életkor és iskolakezdés- a viták tükrében. Új **Pedagógiai Szemle 5. sz.**

Orme, J. E. (1962) British J. Med Psychol., Vol. 35,. 233

Rollin, J. (1994) Rothmans Football Yearbook 1992-1993

Williams, Philip-Davies, Pat- Evans, Roy-Ferguson, Neil. (1970): Season of birth and cognitive development. Nature, Vol. 228. December 12, 1033-1036.

Woloanski, N. (1981): Biologische und soziale Komponenten der Motorishen Entwicklung. In Willimzick, K- Grosser, M. (Hrsg.): Die motorische Entwicklung in Kindes- und Jugendalter. Hofmann K. Verlag. Schorndorf. 324-341.